

Miscellaneous Renovations
NEW FIRST FLOOR TOILET ROOM
AND SHOWER ROOM
Union Station
2 Washington Square
Worcester, MA
(BID SET)
March 2023



DOCUMENTS PREPARED BY



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SECTION 01.11.00

SUMMARY OF WORK

I PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. This section supplements the Conditions of the Contract, Prime Requirements, Drawings, and all other parts of the Contract Documents.
- B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 REQUIREMENTS INCLUDED

- A. Work under this Contract.
- B. Examination of Site and Documents.
- C. Contract Method.
- D. Work Sequence.
- E. Supervision of Work.
- F. Prime Contractor's Use of Premises.
- G. Coordination.
- H. Project Meetings.
- I. Permits, Inspection, and Testing Required by Governing Authorities.
- J. Cutting, Coring, Patching, Unless Otherwise Indicated.
- K. Debris Removal.
- L. Field Measurements.
- M. Safety Regulations.
- N. OSHA Safety and Health Course Documentation.
- O. Damage Responsibility.
- P. Owner Furnished Products.
- Q. Asbestos and Hazardous Materials Discovery.
- R. Special Requirements.
- S. List of Drawings

1.03 WORK UNDER THIS CONTRACT

- A. The work to be done under this contract consists of executing and completing all work required for Miscellaneous Interior Renovations at Union Station, Worcester, MA
- B. The scope of work, without limiting the generality thereof, includes all labor, materials, equipment and services required to perform the work described fully in the Drawings and Specifications and includes, but is not limited to the following major work:
 - 1. Construct new partitions, doors, ceilings and floors for a toilet room and shower room, including installation of finish materials and supplemental equipment. Provide plumbing, mechanical, electrical, fire alarm and sprinkler systems as shown.
 - 2. Revision to the HVAC, electrical, fire alarm and sprinkler systems as required to support the proposed new layout
- C. All other Work as indicated in the contract documents.

- D. The Contractor shall provide a detailed construction work plan and schedule for review, and acceptance by the WRA, and shall meet with Departments representative on an required basis to review activities and restrictions. Schedule shall include shoring and phasing of each area, loading, and all key items required through the project's completion.
- E. The Work of this project also includes the requirements in the Contract, the Sub Contract(s), Sections 0 and Division 1 Sections, any referenced standards in their entirety.
- F. The Existing Building drawings are available for review at the Architect's office during business hours between 9:00 AM and 4:00 PM, with advance notice.
- G. The site is a public facility, and limited interior and exterior of the buildings are available for review at any normal business hours, refer to the invitation for pre bid conference time.
- H. The following major elements will be performed by the Owner, under separate contracts, for which the Prime Contractor has a coordinating responsibility:
 - 1. Bidders are advised that the Worcester Redevelopment Authority (WRA) will be letting multiple contracts for other repairs within and around the building, which will be performed by other contractors outside of this construction contract. The successful bidder will be required to cooperate with other contractors as may be required by the WRA for the successful overall performance of the Work of all contracts. To that end, this contract shall:
 - (a) Attend coordination meetings at the WRA's request
 - (b) Make minor adjustments to construction schedules, when required by the WRA, when the work of multiple contractors must occur in the same general vicinity.
 - (c) Adjust the sequencing of the work, if requested by the WRA, to allow work components by others to be installed in the proper sequence.
- I. The following major elements will be furnished by the Owner, for installation by the Contractor or sub-contractors:
 - 1. Refer to Toilet Accessories section for items to be installed only, by the contractor.
- J. Reference to Drawings: The work to be done under this Contract is shown on the Drawings listed at the end of this Section.
- K. Prevailing Wage:
 - 1. The Massachusetts Standard Labor Wage rates, as outlined in the exhibits, will be used in the construction of this project.
 - 2. In addition, a portion of the funding for this project comes from Federal sources, therefore, this project is subject to Federal Prevailing Wage rates under the Little Davis-Bacon Act.

1.04 RELATED WORK UNDER OTHER CONTRACTS

- A. Work by other contractors on the building is being conducted under separate contract with the City and will need to be coordinated with this work scope.
- B. Cooperate fully with these other contractors so that work under those contracts, and this work may be carried out smoothly, without interfering with or delaying work under this contract or other contracts.

1.05 WORK SEQUENCE SCHEDULING AND COORDINATION

- A. The Work shall be sequenced, scheduled, and coordinated to achieve the Date of Substantial Completion.
 - 1. All deliveries must be scheduled at a minimum of 48 hours in advance with the WRA's representative.
 - 2. All connections to existing utilities must be scheduled and coordinated at a minimum of 72 hours in advance with the WRA's representative, and as scheduled by the WRA. Any shutdowns will be allowed for the local areas only as noted above. Overall power or utility shutdowns are not permitted.
 - 3. Contractors are advised that the building will remain an active transportation center throughout the duration of the project, and that the sequencing of work on certain parts of the building may be subject to the WRA's approval. If the WRA, or any of the train systems serving the station, require certain sequencing of the work, the Contractor will adjust accordingly, at no cost to the Owner.
 - 4. Refer to Section 01.12.00 Project Meetings.
 - 5. Contractors shall sequence the project to meet the Owner's requirements
 - (a) Substantial completion is expected to be 12/01/23

1.06 SCHEDULE OF VALUES

- A. A Schedule of Values and Application for Payment shall be submitted monthly.

1.07 EXAMINATION OF SITE AND DOCUMENTS

- A. A pre-bid meeting will be held at the job site on the date and at the time indicated in the Invitation to Bid.
- B. The bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which the work is to be carried out. The Owner and Designers will not be responsible for errors, omissions, and/or charges for extra work arising from the Prime Contractor's or Subcontractor's failure to familiarize themselves with the contract documents. The Prime Contractor and Subcontractors acknowledge that they are familiar with the conditions and requirements of the contract documents where they require, in any part of the work a given result to be produced, and that the contract documents are adequate and will produce the required results.

1.08 CONTRACT METHOD

- A. Work under this contract shall be lump sum price, for the scopes of work as described in these specifications and shown on the Drawings.

1.09 WORK SEQUENCE

- A. The Work will be conducted in the following sequence of demolition/construction:
 - 1. Actual sequence of the work will be left to the discretion of the Contractor, who will prepare a construction schedule showing the sequence and duration of work, for review and approval by the Owner.
 - 2. Contractors are advised that the building will remain an active transportation center throughout the duration of the project, and that the sequencing of work on certain parts of the building may be subject to the WRA's approval. If the WRA, or any of the train systems serving the station, require certain sequencing of the work, the Contractor will adjust accordingly, at no cost to the Owner.

1.10 SUPERVISION OF WORK

- A. The Prime Contractor shall be held directly responsible for the correct installation of all work performed under this Contract. The Prime Contractor must make good repair, without expense to the Owner, of any part of the new work, or existing work to remain, which may become inoperative on account of leaving the work unprotected or unsupervised during construction of the system or which may break or give out in any manner by reason of poor workmanship, defective materials or any lack of space to allow for expansion and contraction of the work during the Prime Contractor's warranty period, from the date of final acceptance of the work by the Owner.
- B. The Prime Contractor shall furnish a competent Massachusetts licensed superintendent satisfactory to the Owner and to the Designer. The licensed superintendent shall supervise all work under this contract and who shall remain on duty at the site throughout the Contract period while work is in progress.
 - 1. Submit the name and resume of the superintendent for approval to the Architect. Include experience with projects of equal size and complexity.

1.11 PRIME CONTRACTOR'S USE OF PREMISES

- A. Use of the Site: Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy and use by the public. Union Station will be fully functional and occupied throughout the performance of this project.
 - 2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
 - (a) In particular, the drop-off driveway on the Washington Square side of the building, cannot be blocked at any time.
 - (b) Access way to the parking area to the east along the Grafton Street Bridge shall be maintained open to commuters and the public during weekday blackout hours as defined in Section 1.09 D.
- B. Schedule and perform work to afford minimum of interruption to normal and continuous operation of utility systems. Submit for approval, a proposed schedule for performing work; including construction of new utilities, re-routing of existing utilities and final connection of new work to existing work. Schedule shall indicate shutdown time required for each operation.
- C. The Prime Contractor shall schedule as per Section 01.50.00 - Temporary Facilities and Controls, the shutting down or interrupting any utilities, services or facilities which may affect the operation of the building outside the area of work or other buildings, services or facilities.
- D. The Prime Contractor can gain access to the premises during the hours specified below. In addition the Prime Contractor and his personnel will limit themselves only within the working premises during working hours. If work needs to be scheduled during times other than those listed below, Prime Contractor shall inform the Owner one week prior to work.
 - 1. Deliveries: 7:00 AM to 6:00 PM.
 - 2. Interior Work: 7:00 AM to 4:00 PM,
 - 3. Exterior Work (If required): 6:30 AM to 5:00 PM
 - 4. Weekends: with Owner's permission.
 - 5. Holidays: with Owner's permission
- E. The Prime Contractor shall verify that Subcontractors have visited the site and included all costs associated with the location of the project, and any restriction or limitations the location of the project may pose.

- F. All contractors shall at all times conduct their operations in a courteous, professional manner while on the project or in the vicinity of the project. Harassment, offensive language or behavior will not be permitted on the site.
- G. The Owner can neither accept nor assume responsibility for the security of the Contractor's material or equipment which is lost, stolen or vandalized. The Contractor is advised to exert caution in placement and storage of his equipment and material. The WRA will maintain security and control of the building and are present throughout the day and night; however, the contractor is fully responsible for securing all their items, and providing all necessary protective measures.
- H. Parking: Parking spaces on site are very limited and the Owner may not provide designated parking spaces near the construction site for the Contractor's use. The Contractor shall state his/her parking and staging area requirements during the Pre-construction Meeting. The area(s) for materials storage will then be agreed to between the Contractor and the Owner.
1. The General Contractor's personnel, and all other personnel employed on the project, shall not park on the site, and must park at the lot designated for construction parking and as permitted by the General Contractor. Additionally, Contractor personnel may park as legally allowed within City Limits. Parking on street sidewalks or around the bus terminal is prohibited.
 2. All contractor personnel must park as directed by the owner's representative. Each morning the General Contractor's Superintendent shall report the number of contractor personnel that will be working that day to the WRA's Representative. Upon entrance, all contractor personnel shall have a valid identification badge that is to be worn at all times while working on the project.
 3. The WRA will make available location inside at the lower storage room for the Contractor's use for storage, staging, and offices for the duration of the project. Area as located on the plans. The area is limited, and the contractor must make other arrangements for off site storage, staging, and other use at the contractor's own arrangement and cost. Contractors are responsible for supplying temporary partitions/fencing for security, and to remove them upon completion.
 4. An area outside at the loading dock will be provided for the Contractor to unload trucks and to load trash and debris on a limited schedule. There is no area for storage other than noted. Demolition work will be the contractor's responsibility to remove debris from the site as demolished.
 5. Construction deliveries to the project shall be made, subject to working hours, as described above. No other construction vehicles are allowed on site except for those required for the work underway. All deliveries must be coordinated with the Owner a minimum of 48 hours in advance. Deliveries shall be scheduled for normal working hours, but may be scheduled for later or non working hours with prior approval of the Architect and Owner. Delivery trucks and vehicles shall not idle with their motors running for more than five (5) minutes in accordance with applicable City Ordinances. Any person violating this provision shall be subject to fines prescribed by the Ordinances.
- I. The Contractor is responsible for providing an identification badge for his personnel and sub-contractor personnel for security purposes. These identification badges shall be worn at all times. All contractor personnel are restricted to select work areas on any given day at all times unless the Owner grants prior approval. Any employee violating any of these provisions shall be discharged after one (1) written warning by the General Contractor's Superintendent or WRA's representative, with a copy of said warning submitted to the Architect.
- J. Any work to be performed in or requiring access through the building outside of the construction area shall be coordinated with the WRA's representative at least one day in advance of such work.
- K. The General Contractor shall also be responsible for returning the areas adjacent to construction to their original state upon completion of work in that area.

- L. The use of internal combustible engine driven power equipment is also prohibited within the building. Alternate power sources, i.e. generators and compressors, may be placed outside the building to provide power to equipment. Placement of any alternate power sources shall be subject to prior WRA representative's approval.
- M. There will be no washing or washing out of any vehicles at the project site. The contractor shall make necessary provisions to accommodate this work off site.
- N. All cleaning and wash down of tools and/or equipment shall be performed in areas designated only by the WRA's representative. This will be strictly enforced.
- O. Existing lighting shall remain and maintained as operational, and temporary work lighting to be installed as required by each contractor as needed for their work scope. Power is available on site as it exists, and is for convenience outlets only. Water is available at site through limited hose bibbs. All additional power and water required shall be for each contractor to provide at their cost. Available power and water is available on a limited basis, any misuse, as determined by the Owner, the Contractor will be required to disconnect and provide their own power at their cost.
- P. Existing building toilets are available for the contractors use at location designated by the WRA representative.
- Q. Radios, tape players, "boom boxes", or other audio entertainment equipment, including personal entertainment devices, shall not be allowed on the project site.
- R. The Contractor shall not permit smoking within the building. Locate smoking areas away from entries, outdoor intakes, and operable windows, including adjacent buildings.
- S. The Contractor shall not allow the use of intoxicating beverages or non-prescription controlled substance drugs upon or about the work site.
- T. The Contractor shall provide and maintain in good serviceable condition at all times, warning signs and non-combustible barriers, forms and fire resistive tarps or plastic, each of which shall be approved by the Owner, shall be suitable for the purpose, and shall be installed adjacent to each work area, for complete enclosure and/or isolation of all excavations, wells, pits, manholes, shafts, overhead areas, etc., which are associated with the work under the contract. Barriers shall be a secure fence, guardrail, cover, or similar assembly designed and erected to provide protection for concrete, protection from the weather, and to prevent accidental access. Barrier tape and/or sawhorses shall not be used as a means of such access protection.

1.12 COORDINATION

- A. The Prime Contractor shall be responsible for the proper fitting of all the work and for the coordination of the operations of all Subcontractors or material and persons engaged upon the work. The Prime Contractor shall do, or cause his agents to do, all cutting, fitting, adjusting, and repair necessary in order to make the several parts of the work come together properly.
 - 1. Examine Contract Documents in advance of start of construction and identify in writing questions, irregularities or interference to the designer in writing. Failure to identify and address such issues in advance becomes the sole responsibility of the Prime Contractor. A conflict that would cause the reduction of the normal ceiling height of any occupied space is considered to be an interference.
- B. Execute the work in an orderly and careful manner with due regard to the occupants of the facility, the public, the employees, and the normal function of the facility.

- C. The work sequence shall follow planning and schedule established by the Prime Contractor as approved by the Designer and the Owner. The work upon the site of the project shall commence promptly and be executed with full simultaneous progress. Work operations which require the interruption of utilities, service, and access shall be scheduled so as to involve minimum disruption and inconvenience, and to be expedited so as to insure minimum duration of any periods of disruption or inconvenience.
- D. The Prime Contractor shall review the tolerances established in the specifications for each type of work and as established by Subcontractor organizations. The Prime Contractor shall coordinate the various Subcontractors and resolve any conflicts that may exist between Subcontractor tolerances without additional cost to the Owner. The Prime Contractor shall provide any chipping, leveling, shoring or surveys to ensure that the various materials align as detailed by the Designer and as necessary for smooth transitions not noticeable in the finished work.
- E. The General Contractor shall provide a qualified General Superintendent, who shall be present, full time, on site daily during all work in progress until the Date of Substantial Completion, and for such additional time thereafter as the Architect may determine. Only under extenuating circumstances, with the approval of the Architect and Owner, will the Contractor be allowed to substitute for the General Superintendent prior to the date of Final Completion.
 - 1. The General Superintendent shall supervise and direct the activities of other superintendents and foremen on site. He shall not perform the work of the foremen, tradesmen, or home office staff.
 - 2. Provide a dedicated Project Manager in charge of the project, and be responsible for making all submittals, schedules, and other logistics work, and coordinate implementation with their and all sub-contractors.
- F. Each subcontractor shall provide a Lead Foreman, responsible to be on site full time during the work day.
 - 1. Each foreman, in addition to his regular duties, shall be responsible for establishing, maintaining, and providing record drawings, which are required to be updated prior to submitting the current period's draft Application for Payment.
- G. The General Superintendent and Lead Foreman shall not be discharged or changed without prior written consent of the Architect, which will not be unreasonably withheld. The Architect will require that all as-built information be updated and current prior to granting consent.

1.13 PROJECT MEETINGS

- A. Project meetings shall be held on a weekly basis and as required subject to the discretion of the Owner.
- B. Attendees: In addition to the Project Manager and Designer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
- C. In order to expedite construction progress on this project, the Prime Contractor shall order all materials immediately after the approval of shop drawings and shall obtain a fixed date of delivery to the project site for all materials ordered which shall not impede or otherwise interfere with construction progress. The Prime Contractor shall present a list and written proof of all materials and equipment ordered (through purchase orders). Such list shall be presented at the meetings and shall be continuously updated.
- D. Scheduling shall be discussed with all concerned parties, and methods shall be presented by the Prime Contractor, which shall reflect construction completion not being deferred or foreshortened. Identify critical long-lead items and other special scheduling requirements. The project schedule is to include time for submission of shop drawing submittals, time for review, and allowance for resubmittal and review.

- E. The General Superintendent shall submit to the WRA's representative, on the first work day of the week, a written "Weekly Progress Report". Include the following information about the previous week:
 - 1. Construction progress
 - 2. Manpower of each contractor and subcontractor
 - 3. Equipment used
 - 4. Product deliveries
 - 5. Weather conditions
 - 6. Problems, hazards, or accidental injury
- F. The General Superintendent shall submit to the WRA's representative, on the first work day of the week, a written "Weekly Outline Schedule" listing the work activities planned for that week. The "Weekly Outline Schedule" may be a simple listing of each trade's activities delineating areas where work is to be scheduled. Note any significant milestones.

1.14 CERTIFICATE OF SUBSTANTIAL COMPLETION

- A. The Architect shall issue a Certificate of Substantial Completion for the work when and if all of the following conditions have been met:
 - 1. The work is sufficiently complete to allow the Owner beneficial use of the premises. The work remaining to be done is not a danger to the proposed occupants and is of a minor nature.
 - 2. The work is sufficiently complete that the Architect may make affidavits to the Building Official as required by Controlled Construction provisions of the Building Code.
 - 3. The mechanical and electrical systems are fully operational. Required inspections and tests have been successfully completed, and the Owner has been provided instructions regarding operation and maintenance of mechanical and electrical systems in the building, or other installed equipment or systems.
 - 4. The Contractor has made notifications required to pay cost of final billing for utilities and termination of property insurance.
 - 5. The Owner has made notifications required to assume the future cost of utilities and provide property insurance.
 - 6. The Building Official has issued a Certificate of Occupancy without restrictions or conditions relating to the contractor's work.

1.15 PERMITS, INSPECTION, AND TESTING REQUIRED BY GOVERNING AUTHORITIES

- A. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having any jurisdiction require any portion of the Work to be inspected, tested, or approved, the Prime Contractor shall give the Designer, the Owner or his/her designated representative, and such Authority timely notice (5 business days minimum) of its readiness so the Designer may observe such inspecting, testing, or approval.
- B. Prior to the start of construction, the Prime Contractor shall complete application to the applicable Building Code enforcement authority for a Building Permit. Such Permit shall be displayed in a conspicuous location at the project site. The building permit fee shall be paid by the Contractor.
- C. Unless otherwise specified under the Sections of the Specifications, the Prime Contractor shall pay such proper and legal fees to public officers and others as may be necessary for the due and faithful performance

of the work and which may arise incidental to the fulfilling of this Contract. As such, all fees, charges, and assessments in connection with the above shall be paid by the Prime Contractor.

- D. Prime Contractor and specialized Subcontractors as applicable shall identify all permits (other than Prime building permit) required from Authorities having jurisdiction over the Project for the construction and occupancy of the work. The Prime Contractor shall prepare the necessary applications and submit required plans and documents to obtain such permits in a timely manner, and shall furnish the required information to the Building Official and obtain the required permits as early as practicable after award of the Contract.
- E. Prior to the start of construction, the Prime Contractor shall complete applicable applications, permits, and notifications to the MADEP, such as the Demolition/Construction form BWP AQ-06, and pay the required fees. These forms must be submitted at least 10 working days in advance of any regulated activity on the site. Demolition permits must be submitted for any work involving demolition, new construction and renovation.

1.16 CUTTING, CORING, AND PATCHING, UNLESS OTHERWISE INDICATED

- A. The Prime Contractor shall perform and/or coordinate all cutting, coring, fitting and patching of the work as specified in Section 01.73.29 – Cutting and Patching.
- B. The Prime Contractor shall coordinate that the work of the Subcontractor is not endangered by any cutting, coring, excavating, or otherwise altering of the work and shall not allow the cutting or altering the work of any Subcontractor except with the written consent of the Designer.
- C. Performance:
 - 1. Execute cutting and patching by methods which will prevent damage to other work, and will provide proper surfaces to receive installation of repairs.
 - (a) In general, where mechanical cutting is required, cut work with sawing and grinding tools, not with hammering and chopping tools. Core drill openings through concrete work.
 - (b) Work determined disruptive to tenants in other areas of the building may be required to be performed prior to 8:30am or after 5pm weekdays, or as approved during weekend hours.
 - (c) Prior to cutting and structural steel or concrete work, contact Designer and Project Structural Engineer in writing. Do not cut any structural steel and concrete work until approval has been granted by the Designer and the Project Structural Engineer.
 - 2. Employ original installer or fabricator to perform cutting and patching for:
 - (a) Weather-exposed or moisture-resistant elements.
 - (b) Sight-exposed finished surfaces.
 - 3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
 - 4. Restore work which has been cut or removed; install new products matching existing to provide completed Work in accordance with requirements of Contract Documents.
 - 5. Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 - 6. Patch with seams which are durable and as invisible as possible. Flash and seal all penetration of exterior work. Comply with specified tolerances for the work.

7. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.
 - (a) Where patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch.
8. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - (a) For continuous surfaces, refinish to nearest intersection.
 - (b) For an assembly, refinish entire unit.

D. Existing Utilities Services:

1. Interruptions to critical existing utility services will not be allowed except as scheduled per Section 01.50.00 - Temporary Facilities and Controls.
2. The Prime Contractor shall locate and record on Drawings all existing utilities along the course of the work by such means as the Designer and the Owner may approve, and shall preserve such marked locations until the work has progressed to the point where the encountered utility is fully exposed and protected as required. It shall be the Prime Contractor's responsibility to notify the proper authorities and/or utility company before interfering therewith.
3. Existing utilities that are indicated on the Drawings or whose locations are made known to the Prime Contractor prior to excavations, though accuracy and information as to grades and elevations may be lacking, shall be protected from damage during the excavation and backfilling operations and, if damaged by the Prime Contractor, it shall be repaired by the Prime Contractor at his/her own expense.
4. All exposed conduits, wires, and/or cables shall be provided with sufficient protection and support to prevent failure, fraying, or damage due to backfilling or other construction operations.

1.17 DEBRIS REMOVAL

- A. The Prime Contractor shall coordinate the removal of all demolition and construction waste including waste by all Subcontractors from the job site on a daily basis.
- B. Debris shall be legally disposed of in a D.E.P. approved disposal site. Include Bill of Lading in closeout documents.
- C. The Prime Contractor shall bear responsibility for maintaining the building and site clean and free of debris, leaving all work in clean and proper condition satisfactory to the Owner and the Designer. The Prime Contractor shall ensure that each of the Subcontractors clean up during and immediately upon completion of their work. Clean up includes the following tasks:
 1. Remove all rubbish, waste, tools, equipment, appurtenances caused by and used in the execution of work.
- D. Prevent the accumulation of debris at the construction site, storage areas, parking areas, and along access roads and haul routes.
- E. Provide containers for deposit of debris and schedule periodic collection and disposal of debris.
- F. Prohibit overloading of trucks to prevent spillage on access and haul routes.
- G. The Prime Contractor shall be responsible for proper disposal of all construction debris leaving the site.

1.18 FIELD MEASUREMENTS

- A. Although care has been taken to ensure their accuracy, the dimensions shown for existing items and structures are not guaranteed. It is the responsibility of the Prime Contractor to verify these dimensions in the field before fabricating any construction component. No claims for extra payment due to incorrect dimensions will be considered by the Owner.

1.19 SAFETY REGULATIONS

- A. This project is subject to compliance with Public Law 91 596 "Occupational Safety and Health Act" latest edition (OSHA 29 CFR 1926), with respect to all rules and regulations pertaining to construction, including Volume 36, numbers 75 and 105, of the Federal Register, as amended, and as published by the U.S. Department of Labor.
- B. Hazardous Waste Generation: Any work generating Hazardous or so-called Universal Wastes will comply with all requirements of 310 CMR 30.000. The proper storage, use and disposal of any hazardous chemicals or substances brought on site by the Contractor are the responsibility of Contractor. The Owner will not be responsible for any hazardous materials left on site, the cost to remove these materials will be the Contractor's responsibility. All hazardous wastes generated as a result of demolition and remodeling shall be contained, collected, segregated, labeled per all applicable federal EPA, Massachusetts DEP, and Federal DOT regulations or other applicable local, state or federal hazardous waste regulations, pending the appropriate disposition.

1.20 OSHA SAFETY AND HEALTH COURSE DOCUMENTATION

- A. OSHA Safety and Health Course Documentation Records: Chapter 306 of the Massachusetts Acts of 2004 requires that everyone employed at the jobsite must complete a minimum 10-hour long course in construction safety and health approved by the U.S. Occupational Safety and Health Administration (OSHA) prior to working at the jobsite. Compliance is required of Prime Contractors' and Subcontractors' on-site employees at all levels whether stationed in the trailer or working in the field. Unless the Massachusetts Attorney General's office indicates otherwise, this requirement does not apply to home-office employees visiting the site or to suppliers' employees who are making deliveries.
- B. OSHA 10 cards for anyone working on site are to be submitted prior to the first requisition.
- C. Documentation records shall be initially compiled by the Prime Contractor and Subcontractors, and the Prime Contractor shall create and maintain a copy of the documentation on site at all times.

1.21 DAMAGE RESPONSIBILITY

- A. The Prime Contractor shall repair, at no cost to the Owner, any damage to building elements, site appurtenances, landscaping, utilities, etc. caused during demolition operation and work of this Contract.

1.22 OWNER FURNISHED PRODUCTS

- A. Products indicated "N.I.C." (Not in Contract), or "E. O." (Equipment by Owner), or "O.F.O.I." (Owner Furnished Owner Installed), or other similar acronyms as defined in the contract documents will be furnished and installed by the Owner. Coordination and provision of service lines for such products shall be included under these Construction Contract Documents, if indicated. Final connections from service lines to equipment will be by the Owner, unless otherwise indicated

1.23 ASBESTOS AND HAZARDOUS MATERIALS DISCOVERY

- A. If unanticipated asbestos-containing materials or other Hazardous Materials not included in Contract are discovered at any time during the course of work, the Prime Contractor shall cease work in the affected areas

only and continue work in other areas, at the same time notify the Designer of such discovery. Do not proceed with work in such affected areas until written instructions are received. If removal is required, costs shall be negotiated or otherwise established prior to commencement of removal, in accordance with provisions of the Contract.

- B. The Owner or Designer will work with the Contractor to initiate removal or encapsulation of the asbestos. An extension of the completion date may be granted equal to the time lost. Proper notification must be made to the MADEP through the ANF-001 form, and the Owner.

1.24 LIST OF DRAWINGS

T1 - COVER SHEET

A1.0 - FIRST FLOOR TOILET AND SHOWER ROOM PLANS, ELEVATIONS AND DETAILS

FP0.0 - FIRE PROTECTION LEGEND AND ABBREVIATIONS

FP1.0 - FIRE PROTECTION NEW WORK PLAN

P0.0 - PLUMBING LEGEND AND ABBREVIATIONS

P1.0 - PLUMBING PLAN

P2.0 - PLUMBING DETAILS AND SCHEDULES

H0.0 - MECHANICAL LEGEND AND ABBREVIATIONS

H1.0 - HVAC DUCTWORK DEMO AND NEW WORK

H2.0 - HVAC SCHEDULE AND DETAILS

E0.1 - ELECTRICAL LEGEND AND NOTES

E1.0 - ELECTRICAL FLOOR PLANS

E5.0 - ELECTRICAL SCHEDULES

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION
01.11.00

SECTION 01.25.00

SUBSTITUTIONS

I. PART I - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 SCOPE/GENERAL REQUIREMENTS

- A. This section Supplements the General Conditions and other sections of Division 1 and supersedes any provisions regarding material substitutions/Or equals found in any of the technical sections of the specifications.
- B. The requirements of this section are in addition to any provisions of all other sections of these specifications.
- C. Definition - Whenever a specification section names one or more brands for a given item, and the Contractor wishes to submit, for consideration, another brand, the submission shall be considered an "or-equal" or a "material substitution". For the purposes of this Contract, the terms "or-equal" and "material substitution" shall be considered synonymous
- D. In no case may an item be furnished on the Work other than the item named or described, unless the Architect, with the Administrator's written concurrence, shall consider the item equal to the Item so named or described, as provided by M.G.L. c.30 § 39M.
- E. The equality of items offered as "equal" to items named or described shall be proved to the satisfaction of the Architect at the expense of the Contractor submitting the substitution.
- F. The Architect and/or the Department may require that full size samples of both the specified and proposed products be submitted for review and evaluation. The Contractor shall bear full cost for providing, delivering, and disposal of all such samples.
- G. The Contractor shall assume full responsibility for the performance of any item submitted as an "Or-Equal" and assume the costs of any changes in any Work that may be caused by such substitution.

1.03 RELATED SECTIONS

- A. 01.33.00 SUBMITTALS, SHOP DRAWINGS AND SAMPLES

1.04 OR EQUAL APPROVAL PROCESS

- A. The contractor shall fully complete the Substitution Approval Form included in this section, and transmit that will all required submittal materials for the substitution to be considered.
 - 1. The Contractor shall submit to the Architect for consideration of any or-equal substitution a written point-by-point comparison containing the name and full particulars of the proposed product and the product named or described in the Contract Documents.
 - 2. Such submittal shall in no event be made later than 90 calendar days after the Award of the Contract or 120 calendar days prior to the incorporation of the item into the Work. In any case in which the time period specified in the Contract Documents from the Notice to Proceed to Substantial Completion is less than 120 days, this requirement can be modified by the Architect.
 - 3. The Contractor shall be completely responsible for the timely submission of supporting documentation.

4. Upon receipt of a written request for approval of an or-equal substitution, the Architect shall investigate whether the proposed item shall be considered equal to the item named or described in the Contract Documents and in accordance with the provisions of MGL C.30§39M.
5. Upon conclusion of the investigation, the Architect shall promptly advise the Owner with written notice that the item is, or is not, considered acceptable as on Or-Equal substitution with documentation to support the determination.
6. The Owner will then advise whether to proceed with the proposed substitution.
7. Should the Architect determine that the submitted product substitution is not equal to the specified standard the Architect shall send written notice of this to the Contractor.
8. Proceeding with work using the submitted item without the concurrence of the Administrator may result in rejection of the work and removal and replacement at the expense of the Contractor.

SUBSTITUTION REQUEST FORM

Project: _____ Architect's Project Number: _____

Substitution Request Number: _____
To: _____ Date: _____

From: _____
Re: _____ Contract For: _____

Section Title: _____ Description: _____
Section No.: _____ Page: _____ Article/Paragraph: _____
Proposed substitution: _____

Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No./Color: _____
Installer: _____ Address: _____ Phone: _____
History: ☐ New Product ☐ 1 – 4 years old ☐ 5 – 10 years old ☐ More than 10 years old
Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached – REQUIRED BY ARCHITECT

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____
Address: _____ Owner: _____

Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain

Savings to Owner for accepting substitution: _____ (\$ _____)

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests

☐ Reports ☐ Sustainability Criteria

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product including meeting LEED credit requirements, where applicable.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be correct in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

ARCHITECT'S REVIEW AND ACTION

- ☐ Substitution approved – Make submittals per Division 01 Section "Substitution Procedures."
☐ Substitution approved as noted – Make submittals per Division 01 Section "Substitution Procedures."
☐ Substitution rejected – Use specified materials.
☐ Substitution Request received too late – Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E
 ☐ Other _____

END OF SECTION
01.25.00

SECTION 01.31.00

PROJECT MANAGEMENT AND COORDINATION

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 SUMMARY

- A. Without limitations, coordination will include Critical Path Method Scheduling (CPM), coordination of submittals, coordination of all elements of the Work, and coordination of contract closeout.
- B. Description:
 - 1. Coordinate scheduling, submittals, and work of the various trades and elements of the Work to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
 - 2. Coordinate sequence of the Work to accommodate the continued use of the building, and to coincide with other work being performed by the Owner under separate contracts.
- C. Meetings:
 - 1. In addition to progress meetings, hold coordination meetings and pre-installation conferences with personnel and Sub-Contractors to assure coordination of the Work. The coordination meetings are to be separate from the commissioning or commissioning meetings.
- D. Coordination of Submittals:
 - 1. Schedule and coordinate submittals.
 - 2. Coordinate work of various trades having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
 - 3. Coordinate requests for substitutions to assure compatibility of space, of operating elements, and effect on work of other trades.
 - 4. Contractor's mark-up will be excluded from change orders caused by lack of coordination during design.

1.03 FIELD COORDINATION

- A. This project is not anticipated to require coordination drawings, other than shop drawings and manufacturer's standard details where requested in their respective technical sections of the Specifications. The Prime Contractor remains responsible for field coordinating the work of all trades, to see that it comes together without conflict or loss of functionality.
 - 1. Where field coordination is performed, the Prime Contractor shall advise the Designers of any conflict or field condition which results in the system being installed other than as designed.
 - 2. In such instances, contractors are expected to propose alternative approaches based on field conditions revealed through the performance of the demolition. Alternative methods shall not be performed, however, until first approved by the Designers. No additional compensation will be due for field

coordination efforts.

3. Where performing the Work differently than designed creates a conflict with another trade, which was not foreseen or properly coordinated between the contractors, the conflicting conditions shall be revised at no expense to the Owner, to eliminate the conflict.

II. PRODUCTS (Not Used)

III. EXECUTION (Not Used)

END OF SECTION
01.31.00

SECTION 01.32.00

CONSTRUCTION PROGRESS DOCUMENTATION

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS INCLUDED

- A. Procedures and requirements for submission and review of progress schedules and reports.

1.03 RELATED SECTIONS

- A. Section 01.10.00 – SUMMARY
 - 1. Project meetings.
- B. Section 01.31.00 - PROJECT MANAGEMENT AND COORDINATION
 - 1. Progress and coordination meetings.
- C. Section 01.33.00 - SUBMITTAL REQUIREMENTS
 - 1. Project reports.
 - 2. Schedule of values.
 - 3. Shop drawings, product data, and samples.

1.04 CONSTRUCTION SCHEDULE

- A. Prime Contractor shall prepare and submit for Designer and Owner's information, a Critical Path Method (CPM) Progress Schedule for the work of the project. Said schedule will be coordinated with the Owner's Work Plan which involves work by other contractors under separate contract, to include sequencing of the project work and shall be submitted within 2 weeks of pre-construction meeting.
- B. In addition, the Prime Contractor shall prepare and submit at each project meeting, a two-week look-ahead schedule. The schedule shall identify:
 - 1. Major elements of the work which were complete since the last project meeting, organized by wall elevation or by trade.
 - 2. Major elements of the work to be performed in the next two weeks, to be able to track short-term conformance to the overall project schedule.
 - 3. A projection of any upcoming required service interruption notices.

1.05 CRITICAL PATH METHOD SCHEDULING

- A. The Prime Contractor remains responsible for identifying the critical path of all project activities and milestones, and will not be entitled to any additional compensation or any additional days related to Change Order work unless it can be demonstrated that latent conditions impact the critical path.
- B. The critical path schedule shall be updated and resubmitted with each Application for Payment, and shall be

considered a prerequisite for payment.

C. Additional Requirements

1. Provide a list in EXCEL format and the associated database file of every submittal of shop drawings, product data, samples and other submittals required by the contract, General Conditions, Supplementary Conditions and/or technical specifications of the construction contract. This required list shall be set upon a template showing the following: Specification Section, Sub-Section Number, Item Number, Description, Shop Drawing Number, Submittal Review and Approval, Actual Order Date, Procurement and Fabrication, Schedule Delivery Date, Date Received, Scheduled Installation Date and Actual Installation Date.

II. PRODUCTS (Not Used)

III. EXECUTION (Not Used)

END OF SECTION

01.32.00

SECTION 01.33.00

SUBMITTALS

I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 RELATED DOCUMENTS

- A. This Section supplements the General Conditions.
- B. Consult the individual sections of the specifications for the specific submittals required under those sections and for further details and descriptions of the requirements

1.03 GENERAL PROCEDURES FOR SUBMITTALS

- A. Timeliness - The Contractor shall transmit each submittal to the Architect sufficiently in advance of performing related Work or other applicable activities so that the installation is not delayed by processing times, including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Architect in advance of the Work.
- B. Sequence - The Contractor shall transmit each submittal in a sequence which will not result in the Architect's approval having to be later modified or rescinded by reason of subsequent submittals which should have been processed earlier or concurrently for coordination.
- C. Contractor's Review and Approval - Only submittals received from and bearing the stamp of approval of the Contractor will be considered for review by the Architect. Submittals shall be accompanied by a transmittal notice stating name of Project, date of submittal, "To", "From" (Contractor, Subcontractor, Installer, Manufacturer, Supplier), Specification Section, or Drawing No. to which the submittal refers, purpose (first submittal, resubmittal), description, remarks, distribution record, and signature of transmitter.
- D. Architect's Action - The Architect will review the Contractor's submittals and return them with one of the following actions recorded thereon by appropriate markings:
 - 1. Final Unrestricted Release: Where marked "No Exceptions Taken" the Work covered by the submittal may proceed provided it complies with the requirements of the Contract Documents.
 - 2. Final-But-Restricted Release: When marked "Note Markings" or "Comments Attached" the Work may proceed provided it complies with the Architect's notations or corrections on the submittal and complies with the requirements of the Contract Documents. Acceptance of the Work will depend on these compliances.
 - 3. Returned for Resubmittal: When marked "Resubmit" or "Rejected" the Work covered by the submittal (such as purchasing, fabrication, delivery, or other activity) should not proceed. The submittal should be revised or a new submittal resubmitted without delay, in accordance with the Architect's notations stating the reasons for returning the submittal.
- E. Processing - All costs for printing, preparing, packaging, submitting, resubmitting, and mailing, or delivering submittals required by this contract shall be included in the Contract Sum.

1.04 OR EQUALS

- A. Definition - Whenever a specification section names one or more brands for a given item, and the Contractor wishes to submit, for consideration, another brand, the submission shall be considered an "or-equal" or a "material substitution". For the purposes of this Contract, the terms "or-equal" and "material substitution" shall be considered synonymous.
- B. In no case may an item be furnished on the Work other than the item named or described, unless the Architect, with the Owner's written concurrence, shall consider the item equal to the item so named or described.
- C. The equality of items offered as "equal" to items named or described shall be proved to the satisfaction of the Architect at the expense of the Contractor submitting the substitution.

1.05 SUBMISSION OF PRODUCT DATA

- A. The Contractor shall submit an electronic copy of Product Data, in Adobe Acrobat (pdf) format to the Architect. All such data shall be specific and identification of material or equipment submitted shall be clearly marked or highlighted. Data of general nature will not be accepted.
- B. Product Data shall be accompanied by a transmittal notice. The Contractor's stamp of approval shall appear on the printed information itself, in a location which will not impair legibility.
- C. Product Data returned by the Architect as "Rejected" shall be resubmitted until the Architect's approval is obtained.
- D. When the Product Data are acceptable, the Architect will stamp them "No Exceptions Taken", and return 1 copy to the Contractor. The Contractor shall provide and distribute additional copies as may be required to complete the Work.
- E. The Contractor shall maintain one full set of approved, original, Product Data at the site.

1.06 SUBMISSION OF SHOP DRAWINGS

- A. Shop Drawings shall be complete, giving all information necessary or requested in the individual section of the specifications. They shall also show adjoining Work and details of connection thereto.
- B. Shop Drawings shall be for whole systems. Partial submissions will not be accepted.
- C. The Architect reserves the right to review and approve shop drawings only after approval of related product data and samples.
- D. Shop drawings shall be properly identified and contain the name of the project, name of the firm submitting the shop drawings, shop drawing number, date of shop drawings and revisions, Contractor's stamp of approval, and sufficient spaces near the title block for the Architect's stamp.
- E. The Contractor shall submit to the Architect three (3) black line prints of each shop drawing or one electronic copy in Adobe Acrobat (pdf) format, at the Architect's discretion. Prints may be mailed, delivered in roll form or emailed. Each submittal shall be accompanied by a transmittal notice bearing the Contractor's approval stamp.
- F. When the Architect returns a marked submittal with the stamp "Resubmit" or "Confirm", the Contractor shall correct the original drawing or prepare a new drawing and resubmit three prints or an electronic version thereof to the Architect for approval. This procedure shall be repeated until the Architect's approval is obtained.
- G. When the Architect returns submittal with the stamp "No Exceptions Taken", the Contractor shall provide and distribute the prints for all Contractor and Subcontractors use.

H. The Contractor shall maintain one full set of approved shop drawings at the site.

1.07 SUBMISSION OF SAMPLES

- A. Unless otherwise specified in the individual section, the Contractor shall submit two specimens of each sample.
- B. A transmittal notice with the Contractors stamp of approval shall be included with all sample submittals.
- C. Samples shall be of adequate size to permit proper evaluation of materials. Where variations in color or in other characteristics are to be expected, samples shall show the maximum range of variation. Materials exceeding the variation of approved samples will not be approved on the Work.
- D. Samples that can be conveniently mailed shall be sent directly to the Architect, accompanied by a transmittal notice. All transmittals shall be stamped with the Contractor's approval stamp of the material submitted.
- E. All other samples shall be delivered at the field office of the Project Representative with sample identification tag attached and properly filled in.
- F. If a sample is rejected by the Architect, a new sample shall be resubmitted in the specified manner. This procedure shall be repeated until the Architect approves the sample.
- G. Samples will not be returned unless return is requested at the time of submission. The right is reserved to require submission of samples whether or not particular mention is made in the specifications, at no additional cost to the Owner.

END OF SECTION
01.33.00

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SECTION 01.35.00

ENVIRONMENTAL PROCEDURES

I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

1.02 RELATED DOCUMENTS

- A. Refer to 02.41.19 - Selective Demolition.

1.03 HAZARDOUS MATERIALS PROCEDURE

- A. Asbestos
 - 1. Asbestos Materials Exist On-Site: Asbestos Containing Materials (ACM) was found on the exterior terracotta on the building. For this project area, testing was conducted, and tests for asbestos were negative. Test results are published in the Contract specifications. The Station was completely renovated in 1999, and the demolition and work under this scope are at the renovated areas.
 - 2. The Contractor shall designate one of its senior on site employees to be in charge of coordination between the Architect, the Contractor, and all Subcontractors with respect to hazardous materials issues.
 - 3. There might be additional inaccessible ACM in the existing buildings. Refer to items 4 and 5 below.
 - 4. Unknown and inaccessible ACM; During the Demolition work of the Contract, it is possible that previously unknown asbestos materials may be discovered in currently concealed locations.
 - 5. Notification: If the Demolition Contractor or Contractors discover or encounter any ACM during the performance of the work, the Demolition Contractor shall immediately:
 - (a) Stop work, notify the Owner and Clerk of the Works about the presence of suspect ACM and request instructions for proper action, and
 - (b) Take whatever steps and measures are necessary to reduce, control, or eliminate the risk of exposure of workers and the public to the ACM.
 - (c) Every effort will be made to obtain DEP (12 working day notification period) waivers to remove hidden or unforeseen ACM by the asbestos contractor. The Demolition Contractor shall allow sufficient time for the removal of the ACM at no additional charges to the Owner for delays and should waivers be denied by the DEP.
 - 6. Responsible Person On-Site: The Demolition Contractor shall designate one of its senior on site employees to be in charge of coordination between the Architect and the Demolition Contractor with respect to hazardous materials issues.
 - 7. Responsibility for Hazardous Material Discovery: It is the sole responsibility of the Demolition Contractor and its Subcontractors to undertake whatever measures methods of procedures are necessary, required or otherwise appropriate to safeguard the health and safety of all workers and members of the public with respect to identification and discovery of previously unknown hazardous materials during the work of the project.

8. Indemnification: To the fullest extent permitted by law, the Demolition Contractor shall indemnify and hold harmless the Owner and Architect and their agents and employees from and against all claims, damages, losses, and expenses including, but not limited to, attorney's fees arising out of or relating to the performance of the Work, including the discovery or identification of any hazardous materials, provided that any such claim. Damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and is caused in whole or in part by any negligent act or omission of the Demolition Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

B. Lead:

1. The Demolition Contractor shall be made aware that Lead Based Paint exists on painted surfaces throughout each building.
2. All the work of this Contract shall conform to the standards by all applicable Federal, State and Local laws, regulations, ordinance, and guidelines in such form in which they exist at the time of work on the contract and as may be required by subsequent regulations.
3. The Demolition Contractor is solely responsible for means and methods, and techniques used for demolition and lead control. The Demolition Contractor shall collect and control lead contaminated debris and to properly remove and dispose of lead contaminated soil around each building due to demolition activities.
4. The Demolition Contractor shall at his own cost and expense comply with all laws, ordinance, rules, and regulations of Federal, State, Regional, and Local authorities during demolition, prepping, sanding, cutting, burning, scraping, painting over, grinding, and regarding handling, storing, and disposing of lead and lead contaminated waste material.
5. The Demolition Contractor shall submit to the Architect prior to commencing of work the following:
 - (a) Written respiratory and notification program
 - (b) Written lead compliance program in accordance with OSHA regulations including:
 - I. Training requirement certifications
 - II. Supervisor qualifications
 - III. Written compliance program specific to this project
 - IV. Respirators fit test records
 - V. Medical surveillance certificates
6. The EPA and the DEP require demolition debris with lead to be tested in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) to determine the potential for significant amounts of lead to leach out of the waste. If the results are below the DEP standard (5.0 ppm), the waste may be disposed of in a conventional landfill for demolition debris. If, however, the TCLP results are above the DEP standard, the waste must be disposed of in a DEP approved, hazardous waste landfill. The Demolition Contractor shall at own cost and expense perform all required testing of waste by the TCLP. The Demolition Contractor must submit to the Owner a copy of tests performed and all waste shipment records prior to disposing of debris. The Owner reserves the right to have own TCLP samples collected to verify results. All disposal costs shall be at the Demolition Contractor's responsibility.

7. The following references are cited as current applicable publications. This project is subject to compliance with all the regulations including but not limited to:
 - (a) Commonwealth of Massachusetts, Department of Labor and Work Force Development 454 CMR 11.00, Structural Painting Safety Code, as currently amended.
 - (b) Commonwealth of Massachusetts, Department of Environmental Protection, and Hazardous Materials Regulations at 310 CMR 30.00, as currently amended.
 - (c) U.S. Department of Labor, Occupational Safety and Health Administration Title 29 CFR 1910.1025 and 29 CFR Part 1926.62.
 - (d) U.S. Department of Environmental Protection, Resources Conservation and Recovery Act.
 - (e) Commonwealth of Massachusetts, Department of Labor and Work Force Development 454 CMR 22.00.
8. All above regulations are applicable to this project. Where there is a conflict between this section and applicable regulations, the more stringent requirement shall prevail.

C. Other Hazardous Materials:

1. The Demolition Contractor shall be made aware that other hazardous materials are found inside/outside the buildings. The Demolition Contractor shall be responsible for quantifying, removal, and proper disposal of all remaining hazardous materials in/out of the buildings, including but not limited to batteries and related electrolytic material, PCB's, mercury, and Freon inside air conditioners, switches, exit signs, thermostats, paint, etc.

D. Polychlorinated Biphenyls (PCB's);

1. The Demolition Contractor to be made aware that building materials including but not limited to caulking, painted surfaces, glue, coatings, and other building materials might contain >1 ppm of PCB's.
2. The Demolition Contractor shall properly perform required demolition and shall collect all related debris and shall properly dispose and at no additional cost to the Owner.
3. The Demolition Contractor is solely responsible for means and methods, and techniques used for demolition, control, and disposal. The Demolition Contractor shall collect and control possible PCB's contaminated debris and soil due to demolition activities.
4. The Demolition Contractor shall at his own cost and expense comply with all laws, ordinance, rules, and regulations of Federal, State, Regional, and Local authorities during prepping, sanding, cutting, burning, scraping, painting over, grinding, and regarding handling, storing, and disposing of contaminated waste material and during renovation and demolition.

PART 2 - (PRODUCTS) Not Used

PART 3 - (EXECUTION) Not Used

END OF SECTION

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SECTION 01.50.00

TEMPORARY FACILITIES AND CONTROLS

I. PART I - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS INCLUDED

- A. Temporary Facilities and Controls including the following:

1. Temporary Water.
2. Weather Protection.
3. Heating During Construction.
4. Temporary Power.
5. Hoisting Equipment and Machinery.
6. Staging.
7. Maintenance of Access.
8. Dust Control.
9. Noise Control.
10. Indoor Air Quality (IAQ) Management.
11. Enclosures.
12. Cleaning During Construction.
13. Field Offices.
14. Telephone Service.
15. Sanitary Facilities.
16. Construction Barriers.
17. Parking.
18. Debris Control and Removal.
19. Safety Protection.
20. Vehicle and Equipment Protection.
21. Shoring.
22. Construction Fence.
23. Project Identification Sign.
24. Delivery of Materials.
25. Shut Down Notice.
26. Construction Cores.
27. Excavations and Field Survey Requirements

1.03 TEMPORARY WATER

- A. Contractors may make use of water available within and around the project site, at no cost. Connections shall be made where directed by the Owner, and connection points are subject to change at any time.
- B. Hoses and containers for temporary water shall be furnished by the trade requiring the water. The Owner will not provide any hoses for the contractor's use.
- C. Temporary hoses used for transporting water shall not be run unattended or unprotected across parking areas, parking area entrance, walkways, plazas, or steps. Temporary hoses shall not be permitted to be installed along, through or across corridor and occupied rooms or spaces.
- D. Contractors shall not wash out buckets or containers used for mortar, cementitious materials, paint or other materials deleterious to the building's piping, anywhere within the building.

- E. Care shall be taken to protect the interior finishes of the building from soiling from the use of temporary water (wet saw cutting, coring, etc.)
- F. The General Contractor shall provide an adequate supply of drinking water from approved sources of acceptable quality, satisfactorily cooled, for his employees and those of his Subcontractors.
- G. Use of the water may be discontinued by the Owner if, in their opinion, it is wastefully used.

1.04 WEATHER PROTECTION

- A. Although this is primarily an interior renovation of limited scope, Contractors' attention is drawn to the fact that State Statute requires that the General Contractor shall provide temporary enclosures and heat to permit construction work to be carried on during the months of November through March in compliance with M.G.L. Chapter 149, Section 44D(G). Under no circumstances shall the General Contractor suspend any work during the months of November through March because of their reluctance to provide and pay for temporary weather protection. These Specifications are not to be construed as requiring enclosures or heat for operations that are not economically feasible to protect in the judgment of the Designer, which include, without limitation, items such as site work, excavation, steel erection, erection of certain "exterior" wall panels, roofing, and similar operations.
- B. "WEATHER PROTECTION" shall mean the temporary protection of that work adversely affected by moisture, wind, and cold, by covering, enclosing and/or heating. This protection shall provide adequate working areas during the months of November through March as determined by the Designer and consistent with the approved construction schedule to permit the continuous progress of all work necessary to maintain an orderly and efficient sequence of construction operations. The General Contractor shall furnish and install all "weather protection" material and be responsible for all costs, including heating required to maintain a minimum temperature of 50 degrees F. at the working surface. This provision does not supersede any specific requirements for methods of construction, curing of materials or the applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the General Contractor.
 - 1. Within 30 calendar days after his award of contract, the General Contractor shall submit in writing to the Designer for approval, three copies of his proposed methods for "Weather Protection."
 - 2. Installation of weather protection and heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection devices. Heating devices which may cause damage to finish surfaces shall not be used.
 - 3. The General Contractor shall furnish and install one accurate Fahrenheit thermometer at each work area as designated by the Designer. However, one additional accurate Fahrenheit thermometer shall be provided for every 2,000 square feet of floor space where the work areas exceed 2,000 square feet.

1.05 HEATING DURING CONSTRUCTION

- A. Interior heating is not applicable for this project scope.
- B. Exterior heating shall be provided as required under WEATHER PROTECTION, above.

1.06 TEMPORARY POWER

- A. Contractors may utilize electrical power where available in or around the Work Area, and the Owner shall pay the cost of electricity used.
 - 1. The use of cordless tools is strongly encouraged.
 - 2. Contractors shall provide their own electrical cords, and cords shall not be run through, across or draped within corridors or circulation spaces used by the public. If running electrical cords across circulation spaces is unavoidable, cords shall be secured to the floor with readily visible colored duct tape, and shall be removed as soon as power is no longer needed, including tape residue and repair any damage.
- B. Modification of electrical panels is not permitted, except where higher voltages are required for specialty tools. Any panel modifications may only be performed by a licensed electrician, and with the Owner's approval.

- C. Generators for temporary power will not be permitted within the building. If permitted by the Owner, when required due to extenuating circumstances, they shall be located outside where directed by the Owner and shall be:
 - 1. Equipped with mufflers.
 - 2. Located where directed by the Owner, away from windows and air intakes.
 - 3. Discontinued at the Owner's request, if the use of generators affects the use of the building by its occupants.

1.07 HOISTING EQUIPMENT AND MACHINERY

- A. No hoisting equipment is anticipated for this project scope, however, should project conditions necessitate the use of hoisting equipment it shall be furnished, installed, operated and maintained in safe condition by the individual Subcontractors requiring the equipment. All costs for hoisting operating services shall be borne by the Subcontractors unless specifically excepted in the Contract Documents.
 - 1. A licensed equipment manufacturer's representative shall be present at all times, to witness the erection and dismantling of all hoisting equipment and machinery, whenever such equipment is being erected or dismantled. No such work will be performed without the presence of such representative.
 - 2. Hoisting equipment and machinery erection and dismantling shall be performed only by trained, certified, and experienced riggers qualified to perform such work.
 - 3. Copies of such licenses and/or certifications, clearly indicating qualifications, shall be provided to the designer prior to commencement of such erecting and dismantling work.
- B. Review Drawings for hoisting requirements and openness of traffic access routes to installed destinations of specified equipment and furnishings.

1.08 STAGING

- A. All staging, planking and scaffolding, exterior and interior, required for the proper execution of the work and over eight feet in height, shall be furnished, installed, and maintained by the Prime Contractor.
 - 1. Erection and dismantling of staging shall be performed only by trained, certified, and experienced staging personnel qualified to perform such work.
 - 2. Copies of such certifications, clearly indicating qualifications, shall be provided to the Owner prior to commencement of such erecting and dismantling work.
 - 3. All staging up to eight feet in height shall be provided by the individual Subcontractors as applicable to their work.
 - 4. Use of staging extends to the Owner's contractors as may be listed in Section 01.11.00 - Summary of Work, where applicable.

1.09 MAINTENANCE OF ACCESS

- A. The Prime Contractor shall provide and maintain for the duration of his contract, a means of access to, around and within the site, as required by the Owner, for vehicular traffic and authorized personnel. The Prime Contractor shall, without additional compensation from the Owner, furnish labor and materials as may be required from time to time to maintain this means of access in an acceptable condition as determined by the Designer. Pedestrian access shall provide adequate protection against falling debris, slippage, adequate lighting, warning and directional signs, and protection against construction activities.
- B. Material loading into the building shall occur off Harding Street, where directed by the Owner. Construction materials, debris, equipment, etc. shall not be brought through the main entrances of the building.

1.10 DUST CONTROL

- A. The General Contractor shall have all Subcontractors provide adequate means for the purpose of preventing dust caused by construction operations from creating a hazard, nuisance, and from entering adjacent occupied or unoccupied areas throughout the period of the construction contract. Cleanup of dust can be intensive and a problem if dust spreads throughout adjacent space where tenants or the city have stored items.
- B. This provision does not supersede any specific requirements for methods of construction or applicable general conditions set forth in the Contract Articles with added regard to performance obligations of the General Contractor.

1.11 NOISE CONTROL

- A. Work must be scheduled and performed in such a manner as to not interfere with the operations of the Owner. Construction work that is deemed by the Owner to be excessively noisy may be required to be done during non-normal working hours and at no additional expense. Such activities include, but are not limited to:
 - 1. Jackhammering.
 - 2. Shot blasting or floor grinding.
 - 3. Hammerdrilling.
- B. Comply with requirements of authorities having jurisdiction. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.
- C. Execute construction work by methods and by use of equipment which will reduce excess noise.
 - 1. Equip air compressors with silencers, and power equipment with mufflers.
 - 2. Manage vehicular traffic and scheduling to reduce noise.
 - 3. No heavy equipment may be started or idled before 7A.M.

1.12 INDOOR AIR QUALITY (IAQ) MANAGEMENT

- A. Advise the Owner in advance of grinding and dust-generating activities, and coordinate the closure of windows in the vicinity of such work.
- B. Coordinate the shut-down of air handling equipment in the vicinity of dust-generating operations. If shut-down is not feasible or not permissible by the Owner, install temporary disposable filters over any fresh-air intakes.
- C. Wet building construction and equip grinding tools with hoods and connect to HEPA vacuums where dust cannot otherwise be controlled.
- D. Prohibit smoking on site, except where permitted for the general public.

1.13 ENCLOSURES

- A. Temporary enclosures are not anticipated to be required, as the work is entirely exterior and will not create any new openings in the building envelope.

1.14 CLEANING DURING CONSTRUCTION

- A. Unless otherwise specified under the various Sections of the Specifications, the Prime Contractor shall perform clean-up operations during construction as herein specified.
- B. Control accumulation of waste materials and rubbish; periodically dispose of off-site in a legal manner. The Prime Contractor shall bear all costs, including fees resulting from such disposal.

- C. Clean all dirt and debris tracked into other buildings by construction personnel, to the satisfaction of the Owner.
- D. Maintain project in accordance with all local and Federal Regulatory Requirements.
- E. Store volatile wastes in covered metal containers, and remove from premises.
- F. Prevent accumulation of wastes which create hazardous conditions.
- G. Provide adequate ventilation during use of volatile or noxious substances.
- H. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - 1. Do not burn or bury rubbish and waste materials on site.
 - 2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
 - 3. Do not dispose of wastes into streams or waterways.
 - 4. Identify potential sources of cleaning water runoff and propose abatement procedures.
- I. Use only those materials which will not create hazards to health or property and which will not damage surfaces.
- J. Use only those cleaning materials and methods recommended by manufacturer of surface materials to be cleaned.
- K. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.
- L. Provide on-site containers for collection of waste materials, debris, and rubbish.
- M. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal dump site (DEP approved). Recycle where possible.
- N. Handle material in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- O. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.

1.15 FIELD OFFICES

- A. The Owner will provide space within the building, for use as field offices for the contractors. The contractors shall confine their field operations to this area, keep it neat and orderly, and restore it to existing condition at project completion.
- B. Office trailers will not be permitted on site.

1.16 TELEPHONE SERVICE

- A. Wired telephone service to the field office is not required, although contractors may elect to have such service at their own expense.
- B. All Designers, Superintendents and Project Managers shall maintain cellular telephones and be reachable during normal business hours Monday - Friday, and after hours for emergency calls. Phone numbers shall be listed on a Project Directory, to be submitted at the pre-construction meeting.

1.17 SANITARY FACILITIES

- A. Contractor may utilize the public toilet rooms within the building, provided they are kept clean. The Owner reserves the right to revoke this privilege if the toilet rooms are not maintained, in which case, the General

Contractor shall provide suitable toilet facilities on site, in a location as required by the Owner. Maintain chemical toilets where work is in progress and in quantity required by OSHA Code.

- B. Chemical toilets and their maintenance shall meet requirements of state and local health regulations and ordinances and shall be subject to the approval the Resident Engineer and Designer.

1.18 CONSTRUCTION BARRIERS

- A. Proper construction barriers shall be provided around the contract work areas wherever work is being performed or as directed by the Owner.
- B. Construction barriers shall consist of traffic cones, ribbons, tapes, secure fencing, trench covers, wood barriers, warning signs, directional signs, and other traffic materials to keep traffic and people from area of construction and maintain ongoing operations.
- C. Where overhead work is performed, pedestrians and lower portions of the building shall be protected from falling objects. The contractor shall prepare and submit a protection plan for the Owner's approval prior to the start of the work.
- D. Barriers shall be erected at such approved locations as are necessary, sufficiently cross-braced and supported adequately from floors and ceilings as required.

1.19 PARKING

- A. Parking spaces on site are very limited and the Owner may not provide designated parking lot spaces near the construction site for the Contractor's use. Contractors shall anticipate the need to park off-site, and carpool to the project area.
- B. Contractors shall park where directed by the Owner, and move vehicles when requested by the Owner.
 - 1. Access to loading docks, driveways, staff, faculty, visitor or tenant parking shall not be blocked by construction vehicles.
 - 2. Parking in handicapped accessible spaces will not be permitted.
- C. Idling of vehicles on site will not be permitted.
- D. If the Owner authorizes parking on non-paved areas, the Prime Contractor shall be responsible for repairing any damage to lawns or curbs from parked vehicles.

1.20 DEBRIS CONTROL AND REMOVAL

- A. Debris shall not be permitted to accumulate or migrate and the work shall at all times be kept satisfactorily clean. Facility trash receptors shall not be used for the disposal of debris. Dumpsters shall be provided by the Prime Contractor for removal of debris for all Subcontractors.
- B. Remove debris from the work site on a daily basis and dispose of same at any (private or public) DEP approved dump that the Prime Contractor may choose providing that the Prime Contractor shall make all arrangements and obtain all approvals and permits necessary from the owner or officials in charge of such dumps. During disposal process, copies of daily receipts from dumpsite shall be submitted on a regular basis.
- C. Debris shall be transported through the building in covered carts, not overloaded, following a route dictated by the Owner. Movement of debris may be restricted or delayed by the Owner during heavy pedestrian traffic times.

1.21 SAFETY PROTECTION

- A. At no time shall the work be left unattended without proper safety protection and shall not be left unprotected to the weather and accessible to the public. It is the responsibility of the Prime Contractor to maintain proper safety protection for the public while work is in progress or unattended.

1.22 VEHICLE AND EQUIPMENT PROTECTION

- A. All construction activities shall be performed in such a manner so as not to dust, stain or damage any building elements, equipment, vehicles, etc. within general vicinity of the construction work area. Any damage to these items shall be cleaned and repaired at the expense of the Prime Contractor.

- 1. All construction vehicles and equipment on site shall be effectively disabled and secured when not in use.

1.23 SHORING

- A. Not applicable to this project scope. The General Contractor shall provide all temporary shoring and bracing as required for the proposed work. Comply with all applicable codes and standards.

1.24 CONSTRUCTION FENCE

- A. Not required.

1.25 PROJECT IDENTIFICATION

- A. No project sign is required by the Owner.
- B. If the Contractor wishes to provide a project sign, at his own expense, the Owner reserves the right to approve the content and appearance of the sign.
- C. Any signs will be located on site where directed by the Owner, and shall be relocated or removed if the Owner so directs.

1.26 DELIVERY OF MATERIALS

- A. All Materials shall be delivered to the Contractor's or Sub-Contractor's warehouse or may be delivered to the site if the Contractor's representative is present to receive them.
- B. No materials will be received by the Owner's personnel.

1.27 SHUT DOWN NOTICE

- A. The Contractor shall notify the Owner, at least fourteen (14) calendar days in advance, of the need for any utility shut down to install or modify any utilities or building systems. The shutdown request shall indicate:
 - 1. The utility to be shutdown.
 - 2. The duration of the shutdown.
 - 3. The spaces anticipated to be affected by the shutdown.
- B. Investigation of the existing systems to determine the areas served, the location of isolation valves or sub-panels, etc., is to be anticipated and included in the bid scope.

1.28 EXCAVATIONS AND FIELD SURVEY REQUIREMENTS

- A. Not applicable.

II. PART II - PRODUCTS (Not Used)

III. PART III - EXECUTION (Not Used)

END OF SECTION
01.50.00

SECTION 01.73.29

CUTTING AND PATCHING

I. PART-1 GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this section of the specifications.

1.02 SCOPE OF WORK

- A. The General Contractor shall coordinate the work to ensure that all embedded or concealed items are placed prior to the closing of construction. Where opening up construction is required to install any aspect of the work, the General Contractor shall be solely responsible for the cutting and patching of such materials.

1.03 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting and patching.
- B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching.

1.04 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.
- B. Obtain approval of the cutting and patching proposal from the Designer before cutting and patching structural elements.
- C. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Designer's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

1.05 RELATED SECTIONS

- A. General Conditions of the Contract

II. PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.
- B. Concrete, where used to patch abandoned penetrations or damage, shall be:
 - 1. Normal weight concrete proportioned in accordance with ACI 211.1 and ACI 30 for 4,000 psi

compressive strength @ 28 days.

2. At openings over 6" wide, provide ASTM A 615/A 615M, Grade 60, deformed reinforcing bars doweled into the existing slab 48" on center, both sides, staggered.
 3. At horizontal openings less than 6" wide, chip out the top of the opening to enlarge it, creating a tapered or conical hole to patch, such that the patch material cannot drop through the hole.
- C. Terrazzo shall not be cut without the approval of the Architect.
1. Where utilities, equipment, cabinetry or other construction is removed, exposing a portion of terrazzo which is discolored and does not match surroundings, the area shall be stripped of any wax or finishes, and screened or ground, then polished to match the surroundings.
 2. Where demolition or removal of elements which penetrated terrazzo leave behind a hole, the hole shall be finished with an epoxy terrazzo patch which matches the surroundings to the Owner's satisfaction, and is ground and polished to match the surroundings.
- D. Masonry, including brick and block, shall be toothed out where new openings are required, and toothed in with solid-end units to create a solid, clean edge to the opening. Sawcutting and filling exposed cores with grout or other cementitious materials will not be permitted.
1. Block: Concrete masonry units meeting ASTM C90 for loadbearing applications, regardless of location.
 2. Brick: Clay units, grade SW for exterior locations and NW for interior locations as classified in ASTM C62.
 3. Mortar: Type N, unless noted otherwise.
 4. The size, color and texture of patching materials shall match the existing materials being patched.
 5. Salvaged masonry materials, which are in good condition, may be used as patching materials.
- E. Lintels: Where new openings are cut into masonry walls, provide steel lintels to support remaining masonry.
1. Steel to be ASTM A36
 2. Size: 4" x 3-1/2" x 5/16" for openings 36"-54"
 3. Quantity: One per 4" of masonry.
 4. End bearing: minimum 8"
 5. Provide galvanized steel at exterior location, shop primed steel at interior locations.
- F. Grout, where used to close annular space around floor or wall penetrations other than those noted to receive envelope repairs, shall be:
1. Non-shrink type, prepackage and preproportioned, requiring only the addition of potable water before use, meeting or exceeding the following standards:
 - (a) General Properties: ASTM C 1107-02
 - (b) Compressive strength: ASTM C 109
 - (c) Bond Strength: ASTM C 882
- G. Lumber: where cutting of lumber is required for the installation of utilities or recessed items such as toilet room accessories, or for the incidental replacement of damaged or unsuitable framing materials, new materials used to patch, sister, header or box out openings shall be kiln dried, stud grade S-P-F dimensional lumber with a dressed size of 1½" x the depth of the members receiving the work.
1. Use pressure treated lumber when in contact with ground, masonry, concrete or for roof blocking, with CCA preservative and a minimum retention rate of 0.25 pcf. Treat all cut ends by touching up in field with preservative. Use only galvanized fasteners and separate from materials which will react with preservative by using a separation sheet of peel-and-stick bituminous flashing tape.

- H. Gypsum Board: should the performance of the work impact the walls interior, patch gypsum board with ASTM C-1396 board materials of a thickness to match existing.
 - 1. Patches in rated assemblies shall be made with Type X materials.
 - 2. Patches in wet areas shall be made with MR (moisture resistant) materials.
 - 3. Joints and fasteners shall receive 3 coats of setting or drying type joint compound (contractor's option), sanded and feathered in successive wider applications to deliver a Level 4 finish to the patched area.
- I. Plaster: Where cutting and patching involves interior plaster, comply with the following:
 - 1. Comply with ASTM C 842
 - 2. Comply with manufacturer's instructions and install thickness and coats as indicated.
 - 3. Unless otherwise indicated, provide 3-coat work.
 - 4. Base Coat: Ready-mixed, sand aggregate gypsum plaster base.
 - 5. Finish Coat: Ready-mixed gypsum finish plaster.
 - 6. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.

III. PART 3 - EXECUTION

3.01 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
 - 1. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 - 2. Take all precautions necessary to avoid cutting existing pipe, conduit or duct work serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.
- C. Furnish dropcloths, erect dust partitions and take other measures as required to control dust generated by cutting activities and prevent its spread to adjacent areas

3.02 PERFORMANCE

- A. The General Contractor shall be responsible for all cutting and patching, including all cutting and patching required by sub contractors.
 - 1. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
 - 2. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. General: Employ skilled workmen to perform cutting and patching. Where required to maintain an existing product or system warranty, such as a roof warranty, employ a manufacturer's approved and warranted Contractor to perform the cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

- C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.
 - 1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or diamond core drill.
- D. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 - 1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - 2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 - 3. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch, after the patched area has received primer and second coat. Touch-up painting may stop at a corner, pilaster or other visual break in the repaired surface.
 - 4. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.
- E. Site Repair:
 - 1. Restore all lawns, plantings, trees to their original condition.
 - 2. Repair all walkways and driveways that were damaged due to construction.

3.03 CLEANING

- A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature.
- B. Clean any portions of the building which were affected by dirt or dust generated by cutting, sanding or other construction activities.

END OF SECTION

SECTION 01.77.00

CLOSEOUT PROCEDURES

I. PART 1 - GENERAL

1.01 SCOPE

- A. This section lists the procedures required for the proper completion of this project including processing the Release of Retainage and making the Final Payment to the Contractor.
- B. Consult the Individual sections of the specifications for requirements affecting Project Close Out.

1.02 RELATED DOCUMENTS

- A. This section supplements the General Conditions.
- B. Consult the individual sections of the specifications for specific items required under those sections.

1.03 SUBSTANTIAL COMPLETION

- A. Substantial Completion shall be declared when all work on all portions of the building is substantially complete. Partial completion of discreet areas, or incremental warranties for individual portions of the building will not be permitted.
- B. Prior to requesting Substantial Completion the Contractor shall make a thorough inspection of the Work. During this inspection the Contractor shall prepare a comprehensive list of all items remaining to be completed or corrected. This list shall include all remaining Contractor and Subcontractor items to be provided under the Contract Documents.
- C. Upon completion of the items noted on the Contractor's list the Contractor shall notify the Architect that the Work is Substantially Complete. The Architect shall then conduct a similar thorough inspection. If the Architect agrees that the Work is Substantially Complete, the Architect will promptly make a thorough inspection and prepare a punch list, setting forth in accurate detail any items on the Contractor's list and additional items that are not acceptable or incomplete. The Contractor shall coordinate all Subcontractors to achieve prompt completion of the punch list.
- D. The Contractor shall not be relieved of the responsibility to provide Contract items left off of the Architect's punch list.
- E. If the Architect determines that the Work is not Substantially Complete, the Architect shall inform the Contractor of those items that must be completed before the Architect will prepare a punch list. Upon completion of those items, the Contractor shall again request the Architect to prepare a punch list.
- F. When the punch list has been prepared, the Architect will arrange a meeting with the Contractor and Subcontractors to identify and explain all punch list items and answer questions on work which must be done before final acceptance.
- G. The Architect may revise the punch list, from time to time, to ensure that all items of Work are properly completed.
- H. The Architect shall prepare the Certificate of Substantial Completion in accordance with the General Conditions.
- I. The Contractors shall correct the items noted on the punchlist(s). The General Contractor shall check the work of his forces, and of all sub-contractors to verify that the work has been corrected, and notify the architect that the project is ready for reinspection. The Architect and Engineers may, at their discretion,

check the work to confirm the punchlist has been completed, and advise the Owner.

1. If the Contractor calls for reinspection, and the Project is not actually ready or punchlist items have not been corrected and subsequent reinspections are required, the Architect reserves the right to bill the Owner for the reinspections, and such monies will be deducted from the balance due to the Contractor.

1.04 RECORD DRAWINGS

- A. As-built Drawings shall consist of all the Contract Drawings. As-built Drawings shall be kept up-to-date. Information from on-going Work shall be recorded on As-built Drawings within 48 hours of Work being performed.
- B. The Prime Contractor and each Subcontractor shall be required to maintain one set of As-built Drawings, as the work relates to their Sections of the Specifications, at the site.
- C. The As-built Drawings shall be stored and maintained in the Prime Contractor's field office or a secure location apart from other documents used for construction. The As-built Drawings shall be maintained in a clean, dry, and legible condition and shall not be used for construction purposes.
- D. As-built Drawings, as submitted by the Prime Contractor shall be verified in the field by the Designer or his Consultants. Verification by the Designer shall occur during the construction process and prior to the related work being completed and covered up.
- E. The As-built Drawings shall be available at all time for inspection by the Project Manager or Designer. All deficiencies noted shall be promptly corrected.
- F. The following information shall be indicated on the As-Built Drawings:
 1. Record all changes, including change orders, in the location, size, number and type both horizontally and vertically of all elements of the project which deviate from those indicated on all the Contract Drawings.
 2. Record the actual extent, location and type of repairs made, following the repair types noted on the Drawings and the categories of repairs listed in Unit Prices. Utilize the same coding system as appears on the construction documents.
- G. At the end of each month and before payment for materials installed, the Prime Contractor, each Subcontractor, the Architect and Project Manager shall review the As-built Drawings for purpose of payment.
 1. If the changes in location of all installed elements are not shown on the As-Built Drawings and verified in the field, then the material shall not be considered as installed and payment will be withheld.
- H. Prior to the installation of all finish materials, a review of the As-built Drawings shall be made to confirm that all changes have been recorded. All costs to investigate such conditions shall be borne by the applicable party as determined by the Designer.
- I. At the completion of the contract, each Subcontractor shall submit to the Prime Contractor a complete set of his respective As-built Drawings indicating all changes. After checking the above drawings, the General Contractor shall certify in writing on the title sheet of the drawings that they are complete and correct and shall submit the As-built Drawings to the Designer.
- J. The original hand-noted as-Built Drawings shall be scanned in color to Adobe Acrobat (*.pdf) format and submitted on CD or DVD to the Designer, to be added to the complete plans as constructed.

1.05 RECORD SURVEYS

- A. Not applicable.

1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Consult the individual sections of the specifications for the specific requirements for those sections and for further details and descriptions of the requirements.
- B. Prior to final payment and completion the Contractor shall provide all Operating Manuals and Maintenance Instructions as required by the Contract Documents.
- C. Operating Instructions and Manuals:
 - 1. Subcontractors, installers, and suppliers shall furnish to the Contractor two sets of operating and maintenance instructions of all mechanical, electrical, and manually operated equipment furnished and installed by them. Mechanical and electrical subcontractors shall furnish instructions as specified in their respective sections.
 - 2. The Contractor shall collect all of the above instructions, bind them into two complete sets, and submit them to the Architect who will deliver them to the Owner.
 - 3. The Contractor shall prepare a CD of all O&M manuals and deliver to the Owner.
 - 4. Submission of operating and maintenance instructions shall be a condition precedent to final payment
- D. Instruction of Owner's Personnel
 - 1. Where specified in the individual sections of the specifications, the Contractor and Subcontractor shall instruct the Owner's personnel at the site, in the use and maintenance of equipment installed under the Contract.
 - 2. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative, shall be a condition precedent to final payment.

1.07 PARTIAL RELEASE OF RETAINAGE

- A. If within 65 days after Substantial Completion, any of the items on the Architect's punch list are not complete or if the Contractor has not provided the appropriate marked up As Built Drawings, Operating Manuals, Warranties, Guarantees, or Spare Parts the Architect shall assign a monetary value for each incomplete item as well as any other items as provided by M.G.L. c.30 §39K, and the Architect shall prepare a Certificate for Partial Release of Retainage
- B. If the Architect is required to prepare a Certificate for Partial Release of Retainage the Contractor shall complete all remaining Work in accordance with the provisions of the General Conditions.
- C. The Contractor's signature on this Certificate shall be notarized.
- D. The Contractor may make a request for additional releases of retainage when portions of the Work listed on the Architect's punch list have been satisfactorily completed. Each request shall be accompanied by a new application for payment and a new signed and notarized Certificate for Partial Release of Retainage.
- E. The Architect's inspections, required to complete the additional payment applications described above, are subject to provisions of the General Conditions.
- F. If the Owner has required Performance and Payment Bonds, then prior to the partial release of retainage, the General Contractor shall submit to the Owner Consent of Surety to Partial Release of Retainage using AIA

Document G707A or an equivalent document.

1.08 FINAL RELEASE OF RETAINAGE

- A. Prior to the final release of retainage, the Prime Contractor shall submit to the Owner:
1. Consent of Surety, using AIA Document G707 or similar document, if performance and payment bonds were required for the project.
 2. Contractor's Affidavit of Release of Liens, using AIA Document G706A or equivalent. This document shall be accompanied by certified statements from all sub-contractors working on the project, that they have received all monies due, and have paid all suppliers and sub-sub contractors accordingly.
 - (a) Should any payments be outstanding and contingent upon receipt of the retainage in order to be paid, the General Contractor shall submit AIA Document 706, itemizing those items which have not been paid.

END OF SECTION

SECTION 02.41.00

SELECTIVE DEMOLITION

I. PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.
- B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to selective demolition of the following:
 - 1. Selective demolition and disposal of items and components at existing walls in the Work Area.
 - 2. Each subcontractor shall disconnect, cut, cap, and make safe all utilities, equipment and fixtures which are not indicated for salvage or re-use, or otherwise indicated to be abandoned in place as well as any abandoned materials of any kind.
 - (a) Disconnect, cut, cap, and make safe all utility services indicated to be demolished at their primary source. Obtain the approval from authorities having jurisdiction, or applicable service provider prior to the execution of work.
 - (b) Cut, cap, and make safe all existing utility services indicated to be abandoned in place, where so indicated on the Drawings.
 - 3. Plumbing sub-contractor is responsible for the removal and disposal of any/all plumbing related items. This contractor is to remove all general work for their access to the plumbing items and is to be coordinated together in sequence.
 - 4. Electrical sub-contractor is responsible for the removal and disposal of all electrical related items. This contractor is to remove all general work for their access to electrical items and is to be coordinated together in sequence.
 - 5. Identify locations of utilities for work of other sections.
 - 6. Conduct walk through of existing site prior to commencement of selective demolition with Owner and identify items required to remain and maintain their functions.
 - 7. Demolition to be in conjunction with protective measures and overall scope of work.
 - 8. Pre demolition meeting to be held to coordinate the demolition scope with all trades.
 - 9. Final preparation for waterproofing and finish materials shall be by the finish materials installer.
 - 10. In addition to demolition specifically shown, cut, move, or remove existing construction to remain as necessary to provide access or to allow alterations and new work to proceed. Coordinate such relocation's and removal to accommodate the demands and requirements of other trades.

- B. **Alternates:** N/A.
- C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
 - 1. None.
- D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
 - 1. None.
- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:
 - 1. Section 22.00.00 - Fire Protection, for demolition of sprinkler components related to relocation of sprinkler heads.
 - 2. Section 24.00.00 - HVAC, for demolition and revision of air distribution components, thermostats, etc.
 - 3. Section 26.00.00 - Electrical, for demolition of light fixtures, conduits, and other electrical components to permit the installation of new Work.

1.03 SUBMITTALS

- A. Refer to Section 01.33.00 - Submittals for requirements and procedures.
- B. Schedule: Provide detailed sequence of demolition and removal work.
- C. Permits: Submit a copy of permits required by regulatory agencies for demolition.
- D. Special Procedure Submittals: Submit copies of written agreements from private landowners, landfill operators, or other agencies accepting disposal of demolished materials at least two weeks prior to commencement of demolition work.
- E. Closeout Submittals: Submit closeout documents.

1.04 JOB CONDITIONS

- A. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
- B. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.
 - 1. Provide protective measures as required to provide free and safe passage of Owner's personnel.
 - 2. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations. Protect site with suitable coverings when necessary.
 - 3. Remove protections at completion of work.
- C. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.
- D. Traffic: Conduct selective demolition operations and debris removal in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

- E. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
- G. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
- H. Environmental Controls: Use temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

1.05 REFERENCES

- A. Reference Standards: Comply with applicable requirements of the following standards and those other referenced in this Section, under the provisions of Section 01.42.00 - References. Where these standards conflict with specified requirements, the most restrictive requirements shall govern.
 - 1. ANSI A10.6 - Safety Requirements for Demolition Operations.
 - 2. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.06 OWNERSHIP OF REMOVED MATERIALS

- A. Ownership of materials, equipment, and furnishing designated for salvage for re-use in this Project or designated for Owner's use is retained by the Owner.
- B. Ownership of materials, equipment, and furnishings to be removed from the Project which are not defined by the above two paragraphs is retained by the Contractor; if any of these are considered of salvageable value to the Contractor, they may be removed from the Project as work progresses.
 - 1. On-site storage or sale of removed items is prohibited.

1.07 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Comply with all requirements of this contract relative to protection, scheduling, and coordination with the Owner.
 - 2. Hazardous materials: When hazardous materials are encountered, they shall be handled, removed, and disposed of in accordance with all regulatory agency requirements.
 - 3. Coordinate and arrange with utility, mechanical, and electrical trades for their disconnecting, rerouting, and maintenance of existing services leading to adjacent occupied buildings, as part of the work of this Contract.
 - 4. Coordinate Work of this Section with related utilities work identified in the Contract Documents.
- B. Pre Demolition Meeting: At least two weeks prior to commencing the work of this Section, conduct and pre demolition conference at the Project site. Comply with requirements of Section 01.31.00 - Project

Management and Coordination. Coordinate time of meeting to occur prior to installation of work under the related sections named below:

1. Required attendees: Architect, Contractor's project manager and on-site superintendent, demolition sub-contractor's project superintendent, and representatives of related utility trades.
2. Conference Agenda:
 - (a) Scheduling of demolition operations. Review critical demolition sequencing with other work.
 - I. Coordination scheduling with Station's ongoing operations.
 - II. Weather protection for all occupied areas.
 - (b) Coordination of utility service requirements and disconnects.
 - I. Review functioning utility services which are to remain in service throughout demolition work.
 - II. Review requirements for marking location of disconnected utilities, and project record (as built) requirements.
 - (c) Review conditions of existing construction to be demolished.
 - I. Review extent and location of selective demolition.
 - II. Review special demolition and salvage procedures required for historic building elements.
 - III. Exploratory demolition and concealed conditions.
 - (d) Coordination of demolition work with work of other contracts.
 - (e) Review shoring and bracing procedures and structural load limitations of existing structure.
 - (f) Review of site use, staging, and storage locations for salvage materials and materials for recycling program.
 - (g) Emergency weather protection procedures and weather limitations.
 - (h) Review conditions of existing construction to be demolished.
 - (i) Review structural load limitations of existing structure.
 - (j) Review extent and location of selective demolition. Review areas where existing construction is to remain and requires protection.
 - (k) Review special requirements for temporary protection of existing finishes and materials to remain.
 - (l) Review requirements of work performed by other trades that rely on substrates exposed by demolition operations.
 - (m) Procedures for processing field decisions.

- (n) Procedures for handling hazardous materials if encountered.
- (o) Review fire protection procedures for cutting torches and other potentially hazardous operations.
- (p) Review general safety regulations and requirements for demolition work.

C. Sequencing:

- 1. Coordinate and arrange with mechanical and electrical trades for their disconnecting, rerouting, maintenance of existing services in the buildings as required, as part of the work of this Contract.

D. Scheduling:

- 1. Comply with all requirements of this Contract relative to protection, scheduling, phasing, and coordination with Owner.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable codes for demolition work, safety of structure, dust control, and disposal of debris. Conform to procedures applicable when discovering hazardous materials or contaminated substances.
 - 1. The Contractor is directed not to disturb or attempt removal of any discovered hazardous materials or contaminated substances. Immediately notify both the Owner and the Architect upon discovery of such conditions.
 - 2. Hazardous materials or contaminated substances were not encountered at the limited testing at this area of work, however exist on site at other areas and potentially could be encountered. Refer to Sections 01.26.00 - Unit Prices and 01.35.00 - Environmental Procedures.
- B. Obtain and pay for required permits and licenses required from authorities prior to commencing demolition work. Arrange and pay for legal disposal of removed materials and equipment. Obtain proper disposal of removed materials and equipment. Obtain proper disposal receipts for verification.
- C. Notify affected utility companies and Owner before starting work and comply with utility company requirements.

1.09 QUALITY ASSURANCE

- A. General: Conduct the work in a manner giving prime consideration to protection of the public; protection from the weather, control of noise, shocks and vibration; control of dirt and dust; orderly access for and storage of materials; protection of existing buildings; protection of adjacent surfaces and property; coordination and cooperation with the Owner at all times.
 - 1. Comply with all requirements of this contract relative to protection, scheduling and coordination with the Owner.
- B. Qualifications:
 - 1. Demolition subcontractor: Company specializing in performing work on this section with minimum 3 years documented experience.

1.10 SITE CONDITIONS

- A. Comply with wind and weather conditions established at pre-demolition meeting.

II. PART 2 - PRODUCTS (Not Used)

III. PART 3 - EXECUTION

3.01 EXAMINATION

- A. Condition of Structures: Owner assumes no responsibility nor makes any claim as to the actual condition or structural adequacy of any existing construction to be demolished. The Contractor shall investigate and assure himself of the condition of the work to be demolished and shall take all precautions to ensure safety of persons and property.
 - 1. Notify both Owner and Architect if any type of hazardous chemicals, gases, explosives, flammable material, unmarked containers, or similar dangerous substances are discovered. Cease work in affected areas until directed by Architect. Continue work in other areas.
- B. The Contractor shall have examined the existing conditions per requirements of the Conditions of the Contract and Division 1 - General Requirements, and reviewed Contract Documents prior to commencement of demolition. Coordinate and verify scope of selective demolition with other portions of work specified in other sections, and under separate Contract. Change orders will not be issued for removal of any exposed to view materials or equipment, which are either indicated on the Drawings for removal, or not indicated, but necessary to remove for the Work of this Project.

3.02 COORDINATION

- A. All contractors are advised that the building will be occupied throughout construction.
- B. Any shutdowns required to perform demolition of utilities requires submission of a formal request, through the Owner's Project Manager. Refer to 01.50.00 for the shutdown policy.

3.03 PREPARATION

- A. Submit a demolition plan and schedule under the provisions of Section 01.33.00 - Submittals, prior to performing any demolition work. Adjust schedule as required to accommodate ongoing research in occupied areas. In some cases, work after hours may be required.
- B. File all appropriate paperwork, and obtain all required permits prior to the start of demolition, including but not limited to:
 - 1. AQ-06 demolition permit.
 - 2. Dumpster permit.
 - 3. ANF-01, for removal of asbestos-containing materials.
- C. Sequence work in occupied areas so as to minimize disruption, and to allow continued use of spaces.
- D. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent to facilities to remain. Refer also to 01.73.29 - Cutting and Patching.
- E. Cease operations and notify the Owner's Representative immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.
- F. Erect and maintain dust-proof partitions and closures, and other means as required to prevent spread of dust

or fumes to occupied portions of the building, as specified in Section 01.50.00. Temporary partitions shall not restrict access of egress, and shall not reduce the clear width to less than what is required by Code.

- G. Coordinate temporary building HVAC shutdowns in the event dust-generating demolitions is to be performed adjacent to building air intake points. The General Contractor shall provide temporary ventilation through fans, to control the spread of dust through the building and maintain a negative pressure in the project area, relative to the remainder of the building.
- H. Extra care and precaution shall be taken by the GC to protect any live utilities from damage until such time as they can be demolished by the appropriate sub-trade. The GC will be responsible for any and all damages to finished and equipment leaks stemming from damage to any of the utilities within the project area.
- I. Protect existing structures which are not to be demolished. Protect designated materials and equipment to be removed and retained by Owner.
 - 1. Cover or otherwise protect any necessary existing equipment, furniture, and furnishing located beyond the immediate demolition work.
 - 2. Protect existing landscape materials, structures, and appurtenances which are not to be demolished.
- J. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

3.04 INSPECTION

- A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Architect prior to starting work.

3.05 ASBESTOS ADVISORY

- A. Refer to Section 01.35.00 - Environmental Procedures.

3.06 LEAD-CONTAINING PAINT

- A. None.

3.07 GENERAL DEMOLITION REQUIREMENTS

- A. Do not perform more demolition than can be made weather-tight that same day. "Weather-tight" shall mean the complete installation of the air infiltration barrier, including the taping of all seams.
- B. Perform selective demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.
 - 1. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
 - 2. Locate equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 3. Remove debris from elevated portions of building chute, hoist, or other device that will convey debris to grade level in a controlled descent. Do not throw trash from any location..

4. Remove materials by method suitable to avoid free fall and to prevent ground impact or dust generation.
 5. Where existing finishes are indicated to be removed, remove down to bare subsurface without causing damage to the subsurface.
- C. Provide services for effective air and water pollution controls as required by local authorities having jurisdiction.
- D. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict. Submit report to Designer in written, accurate detail. Pending receipt of directive from Designer, rearrange selective demolition schedule as necessary to continue overall job progress without delay.
- E. Notify Architect immediately if materials scheduled to remain are found to be unsuitable for the installation of the new work, or if existing conditions deviate substantially from those shown on the drawings. Remove and replace, or make good, any existing materials unsuitable for installation of new work.
- F. The Bidder shall carry in the bid, the cost of disposing of all items demolished, but prior to performing the demolition the Contractor shall review with the Owner, all items to be demolished and salvage for the Owner any items they wish to retain. Any salvaged items will be relocated and stored in the rooms adjacent to the Work Area, where directed by the Owner.
- G. Items scheduled for demolition shall be removed completely, including all brackets, cleats, hangers or other incidental construction, leaving a clean surface suitable for the installation of new materials.
- H. Remove those components which do not contain hazardous materials, but which are in the way of abatement sub-contractors so that abatement can be performed.
- I. Cut plaster in neat straight lines. Remove existing trim in such a manner as to allow new trim to abut existing trim with straight neat joints. Salvage trim where possible to permit re-installation.
- J. When demolishing masonry, carefully remove materials leaving entire blocks suitable to tooth in new masonry as scheduled. Where cutting units is required, cut straight and neatly along existing mortar joints wherever possible.
- K. Conduct demolition to minimize interference with adjacent and occupied building areas, in compliance with governing laws and buildings, with prime consideration given to the safety, protection and convenience of the public and Owner's personnel. Maintain protected egress and access to the Work at all times. Maintain all commuter traffic- refer to phasing specifications.
1. Maintain protected egress and access to the Work at all times.
 2. Maintain all commuter traffic - refer to phasing specifications.
- L. Neatly cut openings and holes plumb, square, and true to dimensions required. Cut or drill from exposed or finished side into concealed surfaces to avoid marring existing finished surfaces. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering or chopping, to minimize disturbance of adjacent surfaces. Repair damage done to existing elements of building to remain, except repairs specified to be provided under other Sections. Repairs shall be done in such manner as to closely match construction, appearance, and quality of original work.
- M. Use of cutting torches:

1. Do not use cutting torches until work area is cleared of flammable materials.
 2. Maintain adequate ventilation when using cutting torches.
 3. At concealed spaces. Such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations.
 4. Maintain fire watch and portable fire suppression devices during flame cutting operations. Comply with fire prevention measures.
- N. Carefully observe existing structure during demolition operations. Cease operations immediately if structure appears to be in danger. Immediately notify both Architect and Owner's Project Representative. Do not resume demolition operations until directed.
- O. Disconnect, cap, and clearly identify designated utilities within demolition areas
1. Cap and remove abandoned existing utilities back to locations indicated, or to limit line of Contract where terminations are not indicated.
 - (a) Pipes to be demolished that require a connection shall be removed to the extent required to install the new connection. Remove pipe sections by saw cutting, removing a complete pipe section to an existing joint, or other adequate means which results in a clean joint.
 2. Protect and maintain conduits, drains, sewers, pipes, and similar utilities that are not to be demolished.

3.08 FLOORING DEMOLITION

- A. The extent of flooring demolition shall include removal of all materials unsuitable for the application of the new flooring. The contractor performing the demolition shall coordinate with the installer(s) as required, to understand the flooring manufacturer's required substrate. Final prep of all floors with leveling compound, flashing compounds, etc. shall be performed by the trade installing the flooring.
- B. Remove flooring, other than asbestos containing materials, carefully, to maintain the integrity of the substrate. Grind or shotblast existing mastic to deliver a clean concrete substrate suitable for the application of the specified finish.
- C. Fill all depressions already present in the room where construction removed by others, existing holes from damage or removal of utilities, damage left by shotblasting (if performed) and all other defects as required to deliver a level, uniform surface for the installation of finish flooring.
 1. Filler material shall be non-shrink grout.
- D. Fill any abandoned cores for utilities which are removed through this project, or any encountered abandoned utility cores with non-shrink grout.

3.09 EXPLORATORY DEMOLITION AND CONCEALED CONDITIONS

- A. Exploratory Demolition and Concealed Conditions:
 1. Selective demolition work includes controlled exploratory demolition work which is indicated on Drawings and as may be additionally field directed by the Architect. Additional exploratory demolition may also be required to thoroughly investigate and determine the exact location of existing concealed work or to expose concealed conditions to view.

2. Exploratory demolition may be used to clarify the Contract Documents to improve the interface of new and existing work.
- B. Concealed conditions: Carefully check for concealed structure, pipes, conduits, wire, utilities, systems, and other elements before beginning cutting and selective demolition work.
 - C. Discovery: When unknown, concealed utilities and systems are discovered, verify the purpose, routing, circulation, origin, and termination of these items.
 1. If the unknown, concealed items are part of a system to be abandoned, remove the item in its entirety.
 2. Protect discovered concealed items that are part of an existing system to be preserved and incorporated into the Work, or part of an active system to remain. Protect system elements from disturbance and notify both Owner and Architect and follow the Architect's directions.
 - (a) In circumstances when existing system to remain is damaged due to the Work (including cutting, demolition, or exploratory investigation), notify both Owner and Architect immediately. Repair or re-route the damaged system components as directed by the Architect at no additional cost to the Owner.

3.10 GENERAL DUST CONTROL

- A. Contractor shall employ dust and pollution prevention procedures at all times. Compliance with requirements for dust protection and air quality control is required for work areas which abut Owner occupied areas. Dust removal and periodic cleaning requirements apply to all work. Contractor shall employ dust and pollution prevention procedures so that a healthy Owner's environment is fully maintained at all times. Compliance with the requirements in Division One for dust control is mandatory and may not be compromised at any point during construction.
 1. Clean up loose debris daily, or more frequently as required, to prevent wide spreading debris. Keep dumpsters covered when not in use.
 2. Cover handcarts carrying debris being transported through Owner occupied areas.
 3. Wet down debris (as appropriate) to prevent air pollution by dust rising from demolition work. Wet down dumpsters to prevent fires caused by vandals.
 4. Employ tarpaulins on all trucks carrying debris.

3.11 REPAIRS

- A. Repair all damage done to elements of buildings and structures to remain, except repairs specified to be provided under other Sections, or as indicated for removal in subsequent project phase(s). Repairs shall be done in such manner as to closely match construction, appearance and quality of original work.

3.12 DISPOSAL OF DEMOLISHED MATERIALS

- A. Safely remove all demolished materials to dumpsters at grade, and legally dispose of materials, recycling where required by other sections of this specification.
- B. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site.
- C. Recycle materials whenever possible.

- D. Burning of removed materials is not permitted on project site.
- E. Comply with requirements of Section 01.74.19 - Construction Waste Management and Disposal, and specified waste diversion goals.
- F. Record the amount (in tons or cubic yards) of material land filled from the Project, the identity of the landfill, the total amount of tipping fees paid, transportation costs (if separate), and the total disposal cost. Include manifests, weight tickets, receipts, and invoices.

3.13 CLEAN-UP AND REPAIR

- A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Clean adjacent structures and facilities of dust, dirt, and debris caused by demolition work to the satisfaction of Owner, owner(s) of adjacent properties, and authorities having jurisdiction.
- B. Clean site daily where work is performed.
- C. Repair demolition performed in excess of that required. Return structures and surfaces to remain to condition existing prior to commencement of selective demolition work. Repair adjacent construction or surfaces soiled or damaged by selective demolition work.
- D. Any damages to existing furnishings and/or equipment, shall be reimbursed by the general contractor, who shall recoup costs from other contractors as appropriate.
- E. Backfill holes after removal, using loam to a depth of 12" and common fill to depths below 12", to provide a safe stable walking surface for trades installing new work.
- F. Sweep all streets and roads affected by demolition operations.

END OF SECTION 02.41.00

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SECTION 06.10.00

ROUGH CARPENTRY

I. PART 1 - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Wood blocking, cants, and nailers.
 2. Plywood sheathing for blocking and substrates.
- B. **Alternates:** Not Applicable.
- C. **Items to Be Installed Only:** Not Applicable.
- D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
1. None.
- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:
1. None.

1.03 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

II. PART II - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
 - 4. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
- B. Plywood Panels:
 - 1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
 - 2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
 - 3. Factory mark panels according to indicated standard.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: A WPA C2 (lumber) and A WPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to A WPA C31 with inorganic boron (SBX).
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and not containing arsenate.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete in exterior walls.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: For all interior use materials, provide materials that are fire-retardant treated and comply with performance requirements in A WPA C20 (lumber) and A WPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
 - 2. Use treatment that does not promote corrosion of metal fasteners.

2.04 MISCELLANEOUS LUMBER

- A. Blocking: 2" nominal x depth as required for item being mounted.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber.

2.05 PANEL PRODUCTS

- A. Miscellaneous Concealed Plywood: Exposure 1 sheathing, span rating to suit framing in each location, and thickness as indicated but not less than 1/2 inch.
 - 1. Engineered plywood blocking systems, such as “Danback D16F or D24F” by Clark Dietrich Building Systems, are acceptable.
- B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4 inch thick.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Wire, Brads, and Staples: FS FF-N-105.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.07 ACCESSORIES

- A. At existing stud walls, contractors may utilize WingIts anchors rather than opening existing walls to install new blocking. Type of anchor shall be selected to work with handrail brackets being submitted and to resist loads as required by Code.

III. PART III - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

- C. Apply field treatment complying with AWPAC M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- F. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.02 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Provide concealed blocking at all wall mounted items, including but not limited to toilet accessories and equipment.
- C. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION

06.10.00

SECTION 06.61.00

SOLID SURFACING FABRICATIONS

I. PART 1 GENERAL

1.01 GENERAL

- A. This section supplements the Conditions of the Contract, General Requirements, Drawings, and all other parts of the Contract Documents.
- B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Shower surrounds, soap shelves and ceilings.
 - 2. Walls within Shower Room.
 - 3. Threshold at shower.
 - 4. Bench.
 - 5. Shelf at Toilet Room.
 - 6. Sealants and accessories.
- B. **Alternates:** None.
- C. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
 - 1. None.
- D. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
 - 1. Section 10.80.00 - TOILET ROOM ACCESSORIES for robe/towel hooks, and shower curtain rods which are to be attached to solid surface surround and cubby.
- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:
 - 1. Section 06.10.00 - ROUGH CARPENTRY, for blocking to support the work of this section.
 - 2. Section 09.67.00 - RESINOUS FLOORING - for coordination and installation with adjacent materials.
 - 3. Section 22.00.00 - PLUMBING, for fixtures integrated into the work of this section.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
- C. National Electrical Manufacturers Association (NEMA)
- D. International Solid Surface Fabricators Association (ISSFA)
- E. National Sanitation Foundation (NSF)

1.04 SUBMITTALS

- A. Submit in accordance with Section 01.33.00.

- B. Submit qualifications of fabricator and installer, as specified in Quality Assurance.
- C. Shop drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
- D. Samples: Submit minimum 2" x 2" (50 mm x 50 mm) samples. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work.
 - 1. Once material colors are selected, provide mock ups with matching color sealant, color recommend by manufacturer or selected by owner.
- E. Product data:
 - 1. Indicate product description, fabrication information and compliance with specified performance requirements.
 - 2. Manufacturer's installation instructions for counter support brackets.
- F. Maintenance data: Submit care and maintenance data, including repair and cleaning instructions. Include in project close-out documents.

1.05 QUALITY ASSURANCE

- A. Allowable tolerances:
 - 1. Variation in component size: $\pm 1/8"$ (3 mm).
 - 2. Location of openings: $\pm 1/8"$ (3 mm) from indicated location.
- B. Fabricator shall have been in continuous operation for a minimum of 10 years, specializing in solid surface fabrications.
- C. Installer shall have a minimum of 5 years experience with the field installation of solid surfacing, and shall have completed similar installations in the recent past.
- D. Both the fabricator and the installer shall be certified by the manufacturer of the solid surfacing, for the work to be performed. Fabricator and installer shall provide either a Certified Fabricator Installer Number or documentation that they have attended solid surface training courses.
- E. All products are to be by the same manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver no components to project site until areas are ready for installation. Store components indoors prior to installation.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.07 WARRANTY

- A. Provide manufacturer's standard product warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

II. PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. LG “Hi-Macs”
- B. DuPont “Corian”
- C. Wilson “Gibraltar”
- D. **Color:** One color, from price group A or B or from price group 1 or 2, and as selected by Owner.

2.02 WALLS, SHOWER STALL SURROUNDS AND CEILING

- A. Walls, shower stall surrounds and ceiling shall be a multi-panel system consisting of 100% acrylic panels, corner filler inserts.
- B. Panels shall be full height to ceiling, ceiling panels shall bear on the wall panels.
- C. Thickness: 1/4".
- D. Panel edges: Exposed ends of panels shall have chamfered or eased edges, min 1/16" radius. Edges shall be sanded smooth with at least 150 grit sandpaper, to remove any nicks or tool marks.

2.03 BENCH, SHELF and THRESHOLD

- A. System consisting of 100% acrylic panels.
- B. Thickness: 1/2", thickened to 1" at edge of shelf and bench.
- C. Bench, shelf and threshold shall be constructed of single pieces of solid surfacing, without joints, wherever possible. Wherever joints are unavoidable, they shall be adhered with manufacturers recommended adhesive and finished per manufacturers recommendation to be inconspicuous.
 - 1. Edges shall be radiused 1/4", top, bottom and outside corners.

2.04 CORNER SHELVES AT SHOWER

- A. Constructed from same material as shower surround.
- B. Thickness: 1/2", with support bracket.
- C. Corner mount, 45 deg, 8" long legs. No visible fasteners.

2.05 ACCESSORY PRODUCTS

- A. Joint adhesive: Manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints, with a hard seam.
- B. Sealant:
 - 1. Shower panels: manufacturer's standard mildew-resistant, FDA-compliant NSF 51-compliant, UL-listed silicone sealant in colors matching components.
 - 2. Panel adhesive: 100% Silicone.

2.06 FABRICATION

- A. All fabrications shall be in conformance with the solid surfacing manufacturer's fabrication guidelines. This section identifies only the minimum requirements for the performance of the work of this section.
- B. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and sheet manufacturer's requirements. Only L-shaped counters shall have seams.
- C. Form joints between components using manufacturer's standard joint adhesive. Joints shall be inconspicuous in appearance and without voids.
- D. Provide holes and cutouts for plumbing and bath accessories as indicated on the drawings.
 - 1. Cut outs shall be done per manufacturers requirements.
 - 2. Make all cut outs using routers and good quality carbide tipped blades and bits. Smooth back and front side of cut outs.
 - 3. Corners must have minimum 1/8" radius
 - 4. Top and bottom edge must be radius 1/8" round over.
 - 5. Edges must be sanded smooth with minimum 150 grit sand paper to remove nicks and tool marks.
 - 6. Allow 1/8" gap between fixtures and edges of solid surface
 - 7. Certified installer or fabricator must do all cut outs.
- E. Rout and finish component edges to a smooth, uniform finish.
- F. Repair or reject defective or inaccurate work.
- G. Finish: All surfaces shall have uniform semigloss, with a gloss rating of 25-50.

III. PART 3 EXECUTION

3.01 PREPARATION

- A. Examine project area to verify that fixtures and wall sheathing materials are in place and secured.
- B. Confirm walls are sufficiently plumb to receive panel installation within specified tolerances.
- C. Verify dimensions prior to fabrication. Template as required to obtain proper fit.
- D. Furnish information to the plumber regarding required locations for plumbing fixtures. Confirm that rough plumbing for shower is in the proper position, and finished plumbing fixtures and cover plates will align with cutouts in panels. If misaligned, require plumbing to be adjusted.
- E. Have all unsuitable conditions corrected prior to installing work. Start of installation constitutes acceptance of existing conditions.

3.02 SHOWER STALL SURROUND AND CEILING INSTALLATION

- A. Examine the substrate for evenness, dryness and free of oils, ust etc. Start of installation indicates acceptance of substrate.
- B. Install adhesive in accordance with manufacturer's recommendations.
- C. Clean backs of panels with denatured alcohol prior to installation.
- D. Install components plumb and level, in accordance with approved shop drawings and product installation details. Install center panel first, end panels last. Do not use any nails or screws.
- E. Apply continuous beads of sealant around openings cut for faucets, showerhead etc. Press panel in place, and

verify by adhesive squeeze-out that the panel is fully sealed to the substrate around the perimeter of the cut out. Clean any squeeze out prior to curing.

- F. Brace panels overnight to make sure panels are adhered to wall.
- G. Allow installation to cure at least 24 hours before running water over the assembly.
- H. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

3.03 WALLS, BENCH, SHELF AND THRESHOLD INSTALLATION

- A. Examine the substrate for evenness, dryness and free of oils, dust etc. Start of installation indicates acceptance of substrate.
- B. Install adhesive in accordance with manufacturer's recommendations.
- C. Clean backs of panels with denatured alcohol prior to installation.
- D. Install components plumb and level, in accordance with approved shop drawings and product installation details. Install center panel first, end panels last. Do not use any nails or screws.
- E. Apply continuous beads of sealant around openings cut for faucets, showerhead etc. Press panel in place, and verify by adhesive squeeze-out that the panel is fully sealed to the substrate around the perimeter of the cut out. Clean any squeeze out prior to curing.
- F. Brace panels overnight to make sure panels are adhered to wall.
- G. Allow installation to cure at least 24 hours before running water over the assembly.
- H. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

3.04 CLEANING, ADJUSTING AND PROTECTIONS

- A. Clean adhesive squeeze out per manufacturer's recommendations. Polish or buff seams and joinery as required to provide a uniform finish.
- B. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged work that cannot be repaired to architect's satisfaction and invoice for the cost of repairs. Architect to pre-approve cost estimate before repairs are made.
- C. Fabricator/Installer is to provide and review the Care and Maintenance procedures and the warranty with the head of maintenance upon completion of project.

END OF SECTION
06.61.00

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SECTION 08.20.00

DOORS, FRAMES AND HARDWARE

I. PART 1 - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Interior wood doors.
 2. Interior hollow metal frames.
 3. Finish hardware.
- B. **Alternates:** Not Applicable.
- C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
1. Cores, where furnished by Owner.
- D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
1. Not Applicable.
- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:
1. None.

1.03 SUBMITTALS

- A. **Product Data:** Include installation details, material descriptions, dimensions of individual components and profiles, and finishes
- B. **Shop Drawings:**
1. Elevations of each door design.
 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
- C. **Schedule:** Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule, prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

E. Keying Schedule: Not required.

F. Product Certificates: Signed by manufacturers of electrified door hardware certifying that products furnished comply with requirements

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article

H. Maintenance Data: For each type of door hardware to include in maintenance manuals specified in Division 01.

I. Warranties: Special warranties specified in this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Deliver frames wrapped to provide protection during transit and Project-site storage. Do not use nonvented plastic. Package doors individually in plastic bags or cardboard cartons.

C. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

1.05 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.06 WARRANTY

A. Doors: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required
2. Warranty shall include hardware installation and replacement of glass and glazing.
3. Warranty shall be in effect for the life of installation.

1.07 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for the facility's continued adjustment, maintenance, and removal and replacement of door hardware.

II. PART II - PRODUCTS

2.01 WOOD DOORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Algoma Hardwoods Inc.
 2. Eggers Industries; Architectural Door Division.
 3. Marshfield DoorSystems.
 4. Oshkosh Door Company
 5. VT Industries Inc.
- B. Construction:
1. Grade: AWI Premium, with AWI Grade A faces.
 2. Species and Cut: American Cherry, plain sliced.
 3. Match between Veneer Leaves: Book match.
 4. Assembly of Veneer Leaves on Door Faces: Running match.
 5. Finish: Factory applied, transparent finish.
- C. Cores: Comply with the following requirements:
1. Structural Composite Lumber Core: Timberstrand LSL, contributes to IEQ 4.4 and MR 7.
 2. At doors requiring a fire rating, provide core as required by listing agency.

2.02 HOLLOW METAL FRAMES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Anweld International.
 2. Ceco Door Products; an ASSA ABLOY Group Company.
 3. CURRIES Company; an ASSA ABLOY Group Company.
 4. Mesker Door Inc.
 5. Pioneer Industries, Inc.
 6. Republic Builders Products Company.
 7. Steelcraft, an Ingersoll Rand Company.
- B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements. Comply with ANSI A250.8 and with details indicated for type and profile.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Gauge: 0.053-inch-thick steel sheet.
 3. Face: 2" or as dimensioned.
 4. Throat: to wrap wall, or as dimensioned.
 5. Profile: equal double rabbet.
 6. Hardware Reinforcement: ANSI/SDI A250.6 with reinforcement plates from same material as frames.
 7. Anchors:
 - (a) Jamb: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042" thick, with corrugated or perforated straps not less than 2" wide by 10 inches long; or wire anchors not less than 0.177" thick.
 - (b) Floor: Clip-type anchors, with two holes to receive fasteners.
 8. Finish: Shop prime for field finishing under 09.90.00 - Painting
- C. Fabrication:
1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and not visible.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Two per jamb, not more than 18" from top and bottom of frame, not more than 32" apart.
6. Door Silencers: Drill stop in strike jamb to receive three door silencers.
7. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
8. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping.

2.03 FINISH HARDWARE

A. Door 101-1 (interior door from corridor into toilet room)

1. (1) Lockset: Schlage L9000 series, Sargent 8200 series, Best 40H series, Corbin Russwin ML2000 Series or approved equal ANSI A156.13, Grade 1 Operational, Grade 1 Security lockset with 2-3/4" backset and full 3/4" throw. Solid cast lever trim, style and finish selected by Owner. Privacy function.
 - (a) Cylinder to accept standard core used throughout the building. Owner to furnish core.
2. (3) Hinges: Stanley, Hagar, McKinney, or approved equal standard weight, 4-1/2" x 4-1/2", steel, ball bearing hinges with non-removable pins.
3. (1) Closer: LCN 4010/2011, Sargent 281 or approved equal fully hydraulic closer with forged arms, metal cover, a full rack-and-pinion action with a high strength cast iron cylinder. Cylinder body shall be 1-1/2" in diameter, and double heat-treated pinion shall be 11/16" in diameter. Provide all brackets, drop plates, fasteners, etc.
4. (3) Silencers, push-in type.

III. PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to ordering, inspect site to verify components required. Advise Architect of any discrepancies.
- B. Prior to installing, verify the openings are plumb and are dimensioned properly. Insure adequate support has been provided at the operator header. Proceed with the installation only after conditions are deemed satisfactory.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare doors and frames to receive new hardware following AAMA and SDI recommendations.
- B. Utilize factory templates for hardware, neatly drill or tap holes for fasteners. Use precautions to protect existing finishes from damage.

3.03 INSTALLATION

A. Frames:

1. Install frames plumb and level, anchored to floor and to new masonry at jambs.
2. Grout frames where installed in masonry.
3. Maintain spreader bars until installation is complete. Grind/deburr frames where spreaders are

removed.

4. Tolerances:

- (a) Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
- (b) Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
- (c) Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- (d) Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Doors:

- 1. Install doors in frames and adjust for even gaps all around

C. Hardware:

- 1. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - (a) Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - (b) Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
 - (c) Mounting Heights: Mount door hardware units at heights indicated in 521CMR – Massachusetts Architectural Access Board

3.04 ADJUSTING

- A. Adjust equipment per instructions and current ANSI/BHMA 156.19 American National Standard for Power assist and low energy power operated doors.
- B. Adjust all existing hardware installed on existing doors, as may be required for the new hardware to operate properly. This shall include the replacement of any fasteners which may be required to properly square up doors in frames or secure loose components.
- C. 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.
- D. Six-Month Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware and replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.

END OF SECTION
08.20.00

SECTION 09.21.16

GYPSUM BOARD ASSEMBLIES

I. PART I - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Interior gypsum wallboard.
 2. Tile Backing Panels
 3. Steel framing.
 4. Access panels installed in drywall.
 5. Acoustical Products.
- B. **Alternates:** Not Applicable.
- C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
1. None.
- D. **Items to Be Furnished Only:** Not Applicable.
- E. **Related Work:** The following items are not included in the Section, and will be performed under the designated Section:
1. None.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: Not required.
- C. Shop Drawings: If materials and systems other than those specified and those indicated on the Drawings are proposed for use, submit shop drawings signed and sealed by a structural engineer licensed in the Commonwealth of Massachusetts certifying proposed systems meet code requirements, project requirements and the following deflection criteria:

1.04 QUALITY ASSURANCE

- A. Source Limitations: Furnish products from a single manufacturer, where available and to the greatest extent possible.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

1. Deliver and store materials in accordance with Gypsum Association Publications GA-216, GA-238 and GA-801.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Do not install acoustical plaster products until interior environment can be maintained within the manufacturer's recommended temperature and humidity limits.

1.07 WARRANTY

- A. Installer shall warranty the work of this section for a period of 1 year from Substantial Completion.
- B. Provide manufacturer's standard 10 year warranty on acoustical plaster products.

II. PART II - PRODUCTS

2.01 STEEL FRAMING FOR FRAMED ASSEMBLIES

- A. Steel Studs and Runners: ASTM C 645.
 1. Minimum Base-Metal Thickness: 20 gauge.
- B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 1. Minimum Base-Metal Thickness: 0.0312 inch.
- C. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch- wide flanges.
 1. Depth: 1-1/2 inches.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base Metal Thickness: 0.0312 inch.
 2. Depth: 7/8 inches.
- E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- F. Isolation Strip at Exterior Walls: Adhesive-backed, closed-cell vinyl foam strips that allow fastener

penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

2.02 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - (a) USG Corporation.
 - (b) Georgia Pacific Gypsum.
 - (c) Lafarge North America.
 - (d) National Gypsum Company.
- B. Fire-Resistant Type X:
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
 - 3. Non-asbestos
 - 4. Flame Spread <15
 - 5. Smoke Developed = 0
- C. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.

2.03 TILE BACKING PANELS

- A. Reinforced Gypsum Backer Units: ANSI A108.1.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - (a) National Gypsum "Gold Bond EXP Interior Extreme"
 - (b) Georgia-Pacific Gypsum "DenShield"
 - (c) Approved equal.
 - 2. ASTM D3273 mold resistance rating: 10
 - 3. Thickness: 5/8 inch., 1/2" at ceiling locations.
 - 4. Less than 5% water absorption per ASTM C 473.
 - 5. Able to be painted.

2.04 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - (a) Cornerbead.
 - (b) Bullnose bead.
 - (c) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - (d) Expansion (control) joint.
 - (e) Curved-Edge Cornerbead: With notched or flexible flanges.

2.05 JOINT TREATMENT MATERIALS

- A. General:

1. Provide products that comply with ASTM C 475/C 475M.
 2. Apply finishes in compliance with ASTM C 840.
- B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
1. Reinforced Gypsum Backer Units: As recommended by backer unit manufacturer.

2.06 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Access Panels: Williams Brothers Corp. WB UAD 200 12x12 steel, non-fire rated, shop primed with cam lock. Size as noted on Drawings.
- E. Acoustical Sealant: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. Use sealants that have a VOC content of 250 g/L or less when calculate according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Acoustical Sealant for Exposed and Concealed Joints:
 - (a) Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
 - (b) United States Gypsum Co.; SHEETROCK Acoustical Sealant.

III. PART III - EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754. Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install bracing at terminations in assemblies.

3.03 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
- D. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3.04 ACOUSTICAL ITEMS

- A. Install sound attenuating batts in all stud cavities of walls as indicated. Batts are not required on furring applied over existing walls.
- B. Friction fit batts within stud spaces loosely, filling the stud space fully. Do not compress or overstuff insulation. Cut insulation to fit, where stud spacing is less than 16".
- C. Apply acoustical sealant where indicated and where required by UL to achieve the intended STC rating.

3.05 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install wall panels slightly above the finish floor level, but not more than 1" above finish floor. Do not set panels such that water on the floor from cleaning operations will be wicked into panels. Caulk gap between floor and wallboard with neutral-cure silicone sealant.
- D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- H. 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.
- I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.06 APPLYING INTERIOR GYPSUM BOARD

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels to minimize end joints.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.07 APPLYING TILE BACKING PANELS

- A. Install in accordance with GA-216 and ASTM C840.
- B. Do not overdrive fasteners in tile backer board.

3.08 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Designer for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. Curved-Edge Cornerbead: Use at curved openings.

3.09 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 - 1. GA Level 1: Ceiling plenum areas and concealed areas not exposed to view.
 - 2. GA Level 2: Panels that are substrate for tile.
 - 3. GA Level 3: Not used.
 - 4. GA Level 4: Panel surfaces that will be exposed to view (typical panels).
 - 5. GA Level 5: Not used.
- E. Tile Backing Panels: Finish according to manufacturer's written instructions and as required by solid surface manufacturers instructions at Shower Room walls and ceilings.

3.10 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or exhibit mold growth. Repair of damaged panels in place is not acceptable.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION
09.21.16

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SECTION 09.30.00

TILING

I. PART I - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Wall Tile.
 2. Surface preparation for tile and accessories.
- B. **Alternates:** N/A
- C. **Items to Be Installed Only:** Not Applicable.
- D. **Items to Be Furnished Only:** Not Applicable.
- E. **Related Work Specified Elsewhere:** Not Applicable.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- | | |
|-------------------|----------------|
| 1. ASTM C-1027-19 | 5. ASTM C-650 |
| 2. ASTM C-373 | 6. ASTM C-1378 |
| 3. ASTM C-482 | 7. ASTM C-1895 |
| 4. ASTM C-648 | |
- B. American National Standards Institute (ANSI)
1. ANSI A108.1 thru A108.17
 2. ANSI A118.1 thru A118.15
 3. ANSI A137.1
- C. Tile Council of North America (TCNA) Handbook – latest edition

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
1. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.

2. Full-size units of each type of trim and accessory for each color and finish required.

D. Qualification Data: For Installer.

E. Material Test Reports: For each tile-setting and -grouting product.

1.05 QUALITY ASSURANCE

A. Setting and Grouting Materials: Provide materials obtained from one source for each type and color of grout and setting materials.

B. NTMA Standards: Comply with specified provisions and recommendations of NTMA

C. TCNA Standards: Comply with specifications under the current Handbook for Tile Installation

D. Manufacturer to supply written Terrazzo Tile Protocol, upon request.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.06 SOURCE LIMITATIONS

A. All accessories required for the installation of terrazzo tile shall be manufactured by the tile manufacturer to the greatest extent possible, to constitute a "system". Third party products are acceptable only when identified specifically by the tile manufacturer, as eligible for inclusion in the warranty.

B. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packaging and Shipping: Deliver in original unopened packaging with legible manufacturer identification including size, color, manufacture date and job number. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.

B. Storage and Protection: Store indoors in a climate controlled environment, sheltered from moisture and in the original packaging. Tile must be protected from damage by other trades.

1. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

2. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

3. Store liquid additives in unopened containers and protected from freezing.

1.08 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.09 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. Tile and Trim Units: Provide for Owner's use a minimum of 2 percent of the primary sizes and colors of tile specified, boxed and clearly labeled.
 - 2. Grout: Furnish quantity of grout equal to 2 percent of amount installed for each type, composition, and color indicated.

II. PART II – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Daltile Corporation, which is located at: 7834 C.F. Hawn Fwy. P. O. Box 170130; Dallas, TX 75217; Toll Free Tel: 800-933-TILE.
- B. Products by other manufacturers meeting all performance criteria, shape, size and colors available as specified herein, will be acceptable as equals.

2.02 MATERIALS

- A. Portland Cement: ASTM C-150 specifications for Portland Cement
- B. Aggregates: All aggregates to meet ASTM C-33 specifications
 - 1. Aggregates shall have a natural color range and come in a variety of sizes and colors. The aesthetic class/shade range as per ASTM test C609 may vary from a V1 rating to a V2 rating.
- C. Coloring: Pigments used shall be inorganic, resistant to alkalinity, and used per manufacturer's recommendations.
- D. Color Blending: Tiles shall be fabricated such that colors are reasonably uniform and consistent.

2.03 TILE

- A. General: Provide tile that complies with ANSI A137.1 for types, compositions and other characteristics indicated. Provide tile in the locations and of the types colors and pattern indicated on the Drawings and identified in the Schedule and the end of this Section. Tile shall also be provided in accordance with the following:
 - 1. Factory Blending: For tile exhibiting color variations within the ranges selected under Submittal of samples, blend tile in the factory and package so tile taken from one package shows the same range of colors as those taken from other packages.
 - 2. Mounting: For factory mounted tile, provide back or edge mounted tile assemblies as standard with the manufacturer, unless otherwise specified.
 - 3. Factory Applied Temporary Protective Coatings: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with a continuous film of petroleum paraffin wax applied hot. Do not coat unexposed tile surfaces.
- B. Wall Tile:
 - 1. Product: Linear, Color Wheel Collection - glazed ceramic.
 - 2. Water Absorption: Less than .01 percent to less than 20 percent.
 - 3. Breaking Strength: 120-230 lbs.
 - 4. Scratch Hardness: 4.0-6.0
 - 5. Size and Shape: 4 x 12 (4 1/4" x 12 7/8" x 5/16" thick).

6. Surface Finish: Polished.
7. Colors: To be selected from manufacturer's full range. Main field: Color #1 TBD. Accent Band: Color #2 TBD.
8. Trim Units: S44C9MOD Bullnose, 4 x 12 at top of tile wall.
9. Joint width: 1/16" as recommended by manufacturer.

2.04 SETTING AND GROUTING MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - (a) Ardex Engineered Cements.
 - (b) Bostik, Inc.
 - (c) Custom Building Products.
 - (d) Laticrete International, Inc.
 - (e) MAPEI Corporation.
 - (f) Summitville Tiles, Inc.
 - (g) TEC; a subsidiary of H. B. Fuller Company.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
 3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- C. High-Performance Grout: ANSI A118.7.
 1. Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
 - (a) Unsanded grout mixture for joints 1/8 inch (3.2 mm) and narrower.

2.05 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Section 07.92.00 - JOINT SEALANTS.
 1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.
- C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates to adjacent non-tile construction that are subject to in-service exposures of high humidity and extreme temperatures.
 1. Available Products:
 - (a) Custom Building Products; 100% Commercial Silicone Caulk.
 - (b) Dow Corning Corporation; Dow Corning 786.

- (c) GE Silicones; Sanitary 1700.
- (d) Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
- (e) Tremco, Inc.; Tremsil 600 White.

2.06 ACCESSORIES

- A. Moisture Mitigation:
 - 1. When installing tile over new or green concrete, utilize the tile manufacturer's recommended or approved moisture mitigation system unless moisture level of concrete can be confirmed to be within the manufacturer's tolerances.
 - (a) Moisture and pH testing shall be performed using in-situ probes. Calcium carbonate testing is not acceptable.
- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints that does not change color or appearance of grout.

III. PART III – INSTALLATION

3.01 GENERAL

- A. All installations shall comply with the appropriate Installation Method as depicted in the current edition of the Tile Council of North America Handbook for Ceramic, Glass, and Stone Tile Installation for thin-set installations. All specifications must also conform to local codes, ordinances, trade practices, and climatic conditions.
- B. All materials used for installation of must comply with the appropriate ANSI 118 and/or ISO 13007 standards and specifications. Setting materials manufacturer's printed installation instructions are to be followed in every instance.

3.02 EXAMINATION AND PREPARATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Designer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Examine substrate to receive tile with the installer of the substrate and identify any areas that are unsuitable to receive the work of this section. Upon repair or replacement, reinspect area to confirm suitability. Do not proceed with installation over unsuitable substrate. Start of installation constitutes acceptance of existing conditions.
- C. Remove all laitance, chalk, dust grease or other foreign coatings from concrete substrates, which would impair the application of the new tile. Where recommended by the tile manufacturer, prepare concrete substrates by shot blasting or grinding surface.

- D. Confirm moisture level in concrete substrates using in-situ probes. Where moisture levels exceed manufacturer's limitations, apply moisture mitigation to the concrete.
- E. Apply crack suppression membrane over the area to receive terrazzo tile, following manufacturer's recommendations.

3.03 INSTALLATION

- A. Follow appropriate ANSI A-108 installation specifications that correspond with the selected TCNA Installation Method. This includes Substrate and Surfaces inspections, Location and Frequency of EJ171 Movement Joint Guidelines, Placement Techniques, and Grouting Procedures.
- B. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- C. Lay tile with joints oriented symmetrically on the surface to receive them. Ensure that joints are straight and true over the length of the installation, with a maximum deviation of 1/4" over 10'-0".
- D. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.
 - 1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
 - 2. Tap and align faces of tiles such that the maximum lippage is no more than 1/8".
- E. Sound tiles after initial set by tapping, and replace any hollow sounding (unbonded) tiles prior to grouting.

3.04 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.
- D. Grout tiles following the grout manufacturer's recommendation. Apply a grout release agent to tiles when heavily pigmented grout is used and when recommended by the tile manufacturer.

3.05 CLEANING

- A. Clean work following tile manufacturer's recommendations. Remove any haze from tile work and polish prior to Substantial Completion.
- B. Dust mop or vacuum to remove sand, dust and other contaminants off the surface.

END OF SECTION 09.30.00

SECTION 09.67.00

RESINOUS FLOORING

I. PART 1 GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.
- B. This Contractor must be familiar with all other Divisions and Sections of the Specifications which affect the work of this Section.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
 - 1. Prepping of existing concrete floor slab.
 - 2. Pitching and waterproofing of shower floor.
 - 3. Floor coating system with integral flash covered base.
 - 4. Installation accessories.
- B. **Alternates:** None.
- C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
 - 1. None. All of the items to be installed by this trade shall be furnished by this trade.
- D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
 - 1. None.
- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Section:
 - 1. Section 02.41.19 - SELECTIVE DEMOLITION for preparation and patching of existing flooring and rough patching of flooring.
 - 2. Section 06.61.00 - SOLID SURFACING FABRICATIONS for coordination and installation with adjacent materials.
 - 3. Section 22.00.00 - PLUMBING for floor drains which interface with resinous flooring.

1.03 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system with colored quartz aggregate broadcast. Epoxy resin broadcast and aliphatic polyaspartic ester topcoats.
- B. The system shall have the color and texture as specified by the Owner with a nominal thickness of 1/4 inch on floors and 3/16" on walls. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
- C. Cove base to be applied at all floor-to-wall transitions and per manufacturers standard details unless

otherwise noted.

1.04 SUBMITTALS

- A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
- B. Manufacturer's Material Safety Data Sheet (MSDS) for each product being used.
- C. Samples: A 6 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system.

1.05 QUALITY ASSURANCE

- A. The resinous flooring and the waterproofing are each comprised of a multi-component "system". This specification lists one "system" for each, to establish the minimum performance. Substitutions of equal systems are acceptable, however, all components of a given system shall be by a single manufacturer, and specifically identified as compatible with each other.
- B. The Manufacturer shall have a minimum of (10) years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
- C. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
- D. No requests for substitutions shall be considered that would change the generic type of the specified System.
- E. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
- F. System shall be in compliance with the Indoor Air Quality requirements of California section 01350 as verified by a qualified independent testing laboratory.
- G. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.
- B. Storage and Protection: The Applicator shall be provided with a dry storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations. Copies of Materials Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer or other personnel.

1.07 WASTE DISPOSAL

- A. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.08 PROJECT CONDITIONS

- A. Site Requirements

1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
 2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
 3. The Applicator shall ensure that adequate ventilation is available for the work area. This shall include the use of manufacturer's approved fans, smooth bore tubing and closure of the work area.
 4. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.
- B. Conditions of new wood underlayment and subfloor shall be as recommended by the manufacturer.
- C. Safety Requirements: Follow manufacturer's recommendations, including the following
1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
 2. "No Smoking" signs shall be posted at the entrances to the work area.
 3. The Owner shall be responsible for the removal of foodstuffs from the work area.
 4. Non-related personnel in the work area shall be kept to a minimum.

1.09 WARRANTY

- A. Provide manufacturer's standard warranty on all installed products.
- B. Installer shall warranty the system for a period of 1 year after Substantial Completion.

II. PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The basis of this specification is Dur-A-Flex, Inc, Hybri-Flex EC, self leveling broadcast colored quartz, epoxy resin broadcast and polyaspartic ester topcoat seamless flooring system, by Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone (860) 528-9838, Fax: (860) 528-2802.
- B. This specification is for a complete "system". Substitutions which require additional component layers, greater overall thickness or changes to the preparation of the substrate to receive the system, are the responsibility of the installer and shall be provided at no additional cost.
- C. Manufacturer of Approved System shall be single source and made in the USA.
- D. Flooring System: **Dur-A-Flex, Inc, Hybri-Flex EC**, self leveling broadcast colored quartz, epoxy resin broadcast and polyaspartic ester topcoat seamless flooring system.
 1. System Materials:
 - (a) 1/8" Poly-Crete MD SL body coat.
 - (b) Decorative chip broadcast.
 - (c) Broadcast coat: Dura-A-Glaze #4, hardener and resin.
 - (d) Grout coat: Dura-A-Glaze #4, hardener and resin.
 - (e) Topcoats: Armor Top
 2. Patching Materials:

- (a) Shallow Fill and Patching: Use Dur-A-Flex, Inc Poly-Crete MD (up to 1/4")
- (b) Deep Fill and Sloping Material (over 1/4"): Use Dur-A-Flex, Inc Poly-Crete WR.

E. Other epoxy based systems by other manufacturers, which are comprised of different component layers, but offer equal performance as specified herein, will be acceptable.

2.02 PRODUCT REQUIREMENTS

- A. Topping: Poly-Crete SL:
1. Percent Reactive. 100 %
 2. VOC. 0 g/L
 3. Bond Strength to Concrete ASTM D 4541. 400 psi, substrates fails
 4. Compressive Strength, ASTM D 695. 16,000 psi
 5. Tensile Strength, ASTM D 638. 3,700 psi
 6. Flexural Strength, ASTM D 790. 4,700 psi
 7. Impact Resistance ASTM D-2794. 160 inch lbs, No visible damage or deterioration
- B. Broadcast Coat: Dur-A-Glaze #4:
1. Percent Solids. 100 %
 2. VOC. 0.0 g/L
 3. Compressive Strength, ASTM D 695. 11,200 psi
 4. Tensile Strength, ASTM D 638. 2,100 psi
 5. Flexural Strength, ASTM D 790. 5,100 psi
 6. Impact Resistance MIL D-24613. 0.0007" no cracking
 7. Abrasion Resistance, ASTM D 4060 (CS17 Wheel, 1,000 g load, 1000 cycles). 29 mg loss
 8. Flame Spread / NFPA-101, ASTM E 84. Class A
 9. Hardness Shore D ASTM D-224080-85
 10. Water Absorption, MIL D-24613. Nil
 11. Coefficient of Friction ASTM D-2047. >0.6
 12. Potlife @ 70 F. 20 minutes
- C. Topcoat:
1. Percent Solids. 95.2 %
 2. VOC. 0.0 g/L
 3. Tensile Strength, ASTM D 2370. 7,000 psi
 4. Flexibility, (1:4 Cylindrical Mandrel) ASTM D 1737. Pass
 5. Elongation, ASTM D 2370. 9 %
 6. Water Absorption ASTM D 570 0.05 %
 7. Abrasion Resistance, ASTM D 4060 (C-10 Wheel, 1,000 gm load, 1000 cycles). 15 mg weight loss
 8. Impact Resistance MIL D-2794. >160 inch lbs
 9. Hardness, ASTM 3363. >4 H
 10. ASTM, D 2134.40+
 11. QUV, UVB-373/1,500 hrs.90%
 12. 60 Gloss, ASTM D 523.90+
 13. Working Time @ 72 F. 10 minutes
 14. Drying Properties, 72 F, 50% RH. Touch Dry-60 minutes
 15. Recoat, 8 mils. 3-4 hours
 16. Hard Dry, 72 F. 4-5 hours

2.03 FLOORING ACCESSORIES

- A. Cove former, at all 90 degree transitions.
- B. Wall base termination strip: L-profile, 1-1/2" x 1/2", stainless steel.

2.04 PREPARATION MATERIALS

- A. Flooring installer shall be responsible for producing a smooth, waterproof, pitched floor substrate.
- B. The basis of this specification is for a Laticrete system. Equal systems by other manufacturers will be acceptable, however, substitute systems which require additional components for their proper performance will not be grounds for additional charges.
- C. The products listed below include multiple products that comprise a “system”, and are the minimum components required (listed in order of application). All materials shall be compatible and approved by the flooring manufacturer.
 1. Filler coat (for curbs and achieving slope of floor): Laticrete “3701 Fortified Mortar Bed”, or approved equal Latex Portland Cement Mortar for thick beds, screeds, leveling beds and curbs to be weather, frost, shock resistant, GreenGuard compliant, meeting the following physical requirements:
 - (a) Compressive Strength (ANSI A118.4 Modified):..... >4000 psi (27.6 Mpa)
 - (b) Water Absorption (ANSI A118.6):..... ≤ 5%
 - (c) Service Rating (TCA/ASTM C627):..... Extra Heavy
 - (d) Smoke & Flame Contribution (ASTM E84 Modified):..... 0
 - (e) Total VOC Content:..... < 0.05 mg/m
 2. Moisture mitigation material applied to substrate meeting conformance requirements of manufacturer.
 3. Waterproofing System: Laticrete “9235 Waterproofing Membrane” system, consisting of a cold applied, single component liquid, load bearing system and a non-woven rot-proof reinforcing fabric specifically intended for waterproofing membrane. Waterproofing Membrane to be non-toxic, non-flammable, and non-hazardous during storage, mixing, application and when cured. It shall be certified by IAPMO and ICC approved as a shower pan liner and shall also meet the following physical requirements:
 - (a) Hydrostatic Test (ASTM D4068):..... Pass
 - (b) Elongation @ break (ASTM D751):..... 20-30%
 - (c) System Crack Resistance (ANSI A118.12):..... Pass (High)
 - (d) 7 day Tensile Strength (ANSI A118.10):..... >265 psi (1.8 Mpa)
 - (e) 7 day Shear Bond Strength (ANSI A118.10):..... >200 psi (1.4 Mpa)
 - (f) 28 Day Shear Bond Strength (ANSI A118.4):..... >214 psi (1.48 – 2.4 Mpa)
 - (g) Service Rating (TCA/ASTM C627):..... Extra Heavy
 - (h) Total VOC Content:..... < 0.05 mg/m³
 4. Top coat (for priming waterproofing to receive resinous flooring): Laticrete “254 Platinum”, one-step, polymer fortified, thin-set mortar, or approved equal product suitable for creating bonded installations of finish flooring to approved substrates, and meeting ANSI A118.4.

III. PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.
 1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.02 PREPARATION

- A. General

1. The floor shall be pitched for water to flow towards the floor drains, and not have standing or pooling water at any locations. Prior to the epoxy system being installed, the floor pitch shall be water tested in the presence of the Owner's Project Manager or the Architect to confirm pitch over all portions of the floor has been achieved. If proper drainage is not achieved, the floor pitch shall be modified and retested until it is achieved and written approval has been given to install the epoxy system.
 2. The finished installation shall be non-slip, with a coefficient of friction between 0.6 and 0.8.
 3. New and existing substrates shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
- B. Prime concrete slab with a bond coat of thinset mortar applied directly to concrete. The bond coat shall be mixed to a thin slurry and applied over the entire area and allowed to cure if required by the manufacturer.
- C. Slope floors to drain using latex portland cement, adjusting slump within manufacturer's limitations and as required to achieve slope. Trowel or float installed product to provide a uniformly slopes surface without high or low spots. Finish surface as recommended by manufacturer for application of waterproofing.
- D. Apply waterproofing system over mortar bed, following manufacturer's recommended installation procedures.
1. Pretreat cracks, coves, corners, drains and penetrations.
 2. Apply waterproofing system (liquid and fabric) over entire project area floor.
 3. Extend waterproofing up walls within the height scheduled to receive the integral epoxy cove base.
 4. Apply a second coat of liquid over entire waterproofed area.
- E. After waterproofing has dried or cured per manufacturer's requirements, apply a top coat of thinset mortar to act as a primer for bonding the resinous flooring to the waterproofing.

3.03 RESINOUS FLOORING APPLICATION

A. General

1. Installation steps and requirements below are based on the specified system and are the minimum required of the contractor. Approved substitute systems by other manufacturers shall be installed in strict conformance with the manufacturer's written recommendations.
2. Installation shall follow all manufacturer's typical details for the substrates and uses to receive the flooring.
3. The system shall be applied in five distinct steps as listed below:
 - (a) Substrate preparation
 - (b) Topping/overlay application with quartz aggregate broadcast.
 - (c) Resin application with quartz aggregate broadcast.
 - (d) First topcoat application
 - (e) Second topcoat application.
4. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
5. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
6. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.

7. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. Topping Coat

1. The topping shall be applied as a self-leveling system, in one lift with a nominal thickness of 1/8 inch.
2. The topping shall be comprised of three components, a resin, hardener and filler as supplied by the Manufacturer.
3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
4. The topping shall be applied over horizontal surfaces using ½ inch “v” notched squeegee, trowels or other systems approved by the Manufacturer.
5. Immediately upon placing, the topping shall be degassed with a loop roller.
6. Colored quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.8 lbs/sf.
7. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

C. Broadcast Coat

1. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ration of (2) parts resin to (1) part hardener.
2. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
3. The broadcast coat shall be applied over horizontal surfaces using squeegee and back rolled at the rate of 90sf/gal (Q28) or 50 sf/gal (Q11).
4. Colored quartz aggregate shall be broadcast into the wet resin at the rate of 0.5 lbs/sf.
5. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

D. Topcoat

1. The first topcoat shall be squeegee applied and back rolled with a coverage rate og 90 sf/gal (Q28) or 50 sf/gal (Q11).
2. The topcoat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of (1) part hardener to (2) parts resin and installed per the manufacturer’s recommendations and thoroughly dispersed by suitably approved mechanical means such as a high speed paddle mixer.

E. Topcoat

1. The second topcoat shall be squeegee and backed rolled with a coverage rate adjusted to provide a non-slip finish, with the coefficient of friction specified herein.
2. The topcoat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of 1 part hardener to (2) parts resin and installed per the manufacturer’s recommendations.
3. The finished floor will have a nominal thickness of 1/4".

3.04 FIELD QUALITY CONTROL

A. Tests, Inspections

1. The following tests shall be conducted by the Applicator:

- (a) Temperature: air, substrate temperatures and, if applicable, dew point.
- (b) Coverage Rates: rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.05 CLEANING AND PROTECTION

- A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION
09.67.00

SECTION 09.90.00

PAINTING

I. PART 1 - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Interior painting and coating systems.
 2. Surface Preparation.
- B. **Alternates:** The work of this section is subject to the acceptance of Alternates. Refer to Section 01.23.00
- C. **Items to Be Installed Only:** Install the following items as furnished by the designated Sections:
1. None. All items to be installed by this trade, shall be furnished by this trade.
- D. **Items to Be Furnished Only:** Furnish the following items for installation by the designated Sections:
1. None.
- E. **Related Work Specified Elsewhere:**
1. None

1.03 SUBMITTALS

- A. Product Data: For each paint system indicated, including.
1. Product characteristics.
 2. Surface preparation instructions and recommendations.
 3. Primer requirements and finish specification.
 4. Storage and handling requirements and recommendations.
 5. Application methods.
 6. Cautions for storage, handling and installation.
 7. Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's products, colors and sheens available.
- B. Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.
- C. Only submit complying products based on project requirements. One must also comply with the regulations regarding VOCs (CARB, OTC, SCAQMD, LADCO). To ensure compliance with district regulations and other rules, businesses that perform coating activities should contact the local district in each area where the coating will be used.
- D. Coating Maintenance Manual: Upon conclusion of the project, the Contractor or paint manufacturer/supplier shall furnish a coating maintenance manual, such as Sherwin-Williams "Custodian Project Color and Product

Information” report or equal. Manual shall include an Area Summary with finish schedule, Area Detail designating where each product/color/finish was used, product data pages, Material Safety Data Sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors and sheens available.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish surfaces for verification of products, colors and sheens.
 - 2. Finish area designated by Architect.
 - 3. Provide samples that designate primer and finish coats.
 - 4. Do not proceed with remaining work until the Architect approves the mock-up.
- E. Source Limitations:
 - 1. Provide primers and topcoats from a single manufacturer.
 - 2. Provide thinner and admixtures from the paint manufacturer wherever available.

1.05 DELIVERY STORAGE AND HANDLING

- A. Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information.
 - 1. Product name, and type (description).
 - 2. Application and use instructions.
 - 3. Surface preparation.
 - 4. VOC content.
 - 5. Environmental handling.
 - 6. Batch date.
 - 7. Color number.
- B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- C. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.
- D. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.06 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 absolute limits.

1.07 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
- B. Furnish Owner with an additional one percent of each material and color, but not less than 1 gal (3.8 l) or 1 case, as appropriate.

II. PART II - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Sherwin-Williams, Cleveland, OH
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.02 APPLICATIONS/SCOPE

- A. Interior Paints and Coatings: (LEED-09 NC/CI/CS COMPLIANT)
 - 1. Metal: Door frames, misc metals.
 - 2. Drywall: Drywall board, Gypsum board.

2.03 PAINT MATERIALS - GENERAL

- A. Paints and Coatings.
 - 1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
 - 2. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color. Or follow manufactures product instructions for optimal color conformance.
- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.
- D. Color: Refer to Finish Schedule for paint colors, and as selected.

2.04 INTERIOR PAINT SYSTEMS (LEED-09 NC/CI/CS COMPLIANT)

- A. Gypsum Board - Walls
 - 1. One coat of one of the following latex primers:
 - (a) Sherwin Williams "Harmony Interior Latex Primer"
 - (b) California "Elements 100% Acrylic White Primer"
 - (c) Pittsburgh "Pure Performance Interior Latex Primer"
 - 2. Two coats of one of the following eggshell paints:

- (a) Sherwin Williams "Harmony Low Odor Interior Latex Egg-shell, B9 series".
- (b) California "elements 100% Acrylic Zero Eggshell, no. 731"
- (c) Pittsburgh "Pure Performance Eggshell, no. 9-300"

B. Gypsum Board - Ceilings.

- 1. One coat of one of the following latex primers:
 - (a) Sherwin Williams "Harmony Interior Latex Primer"
- 2. Two coats of the following flat paint
 - (a) Sherwin Williams "Harmony Interior Acrylic Latex Anti Microbial"

C. Metal (access doors, door frames, etc.)

- 1. One coat of one of the following epoxy primers (d.f.t. 3.0 - 4.0 mils)
 - (a) Sherwin Williams "Recoatable Epoxy Primer, B67 Series"
 - (b) Benjamin Moore "Epoxy Metal Primer, P33 Series"
 - (c) Pittsburgh "Aquapon WB Epoxy Primer, 98 Series"
- 2. Two coats of one of the following gloss finish epoxy paints (d.f.t. 1.5 - 2.0)
 - (a) Sherwin Williams "Hi-Solids Polyurethane Low-VOC, B65 Series"
 - (b) Benjamin Moore "Acrylic Epoxy Gloss Coating, P43/P44"
 - (c) Pittsburgh "Aquapon WB Epoxy Coatings, 98 Series"

III. PART III - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared; notify Architect of unsatisfactory conditions before proceeding. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- B. Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.
- C. Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Architect immediately if lead based paints are encountered.

3.02 SURFACE PREPARATION

- A. General: Surfaces shall be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion
 - 1. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry a minimum of 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.
 - 2. Remove items including but not limited to thermostats, electrical outlets, switch covers and similar items

prior to painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

- B. Drywall - Interior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting.
- C. Plaster: Must be allowed to dry thoroughly for at least 30 days before painting, unless the products are designed to be used in high pH environments. Room must be ventilated while drying; in cold, damp weather, rooms must be heated. Damaged areas must be repaired with an appropriate patching material. Bare plaster must be cured and hard. Textured, soft, porous, or powdery plaster should be treated with a solution of 1 pint household vinegar to 1 gallon of water. Repeat until the surface is hard, rinse with clear water and allow to dry.

3.03 INSTALLATION

- A. Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendations.
- B. Do not apply to wet or damp surfaces. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days. Test new concrete for moisture content. Wait until wood is fully dry after rain or morning fog or dew.
- C. Apply coatings using methods recommended by manufacturer.
- D. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.
- E. Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.
- F. Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.
- G. Inspection: The coated surface must be inspected and approved by the Architect just prior to the application of each coat.

3.04 PROTECTION

- A. Protect finished coatings from damage until completion of project.
- B. Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

END OF SECTION

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SECTION 10.28.13

TOILET ROOM ACCESSORIES

I. PART I - GENERAL

1.01 GENERAL

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 DESCRIPTION OF WORK

- A. **Work included:** Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Mirrors.
2. Semi-Recessed Waste Receptacles.
3. Sanitary Napkin Disposal.
4. Toilet Paper Dispensers With Shelf.
5. Paper Towel Dispenser.
6. Grab Bars With Flange Covers.
7. Robe/Towel Hook, Coat Rack.
8. Shower Curtain, Curtain Rod and Curtain Hooks
9. Automatic Touch Free Hand Dryers.

- B. **Alternates:** Not Applicable.

- C. **Items to Be Installed Only:**

1. Soap Dispenser, location as shown on drawings. Provide concealed blocking as required.
2. Paper Towel Dispenser, location as shown on drawings. Provide concealed blocking as required.

- D. **Items to Be Furnished Only:** Not Applicable.

- E. **Related Work Specified Elsewhere:** The following items are not included in the Section, and will be performed under the designated Sections:

1. Division 26 - Final electrical connection of hand dryer.

1.03 SUBMITTALS

- A. **Product Data:** For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

- B. **Product Schedule:** Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated on Drawings.
2. Identify products using designations indicated on Drawings.

- C. Maintenance Data: For toilet accessories to include in maintenance manuals.

1.04 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Designer.

1.05 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

II. PART II - PRODUCTS

2.01 MIRRORS:

- A. Manufacturers:

1. American Specialties, Inc. (basis of design).
2. Bobrick Washroom Equipment Company.
3. Bradley Corporation Washroom Specialties Division.
4. Approved equal.

- B. Materials and finishes:

1. Glass: ASTM C 1036-91, No. 1 Quality, 1/4" thick plate/float, silver coated and hermetically sealed with a uniform copper plating, and warranted against silver spoilage for 15 years. glass with silver, copper and organic coating and uniformly ground and polished edges.
2. Frame: 18-8, Type 304, 20 gauge (0.036") stainless steel. Roll-formed one piece construction. Exposed surfaces to have a No. 4 satin finish. Edge and corners are burr free. Channel frame with mitered corners.
 - (a) Mounting Bracket: "H" bracket, with top and bottom wall brackets, fabricated from 20 gauge corrosion protected steel, and shall be spot welded into the "H" hanger. Mirror shall be secured to the lower bracket with a phillips pan head locking screw.
3. Filler: Expanded polyethylene microcell foam sheet material, abrasion resistant and shock absorbing, water resistant, 1/8" thick total layer thickness.

- C. Schedule:

1. Mirror: American Specialties, Inc., Model No. 0620, size as indicated on the Drawings.

2.02 TOILET ROOM ACCESSORIES

- A. Manufacturers:

1. American Specialties, Inc.
2. Peter Pepper Products.
3. Bradley Corporation Washroom Specialties Division.
4. Approved equal. Furnish and install all toilet accessories indicated on the Drawings or as scheduled

below, except toilet accessories specified to be provided under other sections.

- B. Manufacturers' names shall not be visible on exposed surfaces when installed.
- C. Toilet Accessories Schedule: The following schedule of items is to establish type and quality and is not necessarily complete.
 - 1. Trash Receptacles: Bradley Corp. Model 344-10-65, semi-recessed (2" recess with a 4/34" projection from face of wall). Hinged cover with push flap door, door is embossed with "PUSH". Heavy gauge stainless steel cabinet. Satin finish, 12 gallon capacity.
 - 2. Sanitary Napkin Disposal: American Specialties, Inc. Model No. 0473-1A, surface mounted with locking waste receptacle and push door. Fabricated of 18-8 stainless steel, type 304, 22 gauge, No. 4 stain finish.
 - 3. Toilet Paper Dispensers: American Specialties, Inc. Model No. 0697-GAL, surface mounted dual toilet paper holder with shelf. Fabricated from 18-8 stainless steel, type 304, 18 gauge, No. 4 stain finish. Shelf: 5" x 18" with 5/8" hemmed lip on front edge. Include (2) rollers, molded of high impact - resistant polystyrene plastic.
 - 4. Paper Towel Dispenser: American Specialties, Inc. Model No. 0210, surface mounted paper towel dispenser, with a dispense capacity of 525 standard multi-fold or 400 standard C-fold paper towels. Fabricated of 18-8 stainless steel, type 304, 22 gauge, No. 4 stain finish.
 - 5. Grab Bars: American Specialties, Inc. Model No. 3800, 1 1/2" dia. Type -01 configuration, with snap-on flange covers for concealed mounting. Fabricated from 18-8 stainless steel, type 304, 22 gauge covers, and 1/8" thick flange. Bars to have non-slip peened surface. Size as shown on the Drawings.
 - 6. Robe/Towel Hook and Coat Rack: Peter Pepper Products Model No. 2143XL coat rack with 4 hooks, and matching single robe/towel hook 2071-AL. Finish: natural anodized aluminum. Provide in locations as shown on the drawings.
 - 7. Shower Curtain, Curtain Rod and Curtain Hooks: American Specialties, Inc. Shower curtain rod with concealed mounting flanges, 18-8 stainless steel, satin type 304, 20 gauge, 1 1/4" O.D. Model No. 1224-30. Curtain hooks (7) each, Model No. 1200-SHU, 18-8 stainless steel, type 304, 0.098" diameter wire. Curtain Model No. 1200-V-36, antimicrobial 0.0095" thick PVS sheet, 1 1/2" top hem, 3/8" I.D. grommets, 72" high.
 - 8. Automatic Touch Free Hand Dryer: Dyson Airblade V Model No. 307174-01, HU02 sprayed nickel. Low voltage 110-127 V, 15 Amp, 1000 W, 12 second dry time, 420 mph air speed at aperture, sound power level 79 dB(A), sound pressure level 63 dB(A), touch free capacitive sensor activation.
- D. Carefully review the Drawings for other types of toilet accessories and to establish quantities, locations and mounting heights of the various accessories required.
- E. In the event that locations or mounting heights are not indicated, they shall be as directed by Architect.

III. PART III - EXECUTION

3.01 COORDINATION

- A. Where semi-recessed items are shown, furnish shop drawings or cut sheets to framers to ensure adequate space for products.
- B. Coordinate electrical service roughing with electrician, to ensure service extends to the manufacturer's connection point.

- C. Coordinate the locations of blocking for all surface mounted items, to ensure proper support of products as recommended by manufacturer and required by Code.

3.02 EXAMINATION

- A. Examine areas to receive the work of this section prior to the installation of products specified herein. Coordinate examination of blocking locations prior to installation of sheetrock.
- B. Where surface mounted items are shown to be installed on tile surfaces, sound tiles to confirm proper adhesion to substrate before drilling for fasteners. Advise tile installer of any work not suitable to receive specified products.
- C. Start of installation constitutes acceptance of existing conditions.

3.03 INSTALLATION

- A. Install products plumb and level, following manufacturer's guidelines, unless noted otherwise.
- B. Install at heights as noted and in conformance with 521CMR.
- C. Securely attach load-bearing items such as grab bars and baby changing stations with fasteners as required by manufacturer and to withstand code-required loading.
- D. Test all items following installation. Adjust moving parts for smooth operation. Correct any loose or non-functional conditions.

3.04 CLEANING AND PROTECTION

- A. Maintain any plastic protective films in place and remove following Substantial Completion.
- B. Clean all items installed with manufacturer's recommended cleaners.

END OF SECTION 10.28.13

SECTION 21 05 00

FIRE PROTECTION

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B.
 - 1. Work to be done under this SECTION is shown on Drawings numbered:

FP0.0	FIRE PROTECTION LEGEND
FP1.0	FIRE PROTECTION NEW WORK PLAN

1.02 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section.

1.03 SUMMARY

- A. This Section specifies automatic sprinkler systems and standpipe and hose systems for buildings and structures. Materials and equipment specified in this Section include:
 - 1. Pipe, fittings, valves, and specialties.
- B. Fees & Permits: The contractor shall submit plans to the local authorities (state and local) for review and pay for all fees associated with the review.
- C. Sprinklers, cabinets and accessories.
- D. Products furnished but not installed include sprinkler head cabinet with spare sprinkler heads. Furnish to the Owner's maintenance personnel.
- E. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. -
 - 2. Division-10 Section, "FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES" for fire extinguishers and extinguisher cabinets.
 - 3. Division-23 Section "MECHANICAL IDENTIFICATION" for labeling and identification of fire protection piping system and components.

1.04 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Other definitions for fire protection systems are listed in NFPA Standards 13, 14, and 24.
- C. Working Plans as used in this Section means those documents (including drawings and calculations) prepared pursuant to the requirements contained in NFPA 13 and the owner's insurance company for obtaining approval

of the authority having jurisdiction.

1.05 SUBMITTALS

- A. Product Data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and cabinet specified.
- B. Shop Drawings prepared in accordance with NFPA 13 and owner's insurance company identified as "Working Plans," including hydraulic and seismic restraint calculations where applicable, and which have been approved by the authority having jurisdiction.
- C. Maintenance Data for each type sprinkler head, valve, piping specialty, fire protection specialty, fire department connection and cabinet specified, for inclusion in operating and maintenance manual specified in Division 00 and Division-23 Section "BASIC MECHANICAL REQUIREMENTS."
- D. Welders' qualification certificates.
- E. Installer qualifications (refer to Quality Assurance).
- F. Test Reports and Certificates include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping" as described in NFPA 13.
- G. Substitutions: Refer to Division 23 section, "BASIC MECHANICAL REQUIREMENTS", for manufacturer substitutions not listed herein.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Installation and alterations of fire protection piping, equipment, specialties, and accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term "qualified" is defined as being experienced in such work (experienced being a minimum of five previous projects similar in size and scope to this project), familiar with all precautions required, and has successfully completed the necessary examinations and courses required by the authorities having jurisdiction. Refer to Division-01 Section: "Definitions and Standards" for definitions for "Installers."
- B. Regulatory Requirements: Comply with the requirements of the following codes:
 - 1. NFPA 13 - Standard for the Installation of Sprinkler Systems.
 - 2. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.
 - 3. NFPA 1961 - Standard for Fire Hose.
 - 4. NFPA 1963 - Screw Threads and Gaskets for Fire Hose Connections.
ADD OTHER APPLICABLE NFPA STANDARDS THAT MAY BE APPLICABLE, I.E. 231C
RACK STORAGE)
 - 5. UL Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled.
 - 6. Owner's insurance company: Fire protection system materials and components shall be approved for the application anticipated.
 - 7. Project designer must be at a minimum level 3 NICET (National Institute for Certification in Engineering Technologies) certified or a Professional Engineer in Fire Protection Engineering.

1.07 SEQUENCING AND SCHEDULING

- A. Schedule rough-in installations with installations of other building components.

1.08 EXTRA MATERIALS

- A. Valve Wrenches: Furnish to Owner valve wrenches for each type of sprinkler head installed, quantity as required by NFPA 13.
- B. Sprinkler Heads and Cabinets: Furnish extra sprinkler heads of each style included in the project. Furnish each style of sprinkler head in a project cabinet including special wrenches as required by NFPA 13.

1.09 DESIGN CRITERIA

- 1. The fire hazard classifications are listed on the contract documents.

1.10 SYSTEM DESCRIPTION

- A. The project scope of work consists of demolition and new work to three existing wet pipe sprinkler systems. There are three unique areas of work, with independent risers, isolation and drain. The project areas are receiving new ceilings at different elevations. The contract documents prescribe the system design criteria. The fire protection contractor is responsible for full system design and coordination.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide fire protection system products from one of the following:
 - 1. Gate Valves:
 - a. Fairbanks
 - b. Jenkins
 - c. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.
 - d. Stockham
 - 2. Swing Check Valves:
 - a. Fairbanks
 - b. Jenkins
 - c. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.
 - d. Stockham
 - 3. Grooved Mechanical Couplings:
 - a. Stockham
 - b. Victaulic Company of America
 - 4. Water Flow Indicators:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Star Sprinkler Corp.
 - c. Victaulic Company of America

- d. Viking Corp.
- 5. Water-Motor Gongs:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Star Sprinkler Corp.
 - c. Viking Corp.
- 6. Detector Check Valves:
 - a. Ames Company, Inc.
 - b. Kennedy Valve, Div of ITT Grinnell Valve Co., Inc.
 - c. Victaulic Company of America
- 7. Alarm Check Valve:
 - a. Central Sprinkler Corp.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Star Sprinkler Corp.
 - d. Viking Corp.
- 8. Hose Outlet Valves:
 - a. Guardian Fire Equipment, Inc.
 - b. United Brass
 - c. Potter Roemer
 - d. Croker
- 9. Fire Department Connection Valve:
 - a. Guardian Fire Equipment, Inc.
 - b. United Brass
 - c. Potter Roemer
 - d. Croker
- 10. Sprinkler Heads:

Coordinate sprinkler selection with owners insurance provider for type and temperature.

 - a. Automatic Sprinkler Corp of America.
 - b. Central Sprinkler Corp. (a Tyco Company)
 - c. Firematic Sprinkler Devices, Inc.
 - d. Grinnell Corporation (a Tyco Company)
 - e. Guardian Automatic Sprinkler Co., Inc.
 - f. Reliable Automatic Sprinkler Co., Inc.
 - g. Star Sprinkler Corp. (a Tyco Company)
 - h. Viking Corp.
- 11. Fire Hose, Valve, and Extinguisher Cabinets:
 - a. J. L. Industries
 - b. Larsen's Mfg. Co.
 - c. Johnson-Lee, Division of W.F. Lee Corp.

- d. Muckle Manufacturing, Division of Technico, Inc.
- e. Watrous, Inc.

2.02 PIPE AND FITTING MATERIALS

- A. Pipe & Fitting Schedule: The following schedule indicates the pipe and fittings to be used on this project, except where specific requirements are listed elsewhere in this section:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≤2"	A53, grade B, type S or E	Schedule 40, ANSI B36.10
	>2"	A53, grade B, type S or E	Schedule 10, ANSI B36.10
Fittings	≤2"	A126, class B cast iron	Standard, threaded, B16.4
	All Sizes	A536, ductile Iron	synthetic rubber gaskets
Flanges	≤2"	A105, forged carbon steel	class 150, RF, threaded, ANSI B16.5
	>2"	A105, forged carbon steel	class 150, RF, weld neck or slip on, ANSI B16.5
Bolts		A193, grade B7 carbon steel	Hex head (ANSI B18.2.1), B1.1, class 2A course thread
Nuts		A194, Grade 2H, Carbon steel	Heavy hex (ANSI B18.2.2), B1.1, class 2B course thread
Gaskets	Per flange standard	A304, stainless steel, Grafoil filled, spiral wound	class 150, RF, ring style, ANSI B16.20

- B. Provide galvanized pipe and fittings where required by NFPA or Owner's insurance company.
- C. Grooved Mechanical Couplings: Consist of ductile or malleable iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll-grooved pipe and fittings. Grooved mechanical couplings including gaskets used on dry-pipe systems shall be listed for dry-pipe service.

2.03 GENERAL DUTY VALVES

- A. Gate Valves - 2 Inch and Smaller: body and bonnet of cast bronze, 175 pound cold water working pressure - non-shock, threaded ends, solid wedge, outside screw and yoke, rising stem, screw-in bonnet, and malleable iron handwheel.
- B. Gate Valves - 2-1/2 Inch and Larger: iron body; bronze mounted, 175 pound cold water working pressure - non-shock. Valves shall have solid taper wedge; outside screw and yoke, rising stem; flanged bonnet, with body and bonnet conforming to ASTM A 126 Class B; replaceable bronze wedge facing rings; flanged ends; and a packing assembly consisting of a cast iron gland flange, brass gland, packing, bonnet, and bronze bonnet bushing.
- C. Butterfly Valves: Class 300, ductile iron body and disk conforming to ASTM A-536, EPDM coated disk, hand wheel for slow acting applications.
- D. Swing Check Valves: MSS SP-71; Class 175, cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc or cast iron disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.
- E. Reduced Pressure Zone (RPZ) Backflow Preventer: Finished with seated gate valve shutoffs, fused epoxy coated cast iron body, captured spring assemblies, replaceable bronze seat, suitable up to 175 psi, Watts Series 909.

2.04 AUTOMATIC SPRINKLERS

- A. Sprinkler Heads: Glass bulb or fusible link type, and style as indicated or required by the application. Unless otherwise indicated, provide heads with nominal ½" discharge orifice, for "Ordinary" temperature range.
- B. Sprinkler Head Finishes: Provide heads with the following finishes:
 - 1. Upright, Pendent, and Sidewall Styles: White escutcheon in finish spaces, exposed to view; rough bronze finish for heads in unfinished spaces and not exposed to view. Heads shall be wax-coated where installed exposed to acids, chemicals, or other corrosive fumes.
 - 2. Concealed Style: Rough brass, with painted white cover plate.
- C. Sprinkler Head Cabinet and Wrench: finished steel cabinet, suitable for wall mounting, with hinged cover and space for 6 spare sprinkler heads plus sprinkler head wrench. Provide a separate cabinet for each style sprinkler head on the project.

2.05 HOSE, VALVE, AND EXTINGUISHER CABINETS

- A. General: Provide cabinets to house hose valves as indicated.
- B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.
- C. Cabinet Type: Suitable for mounting conditions indicated, of the following types:
 - 1. Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.
 - 2. Semi-Recessed: Cabinet box (tub) partially recessed in walls of shallow depth.
 - 3. Surface-Mounted: Cabinet box (tub) fully exposed and mounted directly on wall.
 - 4. Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.
 - 5. Trimless: For installation in walls where surface of surrounding wall finishes flush with exterior finished surface of frame and door of fire extinguisher cabinet, without any overlapping trim attached to cabinet.
 - a. Provide recessed flange, of same material as box, attached to box to act as plaster stop.
 - 6. Trimless with Hidden Flange: Of design where trim consists of perimeter flange of same metal and finish as box (tub) which overlaps surrounding wall finish and which, in turn is concealed from view by and overlapping door.
 - 7. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 8. Square-Edge Trim: Square edges with backbend depths as follows:
 - a. ¼ to 5/16 inch.
 - b. ½ inch
 - c. 2 inch.

9. Rolled-Edge Trim: Rounded edges with backbend depth as follows:
 - a. 1-1/4 inch.
 - b. 2-1/2 inch.
 - c. 4-1/2 inch.
 10. Trim Metal: Of same metal as door.
- D. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.
1. Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.
 2. Aluminum: Manufacturer's standard flush, hollow aluminum door construction.
 3. Stainless Steel: Manufacturer's standard door construction, fabricated from austenitic stainless steel complying with ASTM A 167, for AISI Type 302/304 alloy.
 4. Unbacked Acrylic: Manufacturer's standard unbacked acrylic door construction with metal edge reinforcing at hinge jamb and at latch.
 5. Aluminum-Backed Acrylic: Manufacturer's standard aluminum-backed obscure-textured acrylic with silk screen lettering or design applied to back of acrylic face.
 6. Door Glazing: Clear float glass complying with FS DD-G-451, Type I, Class 1, Quality q3.
 7. Door Glazing: Tempered float glass complying with FS DD-G-1403, Grade B, Style I, Type I, Quality q3, class as indicated below:
 8. Clear glass: Class 1 (transparent)
 9. Tinted glass: Class 2 (heat absorbing), bronze tint.
 10. Plastic Laminate: High pressure plastic laminate face complying with NEMA LD_3 for GP-50; manufacturer's standard core and steel backing construction.
- E. Door Style: Manufacturer's standard design as indicated.
1. Full-Glass Panel: Float glass, 1/8 inch thick.
 2. Duo-Panel: Float glass, 1/8 inch thick.
 3. Break Glass Panel: Float glass, 1/8 inch thick, with inside latch and lock.
 4. Frameless Tempered Full-Glass Panel: Tempered float glass with polished edges and inside surface etched with lettering or design indicated and frosted.
 5. Solid Panel: Full flush opaque panel of material indicated.
 6. Full-Acrylic Panel: Frameless, 1/2 inch thick clear acrylic.
 - a. Bubble Type: One-piece molded clear plastic.
- F. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide continuous full height hinge permitting door to open 180°.

- G. Door Hardware for Frameless Tempered Full-Glass Panel Door.
1. Provide manufacturer's standard corner-mounted plated steel hinges, corner-mounted plated metal handle, and catch, with finish indicated below:
 - a. Finish: Bright chrome plated, Finish No. 651 in accordance with ANSI/BHMA A156.18.
 - b. Finish: Bright brass plated, clear coated; Finish No. 632 in accordance with ANSI/BHMA A156.18.

2.06 FACTORY FINISHING OF HOSE, VALVE, AND EXTINGUISHER CABINETS

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled. Protect cabinets with plastic or paper covering, prior to shipment.
- B. Painted Finishes: Provide painted finish to comply with requirements indicated below for extent, preparation, and type:
1. Extent of Painted Finish: Apply painted finish to both concealed and exposed surfaces of cabinet components except where other than a painted finish is indicated.
 2. Color: Provide color or color matches indicated, or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
 3. Preparation: Clean surfaces of dirt, grease, and loose rust or mill scale.
 4. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply cabinet manufacturer's standard baked enamel finish system to the following surfaces:
 - a. Interior of cabinet.
 - b. Exterior of cabinet except for those surfaces indicated to receive another finish.
- C. Anodized Aluminum Finishes: Provide architectural anodic coatings complying with the following requirements:
1. Class II Clear (Natural) Anodized Finish: AS-M12C22A31 (mechanical finish, non-specular as fabricated; chemical etch, medium matte; 0.4 mil minimum thick clear anodic coating).
 2. Class I Color Anodized Finish: AA-M12C22A42 (mechanical finish, non-specular as fabricated; chemical etch, medium matte; 0.7 mil minimum thick integrally deposited colored anodic coating).
- D. Provide color matching Architect's sample or, if none established, as selected by Architect from within standard industry colors and color density range.
- E. Stainless Steel Finish: AISI No. 4 polished finish. Furnish with paper masking to protect finish.
- F. Obscure Acrylic Colors: Provide color or combination of colors selected from manufacturer's standard colors.
- G. Plastic Laminate Colors: Provide color, finish and pattern indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PIPE APPLICATIONS

- A. Install systems using schedule 40 threaded or welded, schedule 10 grooved, or combination thereof as allowed by NFPA 13 and the Owner's insurance carrier.

3.03 PIPING INSTALLATIONS

- A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. So far as practical, install piping as indicated.
- B. Deviations from approved "Working Plans" for sprinkler piping, require written approval of the authority having jurisdiction. Written approval shall be on file with the Architect prior to deviating for the approved "Working Plans."
- C. Install sprinkler piping to provide for system drainage in accordance with NFPA 13.
- D. Install adapters on valves, apparatus, and equipment having dissimilar connections.
- E. Hangers and Supports: Comply with the requirements of NFPA 13, NFPA 14 and Owner's insurance carrier. Hanger and support spacing and locations for piping joined with grooved mechanical couplings shall be in accordance with the grooved mechanical coupling manufacturer's written instructions, for rigid systems.
- F. Provide protection from damage where subject to earthquake in accordance with NFPA 13.
- G. Make connections between underground and above-ground piping using an approved transition piece strapped or fastened to prevent separation.
- H. Install test connections sized and located in accordance with NFPA 13 and Owner's insurance carrier, complete with shutoff valve. Test connections may also serve as drain pipes.
- I. Install pressure gage on the riser or feed main at or near each test connection. Provide gage with a connection not less than 1/4 inch and having a soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and where they will not be subject to freezing.

3.04 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Specification section, "BASIC PIPING MATERIALS AND METHODS".

3.05 VALVE INSTALLATIONS

- A. General: Install fire protection specialty valves, fittings, and specialties in accordance with the manufacturer's written instructions, NFPA 13 and 14, and the authority having jurisdiction.
- B. Control Valves: Install supervised-open control valves so located to control all sources of water supply except fire department connections. Where there is more than one control valve, provide permanently marked identification signs indicating the portion of the system controlled by each valve. Refer to Division-23 Section "MECHANICAL IDENTIFICATION" for valve tags and signs.

3.06 SPRINKLER HEAD INSTALLATIONS

- A. Use proper tools to prevent damage during installations.

3.07 FIRE HOSE AND RACK INSTALLATIONS

- A. Install fire hose, valve, and extinguisher cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
- B. Prepare recesses in walls for cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
- C. Securely fasten fire hose, valve, and cabinets to structure, square and plumb, to comply with manufacturer's instructions.
- D. Where exact location of surface-mounted cabinets is not indicated, locate as directed by Architect.
- E. Identify equipment in cabinet with lettering spelling "FIRE EXTINGUISHER" "FIRE HOSE" or "FIRE HOSE AND EXTINGUISHER" applied to door by process indicated below. Provide lettering to comply with requirements indicated for letter style, color, size, spacing and location or, if not otherwise indicated, as selected by Architect from manufacturer's standard arrangements.

3.08 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13 and Owner's insurance company.
- B. Flush, test, and inspect standpipe systems in accordance with NFPA 14 and Owner's insurance company.
- C. Replace piping system components which do not pass the test procedures specified, and retest repaired portion of the system.

END OF SECTION 21 05 00

SECTION 22 05 23

PLUMBING VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes general duty valves common to most plumbing piping systems.
- B. Special duty valves are specified in individual plumbing piping system specifications.

1.03 SUBMITTALS

- A. Refer to Division 01 and Division 23 Section "BASIC MECHANICAL REQUIREMENTS" for administrative and procedural requirements for submittals.
- B. Submit product data, including manufacturer, model number, body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Where required, comply with the requirements of the latest edition of the following Standards:
 - 1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.
 - 2. NSF/ANSI 61 Annex G – Weighted Average Lead Content Evaluation Procedure to a 0.25% Lead Requirement.
 - 3. NSF/ANSI 372 – Drinking Water System Components - Lead Content.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.
- D. "Lead Free" Compliance: All plumbing valves used to convey or dispense water for human consumption shall meet the low lead requirements of NSF/ANSI 61 Annex G and NSF/ANSI 372 for <0.25% weighted average lead content in relation to the wetted surface area in accordance with the Federal "Reduction of Lead in Drinking Water Act" of 2011.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation For Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

3. Set valves in best position for handling. Set ball valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.
- B. Storage: Use the following precautions during storage:
1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 VALVE FEATURES, GENERAL

- A. Pressure and Temperature Ratings: As specified and required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Provide the following special operator features:
1. Hand wheels, fastened to valve stem, for valves other than quarter turn. Operating force not to exceed 80 pounds.
 2. Lever handles on quarter turn valves 6" and smaller. Valves larger than 6" shall be equipped with gear drive operators.
 3. In mechanical spaces only, provide chain wheel operators, for valves 2½" and larger installed 96" or higher above finished floor elevation. Extend chains to an elevation of 60" above finished floor elevation.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. End Connections: As indicated in the valve specifications.
1. Threads: Comply with ANSI B1.20.1.
 2. Flanges: Comply with ANSI B16.24 for cast copper alloy.
 3. Solder Joint: Comply with ANSI B16.18.

2.02 BALL VALVES

- A. Ball Valves, 2" and Smaller, Bronze Body: Rated for 150 psi SWP and 400 psi WOG non-shock; two piece construction; with bronze body, standard (or regular) port, 316 stainless steel ball and stem, replaceable 'Teflon' or "TFE" seats and seals, blowout-proof stem, vinyl covered steel handle, threaded or solder ends and extended stem for insulated piping.

Non-Potable Water Service		
	Threaded	Solder
Apollo	70-14x series	70-24x series
Stockham	T-285-BR-R-66	S-285-BR-R-66
Milwaukee Valve	BA-100S	BA-150S
Watts	LF-B-6080-G2	LF-B-6081-G2

“Lead Free” Potable Water Service		
	Threaded	Solder
Apollo	70LF-14x series	70LF-24x series
Stockham	LFT-285-BR-R-66	LFS-285-BR-R-66
Milwaukee Valve	UPBA100S	UPBA150S
Watts	LF-B-6080-G2	LF-B-6081-G2

- B. Low Point Drain Valves: Bronze body rated for 150 psi saturated steam pressure, 400 psi WOG pressure; two-piece construction; with bronze body, standard (or regular) port, B-16 chrome plated ball and stem, replaceable ‘Teflon’ or ‘TFE’ seats and seals, blowout-proof stem, vinyl covered steel handle. System end shall be thread or solder, opposite end shall be ¾" hose connection with brass cap. Provide ½" inlet for pipe line sizes ≤1", ¾" inlet for line pipe sizes >1".

Non-Potable Water Service		
	Threaded	Solder
Apollo	70-10x-HC series	N/A
Milwaukee Valve	BA-100H	BA-150H
Watts	FBV-3C-CC	FBVS-3C-CC

“Lead Free” Potable Water Service		
	Threaded	Solder
Apollo	70LF-100HC series	70LF-200HC series
Watts	LF-FBV-3C-CC	LF-FBVS-3C-CC

2.03 BUTTERFLY VALVES

- A. Water Service Flanged Joint Piping Systems: Commercial performance “lead free” butterfly valves, 2½" and Larger; MSS SP-67; ANSI Class 150 epoxy coated ductile iron body conforming to ASTM A 536 with aluminum bronze disc, 416 stainless steel shaft, EPDM seats. Provide lever operator with lock for sizes 2-1½" through 6" and gear operator with position indicator for sizes 8" and larger. Lug type valve, wafer type valves are not allowed.

Milwaukee Valve	ML233E & ML333E series
Nibco	LD 2000 series
Watts	DBF-03-121-1 series

- B. Water Service, Grooved Joint with Mechanical Coupling Piping Systems: Commercial performance “lead free” butterfly valves, 2 ½” through 4”; cast brass body conforming to UNS C87850, aluminum bronze disc conforming to UNS C95500, Grade “CHP” Fluoroelastomer, enamel coated steel operator bracket and drive hub adaptor, lever operators with locks, EPDM Grade E liner, grooved ends.

Victaulic	Series 608N
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2.04 CHECK VALVES

- A. Swing Check Valves, 2" and Smaller Bronze Body: MSS SP-80; rated for 125 psi SWP and 200 psi WOG non-shock, cast bronze body and cap conforming to ASTM B-62 or ASTM B-584; with horizontal swing, Y-pattern, brass or bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

Non-Potable Water Service		
	Threaded	Solder
Crane	137	1342
Milwaukee Valve	509	1509
Watts	CVY	CVYS
“Lead Free” Potable Water Service		
	Threaded	Solder
Crane	LF37	LF1340
Milwaukee Valve	UP509	UP1509
Watts	LFCV	LFCVS

2.05 COMBINATION BALANCING/SHUTOFF VALVE (POTABLE WATER SERVICE):

- A. 1/2" through 2", “lead-free” with solder or NPT connections, brass body with stainless steel ball and glass/carbon filled TFE seats.
- B. Balancing valves shall have differential pressure read-out ports across valve seat area and ¼” NPT tapped drain/purge port. Read-out ports shall be fitted with internal EPT inserts/check valves.
- C. Balancing valves shall provide 100% positive, leak-proof shutoff against the same fluid pressure as the valve body pressure rating.
- D. Balancing valves shall provide preset function with a locking device to prevent tampering and allow a return to

the original setting after shutoff.

- E. Balancing valve nominal ratings shall be 250 psi at 250°F.

Bell & Gossett

CB-LF

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open close and close open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.
- C. Examine threads on both the valve and the mating pipe for form (i.e., out of round or local indentation) and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.02 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2" and Smaller: Solder or threaded ends.
 - 2. Copper Tube Size, 2-1/2" and Larger: Flanged.

3.03 VALVE APPLICATIONS

- A. Domestic Hot and Cold Water, ($\leq 2"$): Bronze bodied ball and check valves.
- B. Domestic Hot and Cold Water, $\geq 2-1/2"$: Butterfly valves.
- C. Install "lead free" valves on all potable water systems used to convey or dispense water for human consumption.

3.04 VALVE INSTALLATIONS

- A. General Application: Use ball and butterfly valves for shut off duty and for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves for each fixture and item of equipment arranged to allow fixture or equipment isolation without system shutdown.

- D. Install valves in horizontal piping with stem at or above the center of the pipe.
- E. Install valves in a position to allow full handle movement.
- F. Provide valve stem extensions when valves are installed in insulated piping systems.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
- H. Install drain valves at the low points of all plumbing piping.

3.05 CONNECTIONS

- A. Refer to Division 23 specification, "BASIC PIPING MATERIALS AND METHODS".
- B. Solder Connections:
 - 1. Close ball valves to the full closed position.
 - 2. Remove the cap and disc holder of swing check valves having composition discs.

3.06 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.07 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER DISTRIBUTION PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.

1.02 RELATED SECTIONS

- A. 23 05 53 - MECHANICAL IDENTIFICATION
- B. 23 07 00- MECHANICAL INSULATION

1.03 SUMMARY

- A. This Section includes potable cold water, hot water, and circulation hot water piping, fittings, and specialties within the building to a point 10 feet outside the building.
- B. Products that are installed but may or may not be furnished under this Section include water meters. Coordinate with utility company.

1.04 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).

1.05 REFERENCES:

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated.
 - 1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
 - 2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - 3. ICC LC1002 - PMG Listing Criteria For Press Connection Fittings For Potable Water Tube And Radiant Heating Systems
 - 4. IAPMO PS117 - Copper And Copper Alloy Tubing System Incorporating Press-Type or Nail-Type Connections.
 - 5. NSF/ANSI 61 - Drinking Water System Components - Health Effects
 - 6. NSF/ANSI 61-G Annex G – Weighted Average Lead Content Evaluation Procedure to a 0.25% Lead Requirement
 - 7. NSF/ANSI 372 - Drinking Water System Components – Lead Content

1.06 SUBMITTALS

- A. Refer to Division 1 and Division 23 Section "BASIC MECHANICAL REQUIREMENTS" for administrative and procedural requirements for submittals.
- B. Submit the following:
 - 1. Product data for each piping specialty and special duty valve specified.
 - 2. Product data for water meters, trap primers, thermostatic mixing valves and thermal expansion tanks.
 - 3. Certification of Compliance with ASME and UL fabrication requirements specified below.
 - 4. Provide calculations, per PDI standard practices, of all water hammer arresters, clearly indicating locations of all fixtures served & arrester locations.
 - 5. Piping pressure test and backflow preventer test reports specified in Part 3 of this Section.
 - 6. Reports for cleaning and disinfecting procedures completed and satisfactory bacteriological sample test results.
 - 7. Inspection reports of the Authority Having Jurisdiction.
 - 8. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 23 Section - "BASIC MECHANICAL REQUIREMENTS."

1.07 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following codes:
 - 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. Comply with the requirements of City of Worcester Water Dept.
 - 3. "Lead Free" Compliance: All plumbing valves used to convey or dispense water for human consumption shall meet the low lead requirements of NSF/ANSI 61 Annex G and NSF/ANSI 372 for <0.25% weighted average lead content in relation to the wetted surface area in accordance with the Federal "Reduction of Lead in Drinking Water Act" of 2011.
 - 4. All pipe, fittings and valves installed in potable domestic water systems shall comply with NSF 61 "Drinking Water System Components – Health Effects."

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe in a manner to prevent sagging and bending.

1.09 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.10 EXTRA MATERIALS

- A. Maintenance Stock: Furnish one valve key for each key operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 – PRODUCTS

2.01 PIPE, FITTINGS, AND JOINT MATERIALS

- A. Pipe and Tube: Refer to Part 3, Article, "PIPE APPLICATIONS," for identification of systems where the below materials are to be used.
- B. Annealed Temper Copper Tubing:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≤3"	B88 copper	Type L or K, drawn
Solder Fittings	≤3"	Wrought copper or cast bronze	ANSI B16.22 & B16.18
Press Fittings	≤2"	Wrought copper or bronze	ANSI B16.22 and B16.18, EPDM sealing element
Press Fittings	2 1/2", 3"	Wrought copper or bronze	ANSI B16.22 and B16.18, EPDM sealing element, 420 stainless steel grip ring, PBT separator ring
Bolts	Per flange standard	A193, grade B7 carbon steel	Hex head (ANSI B18.2.1), B1.1, class 2A course thread
Nuts	Per flange standard	A194, Grade 2H, Carbon steel	Heavy hex (ANSI B18.2.2), B1.1, class 2B course thread
Gaskets	Per flange standard	1/16" Compound fiber	

- C. Polypropylene Piping:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≤3"	F-2389	SDR 7.4, Aquatherm Greenpipe® Faser Composite
Fittings	≤3"	F-2389	SDR 7.4, Aquatherm Greenpipe®

- D. CPVC Piping:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≤3"	D-1784, D-2846 & F-441CPVC	Schedule 80
Fittings	≤3"	D2846 & F441CPVC	Schedule 80

- E. Water Service Pipe, ≥2-1/2": Ductile iron pipe conforming to AWWA/ANSI C151 and ductile iron fittings conforming to AWWA/ANSI C110 and C153. Mechanical joints with rubber gasket conforming to AWWA/ANSI C111 and C115. Provide pipe and fittings with interior cement lining conforming to AWWA/ANSI C104 and with exterior bituminous coating, minimum 1 mil thick and conforming to ANSI A21.51, A21.15 and A21.10.

2.02 SPECIAL DUTY VALVES

- A. Interior Wall Hydrant for Utility Spaces: Metal handwheel operated, bronze or brass construction, chrome or rough bronze finish with ASSE 1011 approved vacuum breaker, 3/4" inlet connection, 3/4" hose connection.
- Watts Regulator Co. - #SC8
 - Woodford Mfg. Co. – Model 24
- B. Interior Wall Hydrant for Finished Spaces: Key operated, bronze or brass construction, chrome finish or stainless-steel face with ASSE 1011 approved vacuum breaker, 3/4" inlet connection, 3/4" hose connection.

1. Josam Co. - #71070 series
 2. Woodford Mfg. Co. - #74 series
 3. Zurn Industries Inc., Hydromechanics Div. - #Z-1333
- C. Exterior Wall Hydrant, Exposed Type: Exposed, key operated, bronze or brass construction, chrome finish or stainless-steel face, non-freeze, anti-siphon, automatic draining, with ASSE 1011 approved vacuum breaker, 3/4" inlet, 3/4" hose connection.
1. Josam Co. - #71050 series
 2. Woodford Mfg. Co. - #65 series
 3. Zurn Industries Inc., Hydromechanics Div. - #Z-1310
- D. Exterior Wall Hydrant, Box Type: Flush mounted wall box, key operated door and hydrant, bronze or brass construction with chrome finish, chrome finished brass or stainless-steel box and door, non-freeze, anti-siphon, automatic draining, with integral backflow preventer, 3/4" inlet, 3/4" hose connection.
1. Josam Co. - #71000 series
 2. Woodford Mfg. Co. - #B65 series
 3. Zurn Industries Inc., Hydromechanics Div. - #Z1300

2.03 PIPING SPECIALTIES

- A. Water Hammer Arresters: Bellows type, with stainless steel casing and bellows, pressure rated for 125 psi, tested and certified in accordance with PDI Standard WH-201 and shall conform to ASSE 1010.
1. Josam Co. - #75000 series
 2. J. R. Smith Mfg. Co. – Hydrotrol, #5005-5050
 3. Watts Regulator Co. - #15 series
 4. Zurn Industries, Inc.; Hydromechanics Div. - #Z-1700 Shoktrol series
- B. Vacuum Breakers: Atmospheric type shall conform to ASSE Standard 1001, silicone disc, rough brass finish, for use in low hazard connections where not subject to continuous pressure. Vacuum breakers shall comply with requirements of the maximum lead content regulation per Part 1 – Quality Assurance, when applicable.
1. Conbraco - #AVB1LF (38LF-100) series
 2. Watts Regulator Co. - #LF288A series
 3. Zurn Industries, Inc., Wilkins Regulator Div. - #35XL
- C. Backflow Preventers (service line): Reduced pressure principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include four test cocks and pressure differential relief valve located between 2 positive seating check valves. Backflow preventers shall comply with requirements of ASSE 1013, AWWA/ANSI 511-97 and the maximum lead content regulation per Part 1 – Quality Assurance, when applicable. Shut off valves on backflow preventers of 2" size and smaller shall be full port type ball valves. Provide an air gap drain funnel at the pressure differential relief valve.
1. Conbraco - #40LF-200 series
 2. Watts Regulator Co. – #LF-909 series
 3. Zurn Industries Inc., Wilkins #975 XL2 for 2" and smaller and #375XL for 2 1/2" and larger.
- D. Backflow Preventers (equipment isolation for line sizes 2" and smaller): Reduced pressure principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include four test cocks and pressure differential relief valve located between 2 positive seating check valves. Backflow preventers shall comply with requirements of ASSE 1013, AWWA/ANSI 511-97 and the maximum lead content regulation per Part 1 – Quality Assurance, when applicable. Provide an air gap drain funnel at the pressure differential relief valve.

1. Conbraco - #40LF-200 series
 2. Watts Regulator Co. – #LF-909 series
 3. Zurn Industries Inc. Wilkins #975XL2
- E. Hydronic System Makeup Water Pressure Reducing Valves: Diaphragm operated, cast iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut down, and non-corrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory- set at operating pressure and have the capability for field adjustment.
1. Armstrong Pumps, Inc. - RD-40
 2. Bell and Gossett - FB-38
 3. Taco, Inc. - #335
- F. Water Service Line Pressure-Reducing Valves: Single-seated, direct-operated type, having bronze body with integral strainer and complying with requirements of ASSE Standard 1003 and the maximum lead content regulation per Part 1 – Quality Assurance, when applicable.
1. Conbraco - #PRH-LF series
 2. Watts Regulator Co. - #LF223 series
 3. Zurn Industries Inc., Wilkins Regulator Div. - #500XL series
- G. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, self-closing complying with ANSI Z21.22 listing requirements for temperature and discharge capacity of the appliance for which installed. Temperature relief valves shall be factory set at not more than 210°F, and pressure relief at 150 psi or the pressure vessel manufacturer’s rated working pressure, whichever is less.
1. Watts Regulator Co. - #40XL
 2. Zurn Industries, Inc., Wilkins Regulator Div., #TP series

2.04 WATER METER

- A. General: Provide water meters, including remote registration if applicable, with registration in gallons or cubic feet as required by the local water company. Meters shall comply with the maximum lead content regulation per Part 1 – Quality Assurance, when applicable.
1. Badger Meter, Inc.
 2. Hersey Products, Inc.
 3. Neptune Water Meter Co.; Subs. Neptune Intl. Corp.
 4. Rockwell Intl.; Measurement & Flow Control Div.

2.05 TRAP PRIMER

- A. Fully automatic, “lead-free” brass or bronze body, with integral vacuum breaker/view ports, removable filter screen, 1/2” inlet and outlet connections, activated by a 10 psi pressure drop in adjoining water line, with air gap fitting and distribution unit suitable to serve required number of drain traps. Compliant with the requirements of ASSE standard 1018.
1. Precision Plumbing Products #PR-500 with AG-500 air gap and type DU distribution unit.
 2. MIFAB #M-500 with MI-GAP air gap and MI-DU distribution unit.

2.06 THERMOSTATIC MIXING VALVES FOR LAVATORIES

- A. Lavatory Mixing Valve: Valve shall be of capacity and model as indicated on Drawings. Unit shall be of bronze construction and finish with a single thermostatic element and adjustment knob with locking feature. Unit shall

have inlet check valves.

- B. Valve shall be ASSE 1070 certified and shall comply with the requirements of the maximum lead content regulation per Part 1 – Quality Assurance, when applicable.
- C. Manufacturers:
 - 1. Leonard Valve Co.
 - 2. Lawler Manufacturing Co.
 - 3. Powers Controls
 - 4. Watts Water Technologies

2.07 THERMOSTATIC MIXING VALVES FOR BUILDING MASTER SERVICE

- A. Building Master Mixing Valve: Valve shall be of capacity and model as indicated on Drawings. Unit shall be of bronze construction and finish with a single thermostatic element. Unit shall have inlet check valves and integral wall support.
- B. Valve shall be furnished with locking temperature regulator to prevent accidental movement and adjustable high limit temperature stop.
- C. Valve shall be ASSE 1017 certified and shall comply with the requirements of the maximum lead content regulation per Part 1 – Quality Assurance, when applicable.
- D. Manufacturers:
 - 1. Leonard Valve Co.
 - 2. Lawler Manufacturing Co.
 - 3. Powers Controls

2.08 THERMAL EXPANSION TANKS

- A. NSF 61 approved, constructed per ASME code Section VIII, Division 1, rated for 150 psi working pressure, steel shell, molded polypropylene liner and heavy-duty butyl diaphragm or replaceable heavy duty butyl bladder, stainless steel system connection, charging valve for on-site charging and standard factory pre-charge. Capacities and arrangement as indicated or scheduled on Drawings.
 - 1. Amtrol Therm-X-Trol, ST-C and ST-CL series.
 - 2. Bell & Gossett PTA series.
 - 3. Taco PAX-150 series.
 - 4. Watts DETA series.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine rough-in requirements for plumbing fixtures and other equipment with water connections to verify actual locations of piping connections prior to installation.

3.02 PIPE APPLICATIONS

- A. Above grade, ≤3": Type L, drawn copper tube with wrought copper fittings and solder joints or proprietary Viega ProPress copper press fittings and joints.

3.03 PIPING INSTALLATION

- A. Refer to Division 23 Section "BASIC PIPING MATERIALS AND METHODS" for general piping installation requirements.
- B. Install piping with 1/32"/foot (¼%) downward slope towards drain point.
- C. Insulate piping and plumbing components in accordance with section 23 07 00
- D. Label piping and plumbing components in accordance with section 23 05 53

3.04 HANGERS AND SUPPORTS

- A. Refer to Division 23 Section "HANGERS AND SUPPORTS" for hanger, support, and anchor devices.

3.05 JOINTS

- A. Refer to Division 23 Section "BASIC PIPING MATERIALS AND METHODS" for joint construction.

3.06 VALVE APPLICATIONS

- A. Refer to Division 22 Section "PLUMBING VALVES" for general duty valve applications.
- B. General: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shut-off duty and throttling duty: Use ball valves or commercial grade butterfly valves.

3.07 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and the authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.
- B. Install pressure-reducing valves with inlet and outlet shutoff valves and balance cock bypass when indicated. Install pressure gage on pressure reducing valve inlet and outlet.
- C. Balance Valves: Install "lead-free" balance valve in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated. Balancing valves are specified in Division 22 Section "PLUMBING VALVES".
- D. Install shutoff valves where indicated and as required by the plumbing code.
- E. Install trap primers where indicated on the Drawings serving traps indicated. Trap primers shall be installed a minimum of 36" above the inlet of the trap, shall be located in accessible locations and shall incorporate an air gap fitting.
- F. Install water hammer arresters for each bathroom group and at each location with equipment furnished with fast acting solenoid valves. Arresters shall be located in accessible locations.
- G. Install mixing valves where indicated and required by plumbing code and in compliance with manufacturer's requirements.

3.08 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve with hose end connection, cap and chain on drain connection. For connections 2½" and larger, use flanges instead of unions.

3.09 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
1. Do not enclose, cover, or put into operation the water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 2. During the progress of the installation, notify the authority having jurisdiction at least 5 days prior to the time such inspection must be made. Perform tests specified below in the presence of the authority unless the inspection requirement is waived by the authority.
 3. Rough-in Inspection: Arrange for inspection of the piping system by the authority after system is roughed in and before concealed or closed in and prior to setting fixtures.
 4. Final Inspection: Arrange for a final inspection by the authority to observe the tests specified below if requested by the authority and to ensure compliance with the requirements of the plumbing code.
 5. Other Inspections: Arrange for other inspections in addition to the above if requested by the authority.
 6. Reinspections: Whenever the authority finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the authority.
 7. Reports: Submit inspection reports signed by the authority having jurisdiction.
- B. Test water distribution piping as follows:
1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 3. After press fittings have been installed a stepped pressure test shall be followed. Utilizing air, water, or dry nitrogen, pressurize the system not to exceed 85 psig. Walk the system and check for leaks. If no leaks are identified, proceed to pressurize the system to the specified pressure. If a leaking joint that has not been pressed is identified, relieve the pressure from the system, ensure the tube is fully inserted into the fitting and press the fitting. Resume test procedure, after the necessary repairs have been made.
 4. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
- C. Testing for polypropylene-random (PP-R) piping:
1. Test polypropylene piping systems in accordance with printed recommendations of piping system manufacturer.
- D. Prepare and submit reports for all tests and required corrective action and make reports available to the plumbing

authority when so requested by the authority.

3.10 CLEANING AND DISINFECTING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
3. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
4. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine and isolate (valve off) the system or part thereof and allow to stand for 24 hours or fill the system or part thereof with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate (valve off) and allow to stand for 3 hours.
5. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.
6. Submit water samples in sterile bottles to the health authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination. Consecutive bacteriological samples must be taken 24 hours apart before the water system is put into service.

B. Prepare reports for all cleaning and disinfecting activities.

3.11 COMMISSIONING

A. Fill the system. Check tanks to determine that they are not air bound and that the system is completely full of water.

B. Before operating the system, perform these steps:

1. Close drain valve, hydrants, and hose bibbs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings if recommended by and in accordance with pump manufacturer's requirements.
6. Test operation of backflow preventers in accordance with applicable American Society of Sanitary Engineering (ASSE) standards and utility company standards for service line installations

END OF SECTION 22 11 16

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SECTION 22 13 16

DRAINAGE AND VENT SYSTEMS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.

1.01 SUMMARY

- A. This Section includes building sanitary and storm drainage and vent piping systems, including drains and drainage specialties. The scope of drainage and vent systems is indicated on Drawings and schedules, and by requirements of this Section.

1.02 RELATED SECTIONS

- A. 23 05 53 - MECHANICAL IDENTIFICATION
- B. 23 07 00- MECHANICAL INSULATION

1.03 DEFINITIONS

- A. Drainage System: Includes all the piping within a public or private premise which conveys sewage, rain water, or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- B. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.04 SUBMITTALS

- A. Submit product data for the following products:
 - 1. Drainage piping specialties:
- B. Submit plumbing authority inspection reports.
- C. Submit test reports specified in Part 3.

1.05 QUALITY ASSURANCE

- A. Hydromechanical grease interceptors and automatic grease removal devices shall be designed and tested in accordance with ASME A112.14.3 Appendix A, ASME 112.14.4, PDI G101 or PDI G102.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store pipe in a manner to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of roof drains, flashing, and roof penetrations.
- B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.

- C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.
- D. Coordinate with installation of sanitary and storm sewer systems as necessary to interface with building drains.

1.08 EXTRA MATERIALS

- A. Maintenance Stock: Provide the Owner with any special tools or appurtenances required for the removal of cleanout plugs.

PART 2 – PRODUCTS

2.01 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Hubless cast iron pipe and fittings, service weight or heavier, American Society for Testing and Materials (ASTM) A-74, latest edition using neoprene sealing sleeves meeting specifications of ASTM C-564, and stainless steel mechanical joint couplings meeting specifications of ASTM C1277 (standard duty) or ASTM C1540 (heavy duty), latest editions. To be used for drain, waste, and vent piping above ground when manufactured in accordance with Cast Iron Soil Pipe Institute (CISPI) Standard 310, latest edition.

2.02 DRAINAGE PIPING SPECIALTIES

- A. Floor Cleanouts: Cast iron body and frame, with bronze or brass cleanout plug and adjustable round top. Provide nickel bronze top for areas with exposed concrete finishes; in all other areas provide tops suitable for the finishes intended for the area.
 - 1. Josam Co. #58460A series
 - 2. J.R. Smith Co. #4020 series
 - 3. Zurn Industries #Z-1400
- B. Wall Cleanouts: Cast iron body clean out tee adaptable to pipe with bronze or brass cleanout plug with tapping to accept wall cover. Round stainless-steel cover including screws.
 - 1. Josam Co. #58910 & 58600 series
 - 2. J.R. Smith Co. #4530 series
 - 3. Zurn Industries #Z-1446
- C. Floor Drain Barrier Type Trap Seal: ASSE 1072 certified commercial grade UV and ozone resistant plastic frame with rubber diaphragm to allow gray water flow and to seal the drain opening in the absence of flow.
 - 1. MIFAB MI-GARD.
 - 2. RectorSeal SureSeal.
 - 3. Precision Plumbing Products Pro-Drain Trap Seal.

2.03 AIR ADMITTANCE VALVES

- A. ASSE 1050 and 1051 compliant, ABS and PVC construction, sealing membrane with inside and outside screening to protect the membrane, and protective cover.
 - 1. Studor, Inc.
 - 2. Oatey

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- C. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PIPE APPLICATIONS

- A. Install cast iron soil pipe and fittings for above and below ground, within building, for all sanitary and storm piping services.

3.03 PIPE AND TUBE JOINT CONSTRUCTION

- A. Cast Iron Soil Pipe: Make hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

3.04 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications where applicable.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals specified in Division 23, "BASIC PIPING MATERIALS AND METHODS."
- H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, floors and assemblies, maintain the fire rated integrity.
- I. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90° shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited. A 4 inch by 3 inch water closet connection is

permitted.

- J. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Maintain swab or drag in line and pull past each joint as it is completed.
- K. Install building drain pitched down at minimum slope of 1/4 inch per foot (2%) for piping 2 1/2 inch and smaller, 1/8 inch per foot (1%) for piping 3 inch to 6 inch and 1/16 inch per foot (0.5%) for 8 inch and larger.
- L. Extend building drain to connect to building sewer piping, of size and in location indicated. Building sewer piping is specified in a Division 2 section. Maintain minimum 10 foot horizontal separation to the building water service line.
- M. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.
- N. Waste piping above any working, storage or eating surfaces in food service establishments shall be suitably protected to prevent contamination from leakage.
- O. Drainage piping shall not be installed or altered that creates a dead end (developed length of 2 feet or more) section of piping. Cleanout extensions and piping for future fixtures are not considered as dead ends.
- P. Insulate all piping and equipment in accordance with section 23 07 00 Mechanical Insulation.
- Q. Label piping and plumbing components in accordance with section 23 05 53

3.05 HANGERS AND SUPPORTS

- A. General: Refer to Division 23 Section, "HANGERS AND SUPPORTS".

3.06 INSTALLATION OF PIPING SPECIALTIES

- A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. Ensure that access is provided to the working parts for service and repair.
- B. Install expansion joints on vertical risers as indicated, and as required by the plumbing code.
- C. Cleanouts: Install cleanouts in drainage system piping as indicated, and:
 - 1. As required by plumbing code including clearances for rodding;
 - 2. At each change in direction of piping greater than 45°;
 - 3. At minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
 - 4. At base of each vertical sanitary or storm stack.
 - 5. At the building drain and building sewer junction (30 inches developed length from the exterior face of the building wall) or interior to the building within a 10 foot developed length of the junction.
- D. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as required. The Contractor shall provide pipe extensions as required to be flush with the finish surface. The Contractor shall also coordinate with all other trades to determine the appropriate floor finish and provide a floor cleanout cover compatible with the finish floor material.
- E. Coordinate the installation of access doors by the general contractor in non-accessible ceilings and at walls

where required to access concealed cleanouts.

3.07 INSTALLATION OF AIR ADMITTANCE VALVES

- A. Install air admittance valves in accordance with manufacturer's installation instructions and the plumbing code.
- B. Install air admittance valves in the vertical upright position after pressure testing of the drainage and vent system.
- C. Install air admittance valves in accessible and ventilated spaces to allow air to enter the valve.

3.08 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures, floor drains and trench drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.09 FIELD QUALITY CONTROL

- A. Inspections
 - 1. Do not enclose, cover, or put into operation the drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the authority having jurisdiction, at least 5 days prior to the time such inspection must be made. Perform tests specified below in the presence of the authority unless the inspection requirement is waived by the authority.
 - a. Underground Inspection: Arrange for inspection after trenches or ditches are excavated and bedded, piping is installed and before any backfill is put in place.
 - b. Rough-in Inspection: Arrange for inspection of the piping system after system is roughed-in and before concealed or closed-in and prior to setting fixtures.
 - c. Final Inspection: Arrange for a final inspection by the authority to observe the tests specified below if requested by the authority and to ensure compliance with the requirements of the plumbing code.
 - d. Other Inspections: Arrange for other inspections in addition to the above if requested by the authority.
 - e. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing authority.
 - 3. Reports: Submit inspection reports, signed by the authority having jurisdiction.
- B. Piping System Test: Test drainage and vent system in accordance with the plumbing code and the following:
 - 1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - 3. Rough Plumbing Test Procedure: Test the piping of plumbing drainage and venting systems upon

completion of the rough piping installation. Test with either water or, for piping systems other than plastic, by air.

- a. Water Test: Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during a minimum 1 hour test period. Test piping in sections as required to prevent pressurizing no hub couplings beyond the manufacturer's recommendations. Inspect all joints for leaks.
 - b. Air Test: Tightly close all openings in the piping system, and introduce air under pressure until there is a uniform pressure of 5 psig. Air pressure shall not drop during a minimum 1 hour test period.
4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be visually tested in sufficient detail to determine compliance with the plumbing code. When a smoke test is utilized, plug the stack openings on the roof and building drain where it leaves the building, and introduce a pungent, thick smoke with a smoke machine into the entire system and pressurize the system to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the 15 minute test period. Inspect all plumbing fixture connections for smoke leaks.
 5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
 6. Arrange for observation of tests by the authority having jurisdiction when so requested by the authority.
 7. Prepare and submit reports for all tests and required corrective action and make reports available to the authority having jurisdiction when so requested by the authority.

3.10 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, sediment buckets, trench drains and traps. Remove dirt and debris.

3.11 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 22 13 16

SECTION 230130

HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.03 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.05 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.
 - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
 - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.
- C. Cleaning Conference: Conduct conference with the owner and Engineer at the project site. Provide two weeks notice to all parties for scheduling.
 - 1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Visit the site and examine the existing conditions.
- B. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

- C. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2013.
- D. Prepare written report listing conditions detrimental to performance of the Work.
- E. Proceed with work only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- B. Provide and install new service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection. Locate service points on project documents as part of work planning and trade coordination. Follow specification 23 30 00 for products.
- C. Comply with NADCA ACR 2013, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.03 CLEANING

- A. Comply with NADCA ACR 2013.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:

The project area consists of three Air handling systems. All existing ductwork to remain is to be cleaned. All new ductwork is to be cleaned after construction is substantially complete.

 - 1. Air devices for supply and return air.
 - 2. Air-terminal units.
 - 3. Ductwork:
 - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
 - b. Return-air ducts to the air-handling unit.
 - c. Exhaust-air ducts.
 - 4. Air-Handling Units:
 - a. Interior surfaces of the unit casing.
 - b. Coil surfaces compartment.
 - c. Condensate drain pans.

- d. Fans, fan blades, and fan housings.
- 5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2013 and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2013).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous

surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2013.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2013).
- c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2013, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2013).
3. Coil drain pans shall be subject to NADCA ACR 2013, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.04 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2013, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Additional Verification:

1. Perform surface comparison testing or NADCA vacuum test.
2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

E. Verification of Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of design static pressure, the differential measured when the coil was first installed.
3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

F. Prepare a written cleanliness verification report. At a minimum, include the following:

1. Written documentation of the success of the cleaning.
2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
3. Surface comparison test results if required.
4. Gravimetric analysis (nonporous surfaces only).
5. System areas found to be damaged.

3.05 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2013, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 23 30 00 "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section
- D. 23 30 00 "Metal Ducts"
- E. Replace damaged insulation according to Section 23 07 00 "Duct Insulation."
- F. Ensure that closures do not hinder or alter airflow.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 23 01 30

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SECTION 23 05 00

BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 SUMMARY

- A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination Drawings.
 - 3. Record Documents.
 - 4. Maintenance Manuals.
 - 5. Coordination.
 - 6. Code Conformance.
 - 7. Manufacturers and Equals
 - 8. Guarantee

1.03 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTAL PROCEDURES."
- B. Provide product data and shop drawings for all equipment, trim, devices and materials. Submittals shall be project specific indicating all models, specialties and accessories intended to be provided. Clearly indicate the precise items submitted. Poorly prepared or reproduced submittals will be rejected.
- C. Provide complete coordination drawings.
- D. Provide installation instructions and operation and maintenance data for all equipment in a manual format.
- E. Provide complete "as-built" record document mechanical drawings.
- F. Provide complete copies of all air and water system testing, adjusting and balancing reports.

1.04 QUALITY ASSURANCE

- A. Secure and pay for all necessary fees, permits and approvals, as required for the work of Divisions 21, 22 and 23.
- B. Before commencing work, review the project with the Local and State inspectors. Conform, in every respect, with their separate recommendations, unless the recommendations are inferior to, or in conflict with, the Contract Documents, then Architect's/Engineer's acceptance will be required before proceeding with the work.

1.05 COORDINATION DRAWINGS

- A. Prepare coordination drawings in accordance with Division 1 Section "PROJECT COORDINATION," to a scale of 3/8"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where

space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of piping, ductwork, equipment, and materials. Include the following:
 - a. Clearances for installing and maintaining insulation.
 - b. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
 - c. Equipment connections and support details.
 - d. Exterior wall and foundation penetrations.
 - e. Fire-rated wall and floor penetrations.
 - f. Sizes and location of required concrete pads and bases.
 - g. Valve stem movement.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

1.06 RECORD DOCUMENTS

- A. During the progress of the work, the Contractor shall furnish and keep on file at all times a complete and separate set of black or blue line print record documents. Each shall be clearly, neatly and accurately noted, promptly, as the work progresses, all mechanical changes, revisions, additions, deletions and deviations from the work. Wherever the work was installed, otherwise than as shown on the Contract Drawings, the changes shall be so noted. In addition to the requirements specified in Division 1 section on "FACILITIES OPERATION", indicate the following installed conditions:
- B. Prepare record documents in accordance with the requirements in Division 1 Section "PROJECT RECORD DOCUMENTS." In addition to the requirements specified in Division 1, indicate installed conditions for:
 1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
 2. Mains and branches of piping systems, with valves, steam traps, and control devices located and numbered to correspond with installed tag numbers, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart, refer to Division 23 Section "MECHANICAL IDENTIFICATION." Indicate actual inverts and horizontal locations of underground piping.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Contract Modifications, actual equipment and materials installed.
- C. At the completion of the work, the Contractor shall submit these marked-up prints to the Architect/Engineer for his comments and/or approval. Final payment will be held until the record prints are received and approved by the Architect/Engineer.

1.07 OPERATION & MAINTENANCE MANUALS

- A. Prepare operation & maintenance manuals in accordance with Division 1 Section "FACILITIES OPERATION." In addition to the requirements specified in Division 1, include the following information for equipment items:
1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 4. Servicing instructions and lubrication charts and schedules.
 5. One complete set of non-reproducible (black or blue print) record documents.
 6. A copy of all of the satisfactorily reviewed product and equipment submittals.
 7. Valve and steam trap tag charts.
 8. Satisfactorily reviewed testing, adjusting and balancing report.

1.08 MANUFACTURERS AND EQUALS

- A. The manufacturer's products scheduled on the Drawings have been carefully reviewed and specified to satisfy the intent of the design. If there is a discrepancy between the scheduled product and the specification, the requirements listed in the specification have priority and must be complied with.
- B. Divisions 21, 22 and 23 specification sections may list comparable manufacturers as indicated for product requirements, subject to compliance with the requirements of the Drawings and specifications. Products by these listed alternate manufactures are not considered to be substitutions but must be of similar physical size, capacity, construction, quality, features, and performance characteristics as that of the scheduled manufacturers. It is the Contractor's responsibility to coordinate any connection or other changes if the Contractor elects to install one of the alternate manufacturers.
- C. Products by a manufacturer other than scheduled or specified as an alternative, will be considered substitutions. As a minimum, any proposed substitution must be of similar physical size, capacity, construction, quality, features, and performance characteristics as that of the scheduled manufacturers. In addition, the requirements of Division 1 Section "PRODUCT REQUIREMENTS" must be satisfied. The Contractor is responsible for the rearrangement of any work of his trade or any other trade to accommodate the proposed substitution. In general, substitutions will only be accepted if there is a demonstrated benefit to the Owner such as cost savings, energy savings, reduced maintenance, etc. The Contractor must clearly identify these benefits when submitting for a substitution in accordance with Division 1.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All materials and equipment shall be new and of the best quality and shall conform to standards and carry labels in every case where standards have been established.
- B. To the maximum extent possible, all mechanical equipment for any one system shall be the product of a single

manufacturer. Architect/Engineer reserves the right to disapprove and reject equipment from various manufacturers when acceptable components can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

- C. Following submittal approval, the Contractor shall not make equipment substitutions during the project for any reason without the approval of the Engineer. Any work requiring removal and re-installation due to the Contractor's failure to comply with this requirement shall be the responsibility of the Contractor with no additional cost to the Owner.

PART 3 – EXECUTION

3.01 SAFETY

- A. Contractor shall be responsible for proper protective and safety measures when working under the provisions of the Contract.

3.02 CODE CONFORMANCE

- A. General: Install all systems of Divisions 21, 22 and 23 sections in conformance with all applicable State of Massachusetts and City of Worcester codes in addition to all the specific codes and standards listed in the various Division 21, 22 and 23 sections.
- B. Codes include but are not limited to:
 - 1. 2015 International Building Code (IBC).
 - 2. 2015 International Existing Building Code (IEBC).
 - 3. 2015 International Mechanical Code (IMC).
 - 4. 2015 International Energy Conservation Code (IECC) with MA amendments.
 - 5. Code of Massachusetts (CMR) Regulations including but not limited to:

- 248 – Plumbing
 - 527 – Fire Prevention
 - 780 – State Building Code
 - NFPA-1
 - NFPA-13

3.03 PERFORMANCE

- A. Perform all work which is requisite and essential in completing the intended installation in the proper manner.
- B. The Drawings indicate the general arrangement of equipment, fixtures, piping, ductwork and other mechanical work. Field verification of all dimensions is required. Specifications and Drawings are for assistance and guidance, but exact locations, distances and levels shall be governed by actual field conditions. Piping runs and ductwork are shown diagrammatically only. Furnish, install and place in satisfactory condition, ready for operation, all mechanical items and all other materials needed for complete mechanical systems as indicated on the Drawings.
- C. If any departures from the Construction Documents are deemed necessary by Contractor due to obstruction encountered or otherwise required in order to furnish an efficient, complete and satisfactory installation, details of such departures and the reasons therefore shall be brought to the attention of Architect/Engineer. Do not make departures without prior approval of Architect/Engineer. Departures from the Construction Documents without the approval of the Architect/Engineer will be at the Contractors risk. Any corrections to the installation as a

result of these departures will be by the Contractor with no additional cost to the Owner.

3.04 PREPARATION

- A. The Mechanical Contractor is advised that equipment supplied by other Divisions is subject to change and may require different mechanical connections than is indicated on the Drawings. The Contractor shall review the installation requirements supplied by the equipment manufacturer prior to performing rough in and mechanical connections. Discrepancies shall be brought to the attention of the Architect/Engineer. Any work requiring removal and re-installation due to the Contractor's failure to review these documents shall be the responsibility of the Contractor with no additional cost to the Owner.

3.05 COORDINATION

- A. Layout all work at the site by consultation with other trades before installing work to eliminate any conflict between this work and work of other trades.
- B. The Drawings are schematic in nature, not all fittings, devices, offsets, etc. are shown. It is the responsibility of the Contractor to provide, in his original bid, all necessary equipment to provide a complete project. Any conflicts must be brought to the attention of the Architect/Engineer. Any work requiring removal and re-installation due to the lack of coordination shall be the responsibility of the Contractor with no additional cost to the Owner.

3.06 GUARANTEE

- A. Contractor shall guarantee all work and equipment installed under this Section of the Specifications against any defects (which may occur during one year period starting from day of final acceptance) (for the time period described in Division 1 specifications). Guarantee all other work and damage as a result of such defects. Coordinate with the General Contractor for requirements of guarantee.
- B. Replace any material and equipment prior to final acceptance, which is corroded or otherwise damaged through the failure to properly operate and maintain the installation during construction or testing.
- C. Keep the work in repair and replace any defective materials, equipment or workmanship upon notice from the Architect/Engineer or Owner's representative for a period of one year from date of acceptance.
- D. Materials or equipment requiring excessive service during the first year of operation shall be considered defective.
- E. Post on the equipment and give to the Owner, a list of phone numbers to call for servicing during emergency and guarantee periods.

END OF SECTION 23 05 00

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SECTION 23 05 05

ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.
- B. Division 26

1.02 SUMMARY

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are specified within the individual equipment specification sections and/or on the Drawings.

1.03 REFERENCES

- A. NEMA Standards MG 1: Motors and Generators
- B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment
- D. NEMA Standard KS 1: Enclosed Switches
- E. National Electrical Code (NFPA 70).

1.04 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.05 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.

PART 2 – PRODUCTS

2.01 MOTORS

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
 - 1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
 - 2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the

service factor range.

3. Two speed motors shall have two separate windings on poly phase motors.
4. Temperature Rating:
 - a. Motors without variable frequency speed drives: Rated for 40° C environment with maximum 90° C temperature rise for continuous duty at full load (Class B Insulation).
 - b. Motors with variable frequency speed drives: Rated for 40° C environment with maximum 115° C temperature rise for continuous duty at full load (Class F Insulation).
5. Starting capability: Frequency of starts as indicated by automatic control system, and not less than five evenly time spaced starts per hour for manually controlled motors.
6. Service Factor: 1.15 for poly-phase motors. For single phase motors, 1.4 for 1/20 to 1/8 HP, 1.35 for 1/6 to 1/3 HP, 1.25 for 1/2 to 1 HP.
- B. Explosion proof motor requirements are indicated on Drawings. Explosion proof motors shall meet requirements of NEC, Class 1, Division 1 or NEC, Class I, Division 2, as noted on the drawings.
- C. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
 1. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
 2. Bearings:
 - a. Ball or roller bearings with inner and outer shaft seals.
 - b. Re-greasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
 - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted.
 3. Enclosure Type:
 - a. Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation;
 - b. Guarded drip-proof motors where exposed to contact by employees or building occupants;
 - c. Weather protected Type I for outdoor use, Type II where not housed;
 4. Overload protection: Built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
 5. Efficiency:
 - a. Each Subtype I (per EISA of 2007) general purpose electric motor shall meet efficiency ratings as defined by NEMA MG 1-2006, Table 12-12. Motors shall be NEMA Premium® type and minimum efficiencies shall comply with the following tables:

OPEN DRIP PROOF MOTORS (ODP)			
HP	1200 RPM	1800 RPM	3600 RPM
1	82.5%	85.5%	77.0%
1.5	86.5%	86.5%	84.0%
2	87.5%	86.5%	85.5%
3	88.5%	89.5%	85.5%
5	89.5%	89.5%	86.5%
7.5	90.2%	91.0%	88.5%
10	91.7%	91.7%	89.5%
15	91.7%	93.0%	90.2%
20	92.4%	93.0%	91.0%
25	93.0%	93.6%	91.7%
30	93.6%	94.1%	91.7%
40	94.1%	94.1%	92.4%

TOTALLY ENCLOSED FAN COOLED MOTORS (TEFC) AND EXPLOSION PROOF (XP) MOTORS			
HP	1200 RPM	1800 RPM	3600 RPM
1	82.5%	85.5%	77.0%
1.5	87.5%	86.5%	84.0%
2	88.5%	86.5%	85.5%
3	89.5%	89.5%	86.5%
5	89.5%	89.5%	88.5%
7.5	91.0%	91.7%	89.5%
10	91.0%	91.7%	90.2%
15	91.7%	92.4%	91.0%
20	91.7%	93.0%	91.0%
25	93.0%	93.6%	91.7%
30	93.0%	93.6%	91.7%
40	94.1%	94.1%	92.4%

6. Each Subtype II (per EISA of 2007) general purpose electric motor shall meet efficiency ratings as defined by NEMA MG 1-2006, Table 12-11. Minimum efficiencies shall comply with the following tables:

OPEN DRIP PROOF MOTORS (ODP)			
HP	1200 RPM	1800 RPM	3600 RPM
1	80%	82.5%	-
1.5	84%	84%	82.5%
2	85.5%	84%	84%
3	86.5%	86.5%	84%
5	87.5%	87.5%	85.5%
7.5	88.5%	88.5%	87.5%
10	90.2%	89.5%	88.5%
15	90.2%	91%	89.5%
20	91%	91%	90.2%
25	91.7%	91.7%	91%
30	92.4%	92.4%	91%
40	93%	93%	91.7%

TOTALLY ENCLOSED FAN COOLED MOTORS (TEFC) AND EXPLOSION PROOF (XP) MOTORS			
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HP	1200 RPM	1800 RPM	3600 RPM
1	80%	82.5%	75.5%
1.5	85.5%	84%	82.5%
2	86.5%	84%	84%
3	87.5%	87.5%	85.5%
5	87.5%	87.5%	87.5%
7.5	89.5%	89.5%	88.5%
10	89.5%	89.5%	89.5%
15	90.2%	91%	90.2%
20	90.2%	91%	90.2%
25	91.7%	92.4%	91%
30	91.7%	92.4%	91%
40	93%	93%	91.7%

7. Power Factor: All motors 1 horsepower and larger shall have a minimum 90% power factor rating or shall be provided with capacitors as specified in this section to correct the power factor if the uncorrected power factor is less than 90%.
8. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features, nominal full load motor efficiency and similar information.

2.02 STARTERS, ELECTRICAL DEVICES, AND WIRING

- A. General: Except as otherwise indicated, provide motor controllers and ancillary components which comply with the manufacturer's standard materials, design, and construction in accordance with published product information, and as required for a complete installation.
- B. Combination Magnetic Starters: Full voltage non-reversing type with circuit protective device. Circuit protective devices shall be molded case motor circuit protector breakers for motors sized up to 10 horsepower, and fusible disconnect switches for motors sized larger than 10 horsepower. Circuit protective devices shall be rated for approximately 175% of the motor full load amperage. Fuses shall be dual element time delay type. Molded case circuit breakers shall have symmetrical interrupting capacity, rating to accommodate available short circuit current of the electrical system. Starters shall be 60 Hertz, be mounted in a NEMA rated enclosure suitable for the environment in which it is located, sized properly for the motor horsepower, voltage, and phasing. Minimum size shall be NEMA size 1. All starters shall be sized in accordance with the National Electric Code.
- C. Magnetic Starters: Starters shall be 60 Hertz, be mounted in a NEMA rated enclosure suitable for the environment in which it is located, sized properly for the motor horsepower, voltage, and phasing. Minimum size shall be NEMA size 1. All starters shall be sized in accordance with the National Electric Code.
- D. Provide magnetic starters with fused 120 volt control circuits and auxiliary contacts. Minimum size control transformers shall be 100VA. Provide each magnetic starter with auxiliary contacts, two normally open (NO) and two normally closed (NC). Furnish all combination starters with Hand-Off-Auto (HOA) switches and red pilot 'ON' lights. Bimetallic, isothermic type ambient compensated overload and relay shall be provided in each leg of the starters. Overload relays shall be NEMA Class 20 and sized so that their thermal characteristics closely parallel the motor thermal characteristics as determined from the motor nameplate. Overload relays shall be hand reset from the outside of the starter enclosure by an insulated reset button.
- E. Motor connections: Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.03 CAPACITORS:

- A. Features:

1. Individual unit cells
2. All welded steel housing
3. Each capacitor internally fused
4. Non-flammable synthetic liquid impregnant
5. Craft tissue insulation
6. Aluminum foil electrodes
7. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.

2.04 DISCONNECT SWITCHES

- A. Fusible switches: Fused, each phase; general duty; horsepower rated; quick-make / quick-break mechanism; dead front-line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as required.
- B. Non-fusible switches: For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as required. For equipment larger than 2 horsepower, switches shall be the same as fusible type.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 05 05

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BASIC MECHANICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:
 - 1. Wall and floor sleeves.
 - 2. Mechanical equipment nameplate data.
 - 3. Miscellaneous metals for support of mechanical materials and equipment.
 - 4. Miscellaneous lumber, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
 - 5. Joint sealers for sealing around mechanical materials and equipment.
 - 6. Firestopping materials for sealing mechanical penetrations in fire and smoke barriers, floors, and walls.
 - 7. Access doors.
- B. This Section covers the general execution requirements which are applicable to all mechanical work.
 - 1. Examination.
 - 2. Rough-ins.
 - 3. Mechanical Installations.
 - 4. Installation of Equipment.
 - 5. Cutting and Patching.
 - 6. Painting.
 - 7. Selective Demolition.
 - 8. Cleaning.
- C. Architectural items, structural items, electrical items and other related work are specified in other Sections which are not a part of Division 21, 22 and 23. The mechanical connections to these items or devices are specified in the appropriate Sections of Division 21, 22 and 23. Certain mechanical equipment is specified in other Divisions and is required to be furnished by equipment manufacturers.
- D. Division 21, 22 and 23 covers, in broad detail, the extent of the mechanical work and the equipment to be provided and shall not be construed as a complete description of all the details of design and construction required.
- E. Provide all labor, materials, equipment, articles, and tools and perform all work necessary for the complete execution of the mechanical work, as shown on the Drawings, required by the Specifications and work not specifically shown or specified, yet required to insure the design intent inherent in the work and to comply with all applicable codes and regulations.
- F. The Drawings are generally diagrammatic, intended to convey the scope of the work and indicate the general arrangement of equipment, ductwork and piping and approximate sizes and locations of equipment. Do not scale Drawings. Consult Architectural and Structural Drawings for space conditions.

1.03 SUBMITTALS

- A. Refer to Division 1 and Division 23 Section "BASIC MECHANICAL REQUIREMENTS" for administrative and procedural requirements for submittals.
- B. Submit product data on the following products:
 - 1. Access doors.
 - 2. Joint sealers.
 - 3. Firestopping materials.
- C. Submit shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
- D. Submit welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "QUALITY ASSURANCE" article of this Section.
- E. Submit schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "SUMMARY OF WORK."

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer for the installation and application of joint sealers, firestopping and access doors.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
- C. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- D. Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA, OSHA, AGMA and other generally accepted applicable standards. They shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation and all other conditions or operations. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means. Provisions shall be made for adequate lubrication with readily accessible devices.
- E. Ample clearance shall be provided for repairs, inspection and adjustment. Protruding members such as joints, corners and gear covers shall be finished in appearance. All exposed welds shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI, OSHA, and local industrial codes, including but not limited to, shaft guards on all rotating shafts.
- G. All mechanical work shall be performed by mechanics who are qualified to do such work and who are normally engaged in this type of work. Because of the complexity of the mechanical work, unskilled labor is not permitted.
- H. Fire-Resistance Ratings: Where a fire-resistance classification is required, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.
- I. Firestopping Materials: Firestopping materials must bear the UL label and UL test number. A copy of the test as well as the installation instructions must be included in the submittal.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Properly store all materials and equipment in accordance with the manufacturers' recommendations and as required to protect them from damage, deterioration and corrosion.
- C. Temporarily close all openings to prevent obstruction, damage or the intrusion of foreign materials.
- D. Deliver joint sealer and firestopping materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

1.06 PROJECT CONDITIONS

- A. Conditions Affecting Selective Demolition: The following project conditions apply:
 1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Environmental Conditions: Apply joint sealers and firestopping under temperature and humidity conditions within the limits permitted by the manufacturer. Do not apply joint sealers and firestopping to wet substrates.

1.07 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.
- B. Notify the Architect/Engineer at least 10 days prior to commencing demolition operations.
- C. Perform demolition in phases as specified, indicated or required.

PART 2 – PRODUCTS

2.01 WALL AND FLOOR SLEEVES

- A. Sheet Metal Sleeves (heavy): 16 gage galvanized sheet metal with pipe or Pittsburgh lock longitudinal joint.
- B. Steel Sleeves: Schedule 10, steel pipe, ASTM A53, Grade A.

2.02 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. Nameplate: For each piece of power operated mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

2.03 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.04 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 2 Common boards complying with WCLIB or AWP rules, or Number 2 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- B. Construction Panels: Plywood panels; APA C-D PLUGGED EXT, with exterior glue; thickness not less than 23/32 inches.

2.05 FIRESTOPPING

- A. General: Firestopping caulk, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application. All products shall be installed in the manner determined by the manufacturer as tested by an independent testing laboratory.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M Fire Protection Products.
 - 2. Spec Seal (Specified Technologies Inc.).
 - 3. Rectorseal Corporation.

2.06 ELASTOMERIC JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect/Engineer from manufacturer's standard colors.
- C. General Duty: One-part, neutral core silicone sealant of formulation indicated that is recommended for exposed applications on exterior and interior joints in vertical and horizontal surfaces of concrete, masonry, glass, aluminum, and steel.
- D. Wet Locations: Provide manufacturer's standard one part, mildew resistant, paintable silicone sealant that is recommended for exposed locations on interior ceramic tile, masonry, and metals in bathroom and shower room locations.
- E. Manufacturers:
 - 1. Dow Corning.
 - 2. General Electric.
 - 3. Ohio Sealants, Inc.
 - 4. Pecora Corp.
 - 5. Sonneborn.
 - 6. Tremco, Inc.

2.07 ACCESS DOORS

- A. Refer to Architectural specifications and coordinate access panel work with appropriate trades for all finished spaces.
 - 1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
 - 2. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
 - b. For gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For full-bed plaster applications: galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- B. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
- C. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- D. Locking Devices: Flush, screwdriver-operated cam locks.
- E. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co. Div., Alfab, Inc.
 - 2. J.L. Industries, Activar Inc.
 - 3. Karp Associates, Inc.
 - 4. Milcor Div., Hart & Cooley Inc.
 - 5. Nystrom, Inc.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Prior to performing work required under Division 21, 22 and 23, carefully inspect all existing conditions and the installed work of all other trades and verify that all conditions and all such work is complete to the point where the mechanical work may properly commence.
- B. Verify that mechanical work may be done in complete accordance with all pertinent laws, codes, regulations and the design.
- C. In the event of discrepancy, immediately notify Architect/Engineer.
- D. Do not proceed with the work in areas of discrepancy until all such discrepancies have been fully resolved.
- E. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers, firestopping and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to approved equipment submittals for rough in requirements.

- B. Coordinate rough in with the work of all other trades.
- C. Protect the work and close all openings until equipment and fixtures can be installed.

3.03 MECHANICAL INSTALLATIONS

- A. Layout all work at the site by consultation with other trades before installing work to eliminate any conflict between this work and work of other trades.
- B. Coordinate mechanical work, in advance, with other work. The installation of chases, openings, etc., required for mechanical equipment, shall be done at such time as to minimize the need for any subsequent cutting and patching. Prior to the ordering of any equipment, verify the location, type and characteristics of connections to be furnished.
 - 1. Verify all dimensions by field measurements.
 - 2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
 - 3. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 4. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 6. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form.
 - 8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
 - 9. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
 - 10. Install access doors where units are concealed behind finished surfaces.
 - 11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.04 INSTALLATION OF EQUIPMENT

- A. All equipment shall be installed true, level and in the location shown on the Drawings. Precision gauges and levels shall be used in setting all equipment.
- B. Equipment shall be erected in a neat and workmanlike manner on the foundations and supports at the locations and elevations shown on the Drawings, unless otherwise directed by the Architect/Engineer during installation.

- C. The equipment shall be brought to a proper level by wedges and shims. After the machine has been leveled and aligned, the nuts on the anchor bolts shall be tightened to bond the machine firmly into place against the wedges or shims.
- D. Furnish, install and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of equipment. These shall be of ample size and strength for the purpose intended.
- E. Anchor bolts shall be furnished and built into the concrete foundations.
- F. All equipment shall be installed in such a manner as to provide access for routine maintenance, including lubrication.
- G. Structural steel supports and miscellaneous steel required for supporting and/or hanging equipment and piping furnished under this Division, shall be provided and installed.
- H. All foundations, anchor pads, piers, thrust block, inertia blocks and structural steel supports shall be built to template and reinforced as required for loads imposed on them.
- I. Assume all responsibility for sizes, locations, and design of all foundations, anchor pads, piers, thrust blocks, inertia blocks, curbs and structural steel supports.

3.05 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "EXECUTION REQUIREMENTS." In addition to the requirements specified in Division 1, the following requirements apply:
 - 1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
- B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work.
 - 2. Remove and replace defective Work.
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents.
 - 4. Remove samples of installed Work as specified for testing.
 - 5. Install equipment and materials in existing structures.
 - 6. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
- C. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- E. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers.

3.06 PAINTING

- A. Any equipment or device that receives a factory coat of paint and is damaged during installation, must receive touch painting. Clean and paint to match original finish, all items scratched or otherwise damaged.

- B. Field painting requirements, other than as needed to repair damaged paint on anything with a factory coat of paint, will be covered in Division 9 section "PAINTING".

3.07 SELECTIVE DEMOLITION

- A. General: Demolish, remove, demount, and disconnect abandoned mechanical materials, fixtures and equipment indicated to be removed and not indicated to be salvaged or saved.
- B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged. The Owner reserves the right to retain any and all existing materials and equipment including all items not identified for salvage within the Contract Documents. Existing materials and equipment identified by the Owner to be retained shall remain the property of the Owner. The Contractor shall deliver all salvaged materials and equipment to a storage site as directed by the Owner.
- C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated or identified by the Owner to be salvaged.

3.08 INSTALLATION OF SLEEVES

- A. Applications:
 - 1. Install sheet metal sleeves for all pipes passing through non-fire rated dry wall partitions and walls.
 - 2. Install sheet metal sleeves for all ducts passing through floors and smoke rated walls and in walls constructed of concrete or masonry.
 - 3. Install steel pipe sleeves for all pipes passing through fire and/or smoke rated walls, and in walls constructed of masonry or concrete.
 - 4. Sleeves may be eliminated in walls when holes are cleanly cored or saw cut through solid concrete or masonry.
 - 5. Penetrations through exterior walls shall be sleeved with steel pipe.
- B. Sleeves poured in place shall have anchors welded to the outside of the sleeve to insure embedment in the concrete. All steel shall be painted one coat of a rust inhibitive paint.
- C. Sleeves shall be installed flush with the face of finished walls and ceilings; extend one inch above the level of finished floors.
- D. Where insulated piping and insulated, non fire dampered ductwork passes through fire rated floors and walls, stop insulation at barriers and fire seal sleeved hole fully to bare piping or duct with firestopping and, if necessary, filler material as specified in the firestopping manufacturer's tested assembly.

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.10 APPLICATION OF FIRESTOPPING AND JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply. Comply with recommendations of ASTM C 1193 for use of elastomeric joint sealants.

- B. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- C. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- D. Installation of Fire-Stopping Sealant: The Contractor must determine the penetration is of suitable size and is properly prepared for installation of the fire caulk. Install sealant, including forming, packing, and other accessory materials, to fill openings around mechanical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency. The Contractor must have, for reference on site, the testing laboratory written installation instructions specific to the installation being performed.

3.11 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.12 COORDINATION OF ACCESS DOORS PROVIDED BY OTHER SECTIONS

- A. General: The Mechanical Contractor must coordinate the installation of mechanical work with the installation of access doors. This will require that the Mechanical Contractor become familiar with architectural details in the Architectural Drawings. Mechanical equipment must be laid out so that the access panels as designed can serve their purpose.
- B. Coordinate installation of access doors at all locations and with adequate door size to provide the required access to mechanical system components including but not limited to, fire dampers, smoke dampers, volume dampers, valves, steam traps, controls devices and components, and equipment filters.
- C. Fire-rated access doors and frames shall be furnished for all locations where the doors are to be installed in a rated assembly. Refer to Architectural Drawings for locations of rated assemblies.
- D. All required access doors may not be indicated on the Architectural Drawings. Responsibility for access to all mechanical items is with the Mechanical Contractor and shall be coordinated with the General Contractor. Obtain approval from Architect before installation of access doors not shown on the Drawings or doors that are to be relocated from locations shown on Architectural Drawings due to relocation of equipment to be serviced. Failure to obtain this approval may necessitate rework at the installing Contractors expense.

3.13 CLEANING

- A. Protect equipment against mortar, dust, weather, etc., during construction and leave all equipment clean. Remove from the premises, all debris and unused material and leave premises in a clean and neat condition.
- B. Inspect all items of equipment thoroughly. Repair any items dented, scratched, or otherwise damaged in any manner and paint to match original finish. All items so repaired and refinished shall be brought to the attention of the Architect/Engineer for inspection and approval.

END OF SECTION 23 05 08

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SECTION 23 05 10

BASIC PIPING MATERIALS AND METHODS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes piping materials and installation methods common to more than one Section of Divisions 21, 22 and 23 and includes joining materials, piping specialties, and basic piping installation instructions.

1.03 SUBMITTALS

- A. Refer to Division 1 and Division 23 Section “BASIC MECHANICAL REQUIREMENTS” for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
 - 1. Escutcheons.
 - 2. Dielectric Unions and Waterway Fittings.
 - 3. Mechanical Sleeve Seals.
 - 4. Strainers.
- C. Quality Control Submittals (Welding)
 - 1. Contractor’s welding procedure specification (form WPS). Procedure shall be submitted on a WPS form as described in the ASME Boiler and Pressure Vessel Code. This procedure is intended to provide direction for the welder for making production welds to Code requirements.
 - 2. Contractor’s procedure qualification record (form PQR) for each welding procedure. The PQR is a record of the welding data used to weld test coupons for a WPS; a record of the variables recorded during the welding of the test coupons; and a record of the test results for the tested coupons.
 - 3. Individual welder’s performance qualification record (WPQ) for each WPS submitted by the Contractor and for each welder utilized on the Project.
 - 4. Certified welder, tack welder, and brazer names and identification marks.

1.04 QUALITY ASSURANCE

- A. Welder’s Qualifications: Welder certification test must be administered within twelve months prior to the commencement of work. Certifications are to be performed by an independent testing laboratory within twelve months prior to the commencement of work.
- B. Tack Welding: Tack welding may be performed by non-certified welders. All tack welds, whether performed by certified or non-certified welders, must be ground out and removed.
- C. No welding may take place until a satisfactory reviewed submittal is complete.
- D. Refrigeration piping shall conform to ANSI/ASHRAE Standard 15 “Safety Standard for Refrigeration Systems”.
- E. Brazing procedures for medical gas systems shall conform to NFPA 99.

- F. "Lead Free" Compliance: All plumbing valves used to convey or dispense water for human consumption shall meet the low lead requirements of NSF/ANSI 61 Annex G and NSF/ANSI 372 for <0.25% weighted average lead content in relation to the wetted surface area in accordance with the Federal "Reduction of Lead in Drinking Water Act" of 2011.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory applied plastic end caps on each length of pipe and tube, except for concrete, corrugated metal, hub and spigot pipe. Maintain end caps through shipping, storage and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
- C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Divisions 21, 22 and 23 for specifications on piping and fittings relative to that particular system.
- B. All pipe and fittings shall be fabricated in the USA or Canada.
- C. Elbows for all pipe sizes over 2" diameter shall be long radius type (1.5 the diameter to centerline of pipe). On Victaulic piping systems, standard radius grooved fittings are allowable.
- D. Use reducers, increasers, or reducing tees for change of pipe size. Bushings are not allowed.
- E. Forged steel branch connectors, per the limits set forth in Part 3 of this section, may be used to create branch connections in steel piping systems. All branch connectors shall be 3,000# fittings.
1. "Weld-O-Lets", "Thread-O-Lets", or "Sock-O-Lets".
 2. "Trans-O-Con"

2.02 JOINING MATERIALS

- A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- B. Brazing Materials: Comply with SFA-5.8, Section II, "ASME Boiler and Pressure Vessel Code" for brazing filler metal materials appropriate for the materials being joined. Copper- phosphorus alloy brazing filler metal; BcuP-5 (Staysilv), containing 15% silver (Ag), 5% phosphorus (P), remaining elements are copper (Cu).
- C. Soldering Materials: Soft solder shall be 95 1/2% tin, 4% copper and 1/2% silver. Silvabrite 100 or approved equal.
- D. Gaskets for Flanged Joints: Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried. Gasket type shall be spiral wound 304 stainless steel/graphite type for raised faced joints; NBR gaskets shall be used for flat faced joints. Red rubber gaskets are not allowed.

2.03 PIPING SPECIALTIES

- A. Escutcheons:
1. Steel Escutcheons: Chrome plated, stamped steel, hinged, split ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings. Where escutcheons are to be painted, furnish prime painted.
 - a. McGuire
 - b. Sanitary-Dash Mfg. Co.
 2. Plastic style snap on type escutcheons: Provide chrome plated for exposed finish areas, plain finish for mechanical rooms and areas which will be painted.
 - a. Split One (Sparta Tool and Manufacturing)
- B. Unions: Malleable-iron, Class 150 for steel piping systems and low-pressure service; cast bronze, 125 WSP for copper piping systems and low pressure service, hexagonal stock, with ball-and-socket joints, metal to metal bronze seating surfaces; female threaded ends.
- C. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
1. Elster Perfection
 2. Sioux Chief Manufacturing Co.
 3. Victaulic Co. of America
- D. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 20 mesh perforations. Provide strainers with 125 psi working pressure rating except 250 psi pressure rating for systems with operating pressures of 100 psig or greater.
1. Threaded Ends, 2" and Smaller: Cast iron body for steel piping systems and cast bronze body for copper piping systems, screwed screen retainer with centered blowdown fitted valve and pipe plug.
 2. Flanged Ends, 2½" and Larger: Cast iron body, bolted screen retainer with off center blowdown fitted with valve and pipe plug.
 3. Manufacturers:
 - a. Armstrong Machine Works.
 - b. Hoffman Specialty ITT; Fluid Handling Div.
 - c. Metraflex Co.
 - d. Spirax Sarco.
 - e. Victaulic (Grooved)
 - f. Watts Regulator Co.
- E. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
1. Thunderline Corp., Link-Seal
 2. Calpico, Inc., Pipe Linx
 3. Metraflex Company, MetraSeal

PART 3 – EXECUTION

3.01 GENERAL

- A. Inspection: Examine areas and conditions under which pipe and piping accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Installer.
- B. Coordination: It is the responsibility of the Contractor to coordinate the work of his trade with all other trades prior to the commencement of construction. Any conflicts must be brought to the attention of the Architect/Engineer. Any work requiring removal and reinstallation due to the lack of coordination shall be the responsibility of the Contractor with no additional cost to the Owner.

3.02 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.03 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾" ball valve with hose connection, cap and chain. Install vents at high points. Pitch water piping upward in direction of flow and arrange fittings to permit air to be vented to system high points or to expansion tank, and to permit complete drainage to low points. Use eccentric fittings where necessary.
- H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals, unless otherwise indicated.
- I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.
- J. Temporarily cover the open ends of all pipes not actively being installed and at the end of each work day to prohibit the influx of foreign materials.
- K. Arrange piping to provide adequate provision for thermal expansion and contraction to prevent undue strains on piping or apparatus connected. Arrange branches to take up motion or strain.
- L. Do not locate any piping over electrical equipment.

3.04 FITTINGS AND SPECIALTIES

- A. Use fittings for all changes in direction, at all branch connections, and for change in pipe size.
 - 1. The creation of new outlets from the run of straight copper pipe / tube using a mechanical tool to create the connection (i.e. 'T' Drill) is allowed only in non-pressure piping systems (i.e. gravity condensate).
- B. Remake leaking joints using new materials.
- C. Install dielectric fittings as follows:
 - 1. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems.
 - 2. Install dielectric waterway fittings to connect piping materials of dissimilar metals in wet piping systems.
 - 3. Bronze bodied valves and devices installed in steel piping systems do not require dielectric fittings when both connections are made with steel piping. Iron bodied valves and devices installed in copper systems require dielectric fittings.
- D. Install wye strainers on steam systems with the wye oriented horizontally. Install wye strainers immediately preceding steam traps with wye oriented vertically down. Install wye strainers for water systems with wye oriented vertically down.
- E. Welded forged steel branch connections ("Weld-O-Lets", "Thread-O-Lets", or "Sock-O-Lets") may be used to create branch pipe taps in steel piping systems when the main to branch size ratio (main size divided by branch size) is not less than three to one, and the maximum branch pipe size is 2-1/2" (See table below). Do not 'fish mouth' pipe to create branch piping runs.

Main Size	2-1/2"	3"	4"	5"	6"	8"
Max Branch	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"

- F. Reductions in pipe size made with eccentric reducers shall have the tops level for water piping and bottoms level for steam piping.
- G. Run all horizontal building drains at uniform pitch. Follow indicated lines generally, but make exact layout on the job to work actual fitting dimensions, align piping and avoid interferences.
- H. Mechanical Sleeve Seals: Install per manufacturer's recommended practices. Insure the structure penetration is properly sleeved, refer to Division 23, "BASIC MECHANICAL MATERIALS AND METHODS", and is properly sized. The sleeve must be clean and dry prior to installation. Mechanical sleeve seals to be installed at all exterior wall penetrations, below grade.

3.05 JOINTS

- A. Steel Pipe Joints:
 - 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint sealant (Rectorseal No. 5) or Teflon tape suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than three threads exposed.
 - 2. Pipe Larger Than 2": Weld pipe joints in accordance with ASME Code for "Power Piping," B31.1 or "Building Services Piping" B31.9 as required for the service type, pressures and temperatures of the application and per the contractor's Welding Procedure Specification (WPS).
 - a. Install weld neck flanges at all valves, appurtenances, and equipment with flange type connections.
 - 3. Flanged Joints: Clean flange faces and install gaskets. Align flange surfaces parallel. Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and

gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench. Do not mate flat face flanges with raised face flanges.

4. Grooved Joints 2-1/2" and larger: Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved couplings, fittings, valves and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by the grooved coupling manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

B. Non-ferrous Pipe Joints:

1. Brazed Joints: For copper tube and fitting joints, braze joints in accordance with the AWS "Soldering Manual", ASME Code for Pressure Piping B31.1 - Power Piping, ASME Code for Pressure Piping B31.9 - Building Services Piping, ANSI/ASHRAE Standard 15 "Safety Standard for Refrigeration Systems", the Contractor's tested Brazing Procedure Specification and the following:
 - a. Fill and allow a trickle flow of an inert gas (ie., nitrogen) through the pipe and fittings during brazing to prevent formation of scale. Caution must be exercised not to allow the inert gas to deplete the oxygen, causing asphyxiation.
 - b. Heat joints using oxyacetylene torch. Heat to proper and uniform brazing temperature.
 - c. After installation of piping, but prior to installation of outlet valves, blow lines clear with nitrogen.
2. Soldered Joints: For copper tube and fitting joints, solder joints in accordance with the AWS "Soldering Manual" and "The Copper Handbook". Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
3. Press Joints: Pipe ends shall be cut on a right angle (square) to the pipe. Pipe ends shall be reamed and chamfered, all grease, oil or dirt shall be removed from the pipe end with a clean rag. Visually examine the fitting sealing element to insure there is no damage, and it is properly seated into the fitting. Insert pipe fully into the fitting. Make a mark with a felt tip pen on the pipe at the face of the fitting. Always examine the tube to insure it is fully inserted into the fitting prior to pressing the joint. Press the joints using the fitting manufacturer's approved press tools. Press fittings shall be installed in accordance with the most current edition of the installation guidelines. Sealing element shall be verified for the intended use. Installers shall attend a fitting manufacturer's installation training class.
4. Copper and Brass Threaded Joint Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint sealant or Teflon tape suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than three threads exposed.
5. Flanged Joints: Clean flange faces and install gaskets. Align flange surfaces parallel. Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench. Do not mate flat face flanges with raised face flanges.

C. Polypropylene – Random Pipe Joints:

1. Install fittings and joints using socket-fusion weld joints. All fusion weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.
2. Fusion-weld tooling, welding machines, and devices shall be as specified by the pipe and fittings manufacturer.
3. Prior to joining the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer's specifications.
4. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.

D. Joints for other piping materials are specified within the respective piping system sections.

3.06 FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections. Test all pipe prior to the installation of insulation.

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SECTION 23 05 19

METERS AND GAUGES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.

1.02 SUMMARY

- A. This Section includes the following types of meters and gauges:
 - 1. Thermometers and fittings.
 - 2. Pressure gauges and fittings.
 - 3. Test Plugs.
- B. Meters and gauges furnished as part of factory fabricated equipment are specified as part of equipment assembly in other Division 21, 22 and 23 sections.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections:
 - 1. Product data for each type of meter and gauge showing manufacturer's figure number, scale range, accuracy ratings, connections sizes and arrangements, and accessories for each meter and gauge.
 - 2. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 23 Section 'BASIC MECHANICAL REQUIREMENTS.'

1.04 QUALITY ASSURANCE

- A. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

PART 2 – PRODUCTS

2.01 THERMOMETERS, GENERAL

- A. Accuracy: Plus or minus 1% of range span, or plus or minus one scale division to maximum of 1½% of range span.
- B. Scale range: Temperature ranges for services listed as follows (center of range shall be the scheduled fluid temperature):
 - 1. Domestic Hot Water: 30° to 240°F with 2° scale divisions.
 - 2. Domestic Cold Water: 0° to 100°F with 2° scale divisions.
 - 3. Heating Hot Water: 30° to 300°F with 2° scale divisions.
 - 4. Condenser Water: 0° to 160°F with 2° scale divisions.
 - 5. Heat Pump Water: 0° to 160°F with 2° scale divisions
 - 1. Chilled Water: 0° to 100°F with 2° scale divisions.
 - 2. Steam and Condensate: 50° to 400°F with 2° scale divisions.

2.02 BIMETAL DIAL THERMOMETERS

- A. Type: Direct mounted, bimetal type with adjustable angle feature for 360° rotation and 180° angle adjustment.
- B. Case: Hermetically sealed, 3" diameter case of welded stainless-steel construction with external adjustment.
- C. Bimetal coil, plastic window, white dial with black markings. Liquid filled where subject to vibration.
- D. Stem length as required to suit pipe size and insulation thickness if applicable, ½" NPT stem connection.
- E. Manufacturers, 3" Diameter Case:

	Non-filled	Filled
Ashcroft Inc.	#30EI60E series	#30EL60E series
Tertrice Co.	B8360 series	B8360 series
Weiss Instruments, Inc.	#3VBM series	#SF3VBM series

2.3 INDUSTRIAL LIGHT POWERED DIGITAL THERMOMETERS

- A. Adjustable-angle type stem, case of aluminum or high impact ABS plastic, aluminum stem, 0 to 140°F ambient operating temperature, 10 second update interval.
- B. Display shall be LCD with digits a minimum of 0.5-inch high with the following characteristics:
Resolution: 0.1 °F, Range: -40 to 300 °F, Sensor: Glass passivated thermistor.
- C. Acceptable Manufacturers:
 - 1. Tertrice Co., model SX9
 - 2. Wika Instrument Corp., type TI.D01
 - 3. Weksler Instruments, model AD**AFC

2.04 THERMOMETER WELLS

- A. Threaded Thermometer Wells: 304 stainless steel for steel piping systems, brass for copper piping systems, pressure rated to match piping system design pressure; with 2" extension for insulated piping and threaded cap nut with chain permanently (material to match well material) fastened to well and cap.
- B. Welded Thermometer Wells: Not permitted.

2.05 PRESSURE GAUGES

- A. Type: General use, ASME B40.1, Grade 1A, phosphor bronze bourdon tube type, bottom or center back connection to best suit installation.
- B. Case: Stainless steel, 2½" diameter.
- C. Connector: Stainless, ¼" NPS.
- D. Scale: White coated aluminum, with permanently etched markings.
- E. Accuracy: Plus or minus 1.6% maximum of range span.
- F. All gauges shall be liquid filled. Liquid fill for non-freezing applications shall be glycerin, freezing applications shall be silicone.
- G. Range: Conform to the following:

1. Vacuum: 30" Hg to 15 psi.
2. All fluids: 2 times operating pressure.

H. Manufacturers:

1. Ashcroft Inc. #251009SWL
2. Terice Co. #700LFSS
3. Weiss Instruments Inc. #LF252

2.06 PRESSURE GAUGE ACCESSORIES

A. Siphon:

1. Steam systems: Provide ¼" NPS iron pig tail siphons.
2. Water systems: ¼" NPS steel (for steel pipe) or brass (for copper pipe) nipple, length to allow minimum 3" beyond insulation cover.

B. Snubber

1. Steel piping systems: ¼" stainless steel
 - a. Ashcroft Inc. #112S
 - b. Terice Co. #872-5
 - c. Weiss Instruments Inc. #PSN-S
2. Copper piping systems: ¼" brass
 - a. Ashcroft Inc. #112B
 - b. Terice Co. #872-2
 - c. Weiss Instruments Inc. #PSN-B

C. Isolation Valve

1. Steel piping systems: 1/4" carbon steel ball or needle valve, gauge cocks not permitted.
2. Copper piping systems: 1/4" bronze ball or needle valve, gauge cocks not permitted.

2.07 TEST PLUGS

- A. Test Plugs shall be nickel plated brass body, with ½" MNPT connection and two self-sealing valve type core inserts, suitable for inserting a 1/8" OD probe assembly from a dial type thermometer or pressure gauge. Test plug shall have gasketed and threaded cap with retention chain or strap and a body length to extend 1" beyond piping insulation face. Pressure rating shall be 500 psig.

B. Core Material: Conform to the following for fluid and temperature range:

1. Oil and Gas, to 200°F maximum: Neoprene.
2. Air and Water, to 350°F: EPDM (Nordel).

C. Test Kit: Provide test kit consisting of one pressure gauge, gauge adapter with probe, two bimetal dial thermometers, and carrying case.

1. Dial Type Insertion Thermometers: Bimetal, stainless steel case and stem, 1" diameter dial, dust and leakproof, tapered end stem with nominal length of 5".

D. Manufacturers:

1. Peterson Products Co., Inc.

2. Sisco Manufacturing Co.
3. Trerice Co.
4. Watts Regulator Co.

PART 3 – EXECUTION

3.01 GENERAL

- A. Install thermometers, pressure gauges and test plug products and accessories in accordance with manufacturer recommendations.
- B. Install thermometers, pressure gauges and test plugs and accessories at locations as indicated on the Drawings.

3.02 THERMOMETERS INSTALLATION

- A. Install thermometers in vertical and tilted positions located on pipe at most readable position.
- B. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.03 INSTALLATION OF PRESSURE GAUGES

- A. Install pressure gauges in piping tee with pressure gauge valve, located on pipe at most readable position.
- B. Pressure Gauge Accessories: Install snubbers in liquid piping systems, siphons in steam piping systems.

3.04 INSTALLATION OF TEST PLUGS

- A. Test Plugs: Install in piping tee where required with adequate clearances for probe insertion. Secure cap.

3.05 ADJUSTING AND CLEANING

- A. Adjusting: Adjust faces of meters and gauges to proper angle for best visibility.
- B. Cleaning: Clean windows of meters and gauges and factory finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touchup paint.

3.06 CONNECTIONS

- A. Piping installation requirements are specified in other sections of Division 23. The drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
 1. Install meters and gauges in close proximity to equipment or system components to allow convenient observations without hindering servicing of equipment.

END OF SECTION 23 05 19

SECTION 23 05 23

HVAC VALVES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes general duty valves common to most mechanical (HVAC) piping systems.
- B. Special duty valves are specified in individual HVAC piping system specifications.

1.03 SUBMITTALS

- A. Refer to Division 1 and Division 23 Section “BASIC MECHANICAL REQUIREMENTS” for administrative and procedural requirements for submittals.
- B. Submit product data, including manufacturer, model number, body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

1.04 QUALITY ASSURANCE

- A. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
 - 3. Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.
- B. Storage: Use the following precautions during storage:
 - 1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 - (a)
 - 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 PRODUCTS

2.01 VALVE FEATURES, GENERAL

- A. Pressure and Temperature Ratings: As specified and required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Provide the following special operator features:
 - 1. Hand wheels, fastened to valve stem, for valves other than quarter turn. Operating force not to exceed 80 pounds.
 - 2. Lever handles on quarter turn valves 6" and smaller. Valves larger than 6" shall be equipped with gear drive operators.
 - 3. In mechanical spaces only, provide chain wheel operators, for valves 2½" and larger installed 96" or higher above finished floor elevation. Extend chains to an elevation of 60" above finished floor elevation.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. End Connections: As indicated in the valve specifications.
 - 1. Threads: Comply with ANSI B1.20.1.
 - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for cast copper alloy.
 - 3. Solder Joint: Comply with ANSI B16.18.

2.02 BALL VALVES

- A. Ball Valves, 2" and Smaller, Carbon Steel Body: rated for 150 psi SWP, 2000 psi WOG pressure for ¼" through 1", 1500 psi WOG pressure for 1¼" through 2"; two piece construction; with carbon steel body, standard (or regular) port, 316 stainless steel ball and stem, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, vinyl covered steel handle, threaded ends and extended stem for insulated piping.

Apollo	73A-14x series
Metso-Jamesbury	4000 series
Milwaukee Valve	20CSOR-N1
KF Contromatic, Div. of Circor Energy	7000-SS-LH-M3

- B. Ball Valves, 2" and Smaller, Bronze Body: rated for 150 psi SWP, 400 psi WOG non-shock; two piece construction; with bronze body, standard (or regular) port, 316 stainless steel ball and stem, replaceable 'Teflon' or "TFE" seats and seals, blowout-proof stem, vinyl covered steel handle, threaded or solder ends and extended stem for insulated piping.

	Threaded	Solder
Apollo	70-14x series	70-24x series
Stockham	T-285-BR-R-66	S-285-BR-R-66
Milwaukee Valve	BA-100S	BA-150S
Watts	LF-B-6080-G2	LF-B-6081-G2

- C. Low Point Drain Valves: Bronze body rated for 150 psi SWP, 400 psi WOG pressure; two piece construction; with bronze body, standard (or regular) port, B-16 chrome plated ball and stem, replaceable 'Teflon' or 'TFE' seats and seals, blowout-proof stem, vinyl covered steel handle. System end shall be thread or solder, opposite end shall be 3/4" hose connection with brass cap. Provide 1/2" inlet for pipe line sizes ≤1", 3/4" inlet for line pipe sizes >1".

	Threaded	Solder
Apollo	70-10x-HC series	N/A
Milwaukee Valve	BA-100H	BA-150H
Watts	FBV-3C-CC	FBVS-3C-CC

2.03 BUTTERFLY VALVES

- A. Steam Service: Hi-Performance butterfly valves, 2½" and Larger: MSS SP-67; ANSI Class 150 carbon steel body conforming to ASTM A 216, type WCB. Provide lever operators with locks for sizes 2" through 6" and gear operators with position indicator for sizes 8" through 24". Lug type, bi-directional valves with 316 stainless steel disc, 17-4 PH stainless steel shaft, filled (reinforced) TFE seats and TFE packing. Wafer type valves are not allowed.

Flowseal	1LA-121RTG
Metso-Jamesbury	Wafer Sphere #815-L-11-22HBXZ
WKM	DynaCentric #A5111-02-S02-11

- B. Water Service Flanged Joint Piping Systems: Commercial performance butterfly valves, 2½" and Larger; MSS SP-67; ANSI Class 150 cast iron body conforming to ASTM A 126 or ductile iron body conforming to ASTM A536. Provide lever operators with locks for sizes 2-1/2" through 6" and gear operators with position indicator for sizes 8" and larger. Lug type valves with aluminum bronze disc, 416 stainless steel shaft, EPDM seats. Wafer type valves are not allowed.

Center Line Series 200	#C1061352/5 & C2061352/5
Milwaukee Valve	CL223E & CL323E series
Watts	DBF-03-121-1 series

- C. Water Service, Grooved Joint with Mechanical Coupling Piping Systems: Commercial performance butterfly valves, 2 ½" and larger; ductile iron body and disc conforming to ASTM A-536 with heat fused coating of polyphenylene sulfide or epoxy coating, lever operators with locks for sizes 2 through 6 inches and gear operator for sizes 8" and larger, EPDM Grade E liner, grooved ends.

Victaulic	Vic-300
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2.04 CHECK VALVES

- A. Swing Check Valves, 2" and Smaller Bronze Body: MSS SP-80; rated for 125 psi SWP and 200 psi WOG non-shock, cast bronze body and cap conforming to ASTM B-62 or ASTM B-584; with horizontal swing, Y-pattern, brass or bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

	Threaded	Solder
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Crane	137	1342
Milwaukee Valve	509	1509
Watts	CVY	CVYS

- B. Swing Check Valves, 2" and Smaller Bronze Body: MSS SP-80; Class 300, cast bronze body and cap conforming to ASTM B-61; with horizontal swing, Y-pattern, bronze disc; and having threaded ends. Provide valves capable of being reground while the valve remains in the line.

Crane	76E
Milwaukee Valve	507
Stockham Valve & Fittings	B-375

- C. Swing Check Valve, 2" and Smaller, Ductile Iron: Ductile iron body, cap and disc conforming to ASTM A-536, stainless steel hinge pin and plug, 300 psi SWP, threaded ends.

Crane	346 ½
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- D. Swing Check Valve, 2½" and Larger, Cast Iron: MSS SP-71, class 250 cast iron body and cap, bronze (ASTM B-62) disc (≤3") or bronze faced iron disk (>3"), brass, bronze or stainless steel hinge pin.

Crane	39E
Milwaukee Valve	F-2970M
Stockham Valve & Fittings	F-947

- E. Spring Loaded Silent Check Valve, 2" and smaller: MSS SP-61; 300 psi non-shock pressure rating, 18-8 stainless steel construction throughout including guard cage, spring, valve disc, retaining ring and seat.

Durabla	BSS
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- F. Split Disc Non-Slam Wafer Check Valves: Cast iron body 125lb., ASTM A126-B, with replaceable EPDM seat, non-slam design, lapped and balanced twin bronze valve plates, 316 stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

Mueller	71-A-H-B-6-H
Technocheck	5050

2.05 BALANCING VALVE:

- A. 3/8" through 2", with solder NPT connections, metal brass copper alloy construction with a minimum of four, 360° rotations of handwheel for maximum setting.
- B. 2½" and larger, with flanged connections, cast iron body with all other parts of nonferrous copper alloy construction with eight or twelve 360° rotations of handwheel for maximum setting.
- C. Balancing valves to have provisions for measuring differential pressure, flow rates, flow temperature and air venting as an integral part of the valve body and be of the globe style, wye pattern design.
- D. Balancing valves shall provide 100% positive, leakproof shutoff against the same fluid pressure as the valve body pressure rating.
- E. Balancing valves to provide preset function with a locking device to prevent tampering and allow a return to the original setting after shutoff.

- F. Balancing valves shall have a graduated display for presetting. A drain/fill connection with integral stop valve shall be included.
- G. Balancing valves in sizes ½" to 2" NPT to be shipped in a container which shall be used as insulation after valve installation. The insulation to have a "R" value of 4.5.
- H. Balancing valve nominal ratings shall be 250 psi at 250°F.
- I. Provide manufacturer's preformed insulation covers when valves are installed in insulated piping systems.

Tour & Andersson	STAD & STAF
Armstrong	CBV-T & CBV-G
MEPCO	MPV series

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.
- B. Actuate valve through an open close and close open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.
- C. Examine threads on both the valve and the mating pipe for form (i.e., out of round or local indentation) and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.
- F. Replace defective valves with new valves.

3.02 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2" and Smaller: Solder or threaded ends.
 - 2. Copper Tube Size, 2-1/2" and Larger: Flanged.
 - 3. Steel Pipe Sizes, 2" and Smaller: Threaded end.
 - 4. Steel Pipe Sizes 2½" and Larger: Flanged for welded piping; grooved end for grooved mechanical couplings.

3.03 VALVE APPLICATIONS

- A. HVAC Water Systems, ≤210°F: Commercial performance cast iron butterfly valves, bronze bodied ball, globe, and check valves for copper piping systems. Carbon steel ball valves, bronze (≤2") or malleable iron (all sizes) check and globe valves, and commercial performance cast iron body butterfly valves for steel piping systems.

- B. Steam and (Gravity and Pumped) Condensate: Carbon steel ball ($\leq 2"$) and hi-performance carbon steel butterfly valves, bronze ($\leq 2"$) or malleable iron (all sizes) check valves.
- C. Non-slam check valves: Install at discharges of pumps.

3.04 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

VALVES – 2" AND SMALLER				
SERVICE	BALL	GATE	CHECK	GLOBE
HVAC Systems $\leq 210^{\circ}\text{F}$ Supply and Return	400 WOG (Bronze body) 2000 WOG (Steel body) $\frac{1}{4}"$ -1" 1500 WOG (Steel body) 1-1/4"-2"	125	150	125
≤ 15 psig Steam and Condensate Return	150 SWP	125	300	125
15 \rightarrow 75 psig Steam and Condensate Return	150 SWP	250	300	250
Pumped Condensate	400 WOG (Bronze body) 2000 WOG (Steel body) $\frac{1}{4}"$ -1" 1500 WOG (Steel body) 1-1/4"-2"	125	300	N/A

Note 1: Valve size may be extended to include $\leq 3"$ pipe line size.

VALVES – 2½" AND LARGER				
SERVICE	BUTTERFLY	GATE	CHECK	GLOBE
HVAC Systems $\leq 210^{\circ}\text{F}$ Supply and Return	150	125	150	N/A
≤ 15 psig Steam and Condensate Return	150	125	300	125
15 \rightarrow 75 psig Steam and Condensate Return	150	250	300	250
Pumped Condensate	150	125	300	N/A

3.05 VALVE INSTALLATIONS

- A. General Application: Use gate, ball, and butterfly valves for shut off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves for each item of equipment arranged to allow equipment isolation without system shutdown.
- D. Install valves in horizontal piping with stem at or above the center of the pipe.
- E. Install valves in a position to allow full stem and handle movement.
- F. Provide valve stem extensions when valves are installed in insulated piping systems.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Spring Loaded Silent and Split Disc Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Install drain valves at the low points of all piping systems.

3.06 CONNECTIONS

- A. Refer to Division 23 specification, "BASIC PIPING MATERIALS AND METHODS".
- B. Solder Connections:
 - 1. Close ball valves to the full closed position.
 - 2. Open gate and globe valves to full open position.
 - 3. Remove the cap and disc holder of swing check valves having composition discs.

3.07 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.08 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

END OF SECTION 23 05 23

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SECTION 23 05 29

HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This section includes the following:
 - 1. Horizontal piping hangers and supports.
 - 2. Vertical piping clamps.
 - 3. Hanger rod attachments.
 - 4. Building attachments.
 - 5. Saddles and shields.
 - 6. Miscellaneous materials.
 - 7. Pipe alignment guides.
 - 8. Anchors.
 - 9. Equipment supports.
- B. Related Sections:
 - 1. For spring isolation hangers refer to Division 23 section, "VIBRATION CONTROL".
 - 2. Refer to Division 23 section, "SEISMIC RESTRAINT FOR MECHANICAL SYSTEMS AND EQUIPMENT".

1.03 SUBMITTALS

- A. Product data, including installation instructions for each type of hangers and supports. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, piping system, and features for each required.
- B. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
- C. Maintenance data for engineered hangers and supports for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23 Section "BASIC MECHANICAL REQUIREMENTS."

1.04 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code – Steel."
- B. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of supports and anchors.

PART 2 – PRODUCTS

2.01 MANUFACTURED UNITS

- A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58, current edition.
- B. Pipe attachments shall have nonmetallic coating for electrolytic protection or shall be of copper construction where attachments are in direct contact with copper tubing.
- C. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow required travel.

2.02 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be one part cement to three parts sand, by volume, with minimum amount of water required for placement and hydration.

2.03 FINISHES

- A. All hangers and support components must be factory painted with manufacturer's standard primer.
 - 1. Exception: Any component that has a galvanized or epoxy finish does not need the factory standard primer.
- B. All hangers and components that are to be installed exposed to the weather must be provided with hot dipped galvanized finish per ASTM A123.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Review with the Architect substrates of questionable integrity prior to installation.
- C. Refer to division 23 section, "SEISMIC RESTRAINT FOR MECHANICAL SYSTEMS & EQUIPMENT".

3.02 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Install supports with maximum spacings complying with the most stringent of:
 - 1. MSS SP 69, latest edition.
 - 2. Applicable Mechanical and Plumbing Codes.
 - 3. The following schedule:

	Pipe Size	Steel Pipe	Copper Pipe	Cast Iron Pipe	PVC Pipe
Horizontal	$\leq 3/4"$	7'	5'	10'	4'
	1" – 1 1/4"	7'	6'	10'	4'
	1 1/2"	9'	8'	10'	4'
	2"	10'	8'	10'	4'
	2 1/2"	11'	9'	10'	4'

	≥3"	12'	10'	10'	4'
Vertical	All sizes: at every floor or as scheduled	12'	12'	10'	4'

- a. The above chart reflects PVC pipe spacing with 100°F fluid temperature. Higher temperatures may require closer spacings, refer to manufacturer's printed recommended spacings.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on field fabricated, heavy duty trapeze supports where possible. Where piping of various sizes are supported together by trapeze supports, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers. Where piping is supported with trapeze supports, install clamps or clips to keep lines in their relative lateral positions. Lines subject to thermal expansion shall be free to roll axially or slide on the piping support.
- C. Install building attachments within concrete or to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms
- D. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- E. Steel 'C' clamps (MSS type 23) are permitted for use with hangers supporting single pipes ≤2". Use malleable iron beam clamps (MSS type 19) or center beam hangers (MSS types 21, 22, 27, 28, 29, or 30) for single pipe hangers >2" and multiple pipe hangers
- F. Trapezes: Provide field fabricated or pre-manufactured.
 1. Field Fabricated, Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.
 2. Manufactured Steel Trapezes: Manufactured steel channel shapes of dimensions and gauge as required for loads carried per ASTM A570 GR 33 and A366 as manufactured by Unistrut or approved equal.
 3. Trapeze hangers shall be sized for all loads imposed on the trapeze and in accordance with all applicable codes.
 4. Where trapeze hangers support fire protection pipes, the trapeze must conform to the requirements of NFPA 13.
 5. Trapezes for exterior locations must be provided with a galvanized or rust inhibiting acrylic baked enamel finish.
- G. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- H. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated and specified pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- J. Uninsulated Piping: Provide adjustable clevis hangers, MSS Type-1. Provide steel for use with steel piping and copper for use with copper piping. For any other piping system, provide hangers of a compatible material.

3.03 INSULATED PIPING REQUIREMENTS

- A. Supports for steam and condensate return piping 2" and larger and heating hot water piping 3" and larger shall be provided with a slide support or saddle and roller hanger:
 - 1. Provide Teflon slide type supports MSS Type 35 or provide protection saddles MSS Type 39 with either adjustable roller hangers MSS Type 43 or single pipe rolls MSS type 41. Fill interior voids of saddles with segments of insulation that match adjoining pipe insulation
- B. Supports for piping lines 1-½" and larger and not provided with a slide or saddle and roller, shall be provided with a non-compressible insulation insert and shield:
 - 1. Hangers: Provide adjustable steel clevis hangers MSS Type 1 for insulated piping, sized for insulation outside diameter.
 - 2. Shields: Install G-90 galvanized steel protective insulation shields MSS type 40.
 - 3. Shields shall span an arc of 180°, minimum sizes as follows:

Pipe Size	Length	Thickness
¼" → 3 ½"	12"	18 ga
4"	12"	16 ga
5" → 6"	18"	16 ga
8" → 14"	24"	14 ga
16" → 24"	24"	12 ga
 - 4. Inserts: Install high compressive strength calcium silicate insert at hangers. Insert material shall be at least as long as the protective shield. Insert shall encompass at least the bottom 180° of the piping.
 - a. Where piping insulation includes a vapor barrier, the vapor barrier must be continuous over the non-compressible insert insulation.
- C. Supports for all insulated piping that does not require a slide or saddle and roll or non-compressive insert shall be provided with a protective shield that complies with above requirements for shields.

3.04 INSTALLATION OF ANCHORS

- A. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- B. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- C. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.05 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.
- B. Anchor to building substrate.
- C. Cold set in accordance with manufacturer recommendations.

3.06 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

- B. Grouting: Place grout under supports for piping and equipment.

3.07 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Grind smooth welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.08 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Touch Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
- C. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- D. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair finish to comply with ASTM A 780.

END OF SECTION 23 05 29

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SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.

1.02 SUMMARY

- A. Types of identification devices specified in this Section include the following:
 - 1. Plastic Pipe Markers.
 - 2. Plastic Tape.
 - 3. Plastic Duct Markers.
 - 4. Valve Tags.
 - 5. Valve Schedule Frames.
 - 6. Engraved Plastic Laminate Signs.
 - 7. Plastic Equipment Markers.
 - 8. Plasticized Tags.
 - 9. Adhesive Labels.
- B. Mechanical identification furnished as part of factory fabricated equipment is specified as part of equipment assembly in other Division 21, 22 and 23 sections.
- C. Refer to other Division 23 sections for identification requirements at central station mechanical control center; not work of this section.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required. Provide a list of the nomenclature as well as the color scheme intended for use for identification of pipe services.
- B. Schedules: Submit valve schedule for each piping system, typewritten and produced on Mechanical Contractor's letterhead or 8½" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves that are intended for emergency shutoff and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, include valve tag schedules in the Maintenance Manuals that include all of the valve schedules.
- C. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 1.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.
- B. Codes and Standards:
 - 1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PART 2 – PRODUCTS

2.01 PLASTIC PIPE MARKERS

- A. Snap-on or strap-on type vinyl markers with integral flow arrows and factory applied graphics.
- B. Insulation: Furnish ½" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 180° F or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- C. Adjust size of marker and letters to accommodate the outside diameter, including insulation, of the pipe identified. Follow the guidelines published in ANSI A13.1 for marker/lettering size and color.
- D. Lettering: Include in the submittal the manufacturer's standard preprinted nomenclature which best describes piping system in each instance, for review by the Architect/Engineer.
- E. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- F. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
 - 1. Brady (W.H.) Co.; Signmark Div. – Brady Snap-on & Strap-on Vinyl Pipe Markers
 - 2. Brimar Industries, Inc. – System #1 Pipemarkers
 - 3. Seton Name Plate Corp. - Setmark
- G. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
 - 1. Brady (W.H.) Co.; Signmark Div. – Self Sticking Vinyl Pipe Markers
 - 2. Brimar Industries, Inc. – E-Z Pipe Markers
 - 3. Seton Name Plate Corp. – Seton Code

2.02 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:
 - 1. Green: Cold air.
 - 2. Yellow: Hot air.
 - 3. Yellow/Green: Supply air.
 - 4. Blue: Exhaust, outside, return, and mixed air.
- B. Nomenclature: Include the following:
 - 1. Direction of air flow.
 - 2. Duct service (supply, return, exhaust, etc.).

2.03 VALVE TAGS

- A. Provide 19 gage polished brass valve tags with stamp engraved piping system abbreviation in ¼" high letters and sequenced valve and steam trap numbers ½" high, and with 5/32" hole for fastener.
 - 1. Provide 1½" →2" diameter tags, except as otherwise indicated.

2. Fill tag engraving with black enamel.

2.04 VALVE SCHEDULE FRAMES

- A. General: For each page of the schedule(s), provide frames of finished hardwood or extruded aluminum and plastic (lexan) panes. Secure with screws for secure, removable mounting on walls.

2.05 ENGRAVED PLASTIC LAMINATE SIGNS AND EQUIPMENT MARKERS

- A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color). Provide holes for mechanical fastening, except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Approximate size: 4½" x 6" for equipment.

2.06 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as required for proper identification and operation/maintenance of mechanical systems and equipment.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
- B. Location: Label all ducts in each penthouse and mechanical equipment room.
- C. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs.
- D. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.
- E. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.03 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot uninsulated pipes. Where additional bands are required to secure the marker to the (insulated) pipe, the band shall completely circumvent the pipe and lap itself by a minimum of 1".
- B. Locate pipe markers and color bands as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch, excluding short takeoffs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
 - 3. Near locations where pipes pass through walls or floors/ ceilings, or enclosures.
 - 4. At access doors, manholes and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced intermediately at maximum spacing of 25' along each piping run.

3.04 VALVE IDENTIFICATION

- A. General: Provide a valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, interior and exterior hose bibs, shut off valves at plumbing fixtures, HVAC terminal devices, and similar rough-in connections of end use fixtures and units. List each tagged valve in the valve schedules for each piping system.
- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
 - 1. Where more than one major machine room is shown for project, install mounted valve schedule(s) in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than a single machine room.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main control and operating valves.
 - 2. Fuel burning units including boilers, furnaces, heaters, stills, and absorption units.
 - 3. Pumps, compressors, chillers, condensers and similar motor driven units.
 - 4. Heat exchangers, coils, evaporators, cooling towers, heat recovery units and similar equipment.
 - 5. Fans, blowers, primary balancing dampers and mixing boxes.
 - 6. Packaged AHU central station units.
 - 7. Tanks and pressure vessels.

8. Humidifiers, water treatment systems, and similar equipment.

- B. Lettering Size: Minimum ½" high lettering for name of unit. Provide secondary lettering of β to ¾ of size of the principal lettering.

3.06 NON-POTABLE WATER OUTLET IDENTIFICATION

- A. General: Install engraved plastic laminate signs at each non-potable water hose connection, wall hydrant, faucet and similar type outlets. Secure signs to walls adjacent to the outlet with permanent adhesive.
- B. Lettering: Provide ½" high lettering which reads "CAUTION: NON-POTABLE WATER – DO NOT DRINK".

3.07 CONCEALED EQUIPMENT LOCATION IDENTIFICATION

- A. General: Install adhesive type labels on room side of suspended acoustical ceiling grid or other discrete locations as directed by Architect near access point for each major item of concealed mechanical equipment and as specified herein. Provide labels for the following concealed equipment:
1. Air terminals (VAV boxes).
 2. Control dampers.
 3. Toilet room water supply isolation valves.
 4. Cooking hood exhaust duct access doors.
- B. Lettering: Provide labels with 3/8" high lettering for unit tag number and with black lettering on white adhesive strip.

3.08 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device that has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 05 53

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this Section.
- B. Related Sections:
 - 1. Other Division 22 and 23 Sections specify balancing devices and their installation, and materials and installations of mechanical systems.

1.02 SUMMARY

- A. This Section specifies the requirements and procedures for total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid (hydronic and air) quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. Also included is verification of system construction integrity and where noted, controls system performance verification and sound measurements.
- B. Test, adjust, and balance the following mechanical systems:
 - 1. All air systems, including NC level verification.
 - 2. All hydronic (water) systems, including Pressure independent control valve flows.

1.03 DEFINITIONS

- A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:
 - 1. The balance of air and water distribution;
 - 2. Adjustment of total system to provide design quantities;
 - 3. Electrical measurement;
 - 4. Verification of performance of all equipment and automatic controls;
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the system's major or entire fluid flow.

- I. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.
- K. Branch: Duct or pipe serving a single terminal.

1.04 QUALITY ASSURANCE

A. Contractor Qualifications:

- 1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- 2. The independent testing, adjusting, and balancing agency shall be certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project.
- 3. In lieu of satisfying the requirements of section 1.4.A.2, the contractor need not be certified, but rather, have a minimum of ten years experience with similar projects. The contractor shall provide suitable evidence of past performance, including references, justifying the firm's capabilities. This does not relieve the contractor from the provisions stipulated in section 1.4.B

B. Codes and Standards:

- 1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
- 2. AABC: "National Standards For Total System Balance".
- 3. ASHRAE: ASHRAE Handbook, HVAC Applications, latest edition, "Testing, Adjusting, and Balancing".

C. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with representatives of the installers of the mechanical and controls systems. The objective of the conference is final coordination and verification of system operation, readiness for testing, adjusting, and balancing, and to establish procedures for mechanics to be available to perform incidental remedial work

1.05 SUBMITTALS

A. The first submittal, to be made in a timely manner to allow review by engineer in advance of commencement of actual testing and balancing. The first submittal shall consist of the following:

- 1. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.
- 2. Sample Forms: Submit sample forms of each type required for the project.
- 3. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.
- 4. Contractor qualifications:
 - a. NEBB certificate.
 - b. AABC certificate.

- c. Project portfolio illustrating ten years of experience; project names and references
- B. The second submittal, to be made after the first submittal has been satisfactorily reviewed, shall be made after the balancing work has been performed.
 - 1. Certified Reports: Submit testing, adjusting, and balancing reports bearing the signature of the test and balance lead technician. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured to establish normal operating values of the systems. Final reports shall be type written, organized and formatted as specified below.
 - 2. Report Format: Report forms shall be those included in the first submittal for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in a reinforced, vinyl binder. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Air Systems
 - c. Hydronic Systems
 - d. Temperature Control Systems
 - e. Special Systems
 - 3. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project; including addresses, contact names, and telephone numbers. Provide a listing of the instruments used for the procedures along with the proof of calibration.
 - b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC or NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
 - 4. Refer to Part 3 for additional documentation requirements.

1.06 PROJECT CONDITIONS

- A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.07 SEQUENCING AND SCHEDULING

- A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS (Not Used).

PART 3 - EXECUTION

3.01 PRE-BALANCE PROCEDURES

A. General Procedures

1. Obtain design Drawings and Specifications and become thoroughly acquainted with the design intent.
2. Obtain copies of satisfactorily reviewed shop drawings of all air handling equipment, outlets (supply, return, and exhaust), pumps, coils, terminals and temperature control diagrams.

B. Air System Procedures

1. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.
2. Check filters for cleanliness.
3. Check lubrication of all motors and bearings.
4. Check fan belt tension.
5. Check fan rotation.

C. Water System Procedures

1. Verify all strainers have been cleaned.
2. Examine hydronic systems and determine if water has been treated and cleaned.
3. Check pump rotation.
4. Set automatic fill valves for required system pressure.
5. Check expansion tanks to determine that they are properly charged.
6. Check that the system is completely full of water.
7. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
8. Check lubrication of all motors and bearings.
9. Verify glycol systems are 50% glycol.

3.02 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.
- B. Provide instruments meeting the specifications of the referenced standards.
- C. Use only those instruments that have the maximum field measuring accuracy and are best suited to the function being measured.
- D. Apply instrument as recommended by the manufacturer.
- E. Use instruments with minimum scale and maximum subdivisions and with proper scale ranges for the value being measured.

- F. When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 5%. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.
- G. Take all reading with the eye at the level of the indicated value to prevent parallax.
- H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- I. Take measurements in the system where best suited to the task.

3.03 GENERAL TESTING, ADJUSTING, AND BALANCING REQUIREMENTS

- A. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- B. Patch insulation, ductwork, and housings, using materials identical to those removed.
- C. Seal ducts and piping, and test for and repair leaks.
- D. Seal insulation to reestablish integrity of the vapor barrier.
- E. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- F. As part of the scope of this specification section, the Contractor shall make any changes in the pulleys, belts, or sheaves, as required, for correct balance at no additional cost to the Owner.
- G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- H. Retest, adjust, and balance systems a second time if required for "comfort" balance.

3.04 AIR SYSTEM BALANCING PROCEDURE

- A. Prepare individual schematic drawings of each air system.
- B. Perform a system profile of all air systems indicating on the previously developed sketch the pressure drop of each air handler component, including the inlet and discharge plenums.
- C. Artificially load the air filters in air handling units to simulate the midpoint resistance. Balance the duct distribution system when in this mode.
- D. Determine best locations in main and branch ductwork for most accurate duct traverses. Establish overall fan flow at or above design point.
- E. Establish airflow at all terminal inlets and outlets at design point. If necessary, adjust main fan speed to deliver more air. Determine leakage based on difference between main system traverse and sum of terminal inlets and outlets.
- F. Verify fan and motor operating characteristics and compare to manufacturer's fan curve.
- G. Where air systems have a variable speed drive, set at 90% speed and adjust sheaves to deliver required air at this speed.
- H. Prepare schematic diagrams of system "as-built" ductwork to facilitate reporting.

3.05 HYDRONIC SYSTEM BALANCING PROCEDURE

- A. Initiate balancing with discharge balance valve full open to allow full flow to system.
- B. Through a global control system command or other means, force all terminal and coil control valves to full open position.
- C. Establish flow at all terminals and coils at design point. If system includes a diversity factor, proportionally balance all terminals and coils.
- D. Where hydronic systems do not have variable speed drives, adjust discharge balance valve at pump as required to achieve design flows.
- E. Where hydronic systems have a variable speed drive, maintain discharge valves in full open position and allow VFD to maintain proper pump speed and flow.

3.06 VARIABLE VOLUME AIR TERMINAL UNITS

- A. Through a global control command or other means, start balancing process with VAV dampers in 90% open position. Balance the medium pressure ductwork to provide 100% of the required air flow and pressure to satisfy each of the VAV boxes either through balance dampers upstream of VAV or through adjustment of controller linkage.
- B. Where diversity has been taken in the sizing of the main air system, provide a proportional balance of the VAV terminals. Room terminal must be balance with VAV terminal delivering full design flow.
- C. After medium pressure (upstream of VAV) system is balanced, establish design flows at supply room terminals.

3.07 AUTOMATIC WATER FLOW CONTROL VALVES

- A. For equipment using pressure independent automatic control valves (ie Reheat coils), provide flow measurements for all valves using ultrasonic measurement. Use P&T ports across calibrated orifices on valves if available. Verification of proper system differential pressure to operate the valves is required.

3.08 REVIEW SYSTEM CONSTRUCTION INTEGRITY

- A. General Ductwork Review: Review all ductwork for general conformance with Drawings. Identify fittings that do not comply with Drawings and Specifications and may be causing excessive pressure drop or noise.
- B. Ductwork Sealing: Generally, review and document the entire duct system to verify that system has been sealed to SMACNA seal class A standards (all seams, joints, and penetrations sealed).
- C. Diffuser Duct Connections: Review and document that the connection to all diffusers meets standard details on Drawings. Verify and document that flexible ductwork does not exceed maximum specified length and that joints between flex and rigid ductwork are secure. Verify that a hard elbow or sufficient straight duct has been installed at all diffusers per standard detail on Drawings.
- D. VAV Duct Connections: Review and document that the duct inlet to VAV terminals is correct and meets requirements for straight duct diameters based on Drawing standard detail and manufacturer's recommendation.
- E. Fire Damper Access/Operation: Review and document fire dampers have been installed in the correct and locked position. Verify and document that all dampers will slide freely to closed position and are not blocked by screws, etc. Verify and document that there is sufficient access to all dampers.
- F. Heating and Cooling Terminal Units: Review and document the installation of heating and cooling terminal units. Note that units are installed level, drain pan has proper slope, and fan operation is unrestricted.

3.09 CONTROLS COMMISSIONING

- A. General: The testing and balancing subcontractor or other entity independent of the controls installer must

perform this work. Coordination with the controls installer is required. The general intent is to take field measurements and make other observations to verify that the control system is calibrated and operating properly.

- B. Air Handling Units: Provide a field measurement to confirm the control system calibration of all temperature sensors, humidity (including enthalpy) sensors, pressure sensors, and flow sensors. Include sensors mounted beyond the AHU such as outside air temperature sensors, duct static pressure sensors, etc. Perform this work in the presence of the controls installer. Record the measured value and observe and record the value sensed by the control system.
- C. Hydronic Heat Exchangers: Provide a field measurement to confirm the control system calibration of all temperature sensors, pressure sensors, and flow sensors (where included). Perform this work in the presence of the controls installer. Record the measured value and observe and record the value sensed by the control system.
- D. VAV Terminal Units: On all VAV terminal units, manually operate thermostat and observe that damper reacts in a proper manner to a call for cooling and that reheat valve responds to a call for heat. Where room sensors do not have manual control, use a hair dryer or other means to force a control system reaction.
 - 1. On all VAV terminal units, provide a field measurement to confirm the control system calibration at room temperature sensors, and unit flow sensors. Perform this work in the presence of the controls installer. Record the measured value and observe and record the value sensed by the control system.
- E. Heating/Cooling Terminal Units: On all heating/cooling terminal units, manually operate thermostat and observe that control valve and fan (where included) reacts in a proper manner to a call for heating or cooling. Where room sensors do not have manual control, use a hair dryer or other means to force a control system reaction.
 - 1. On all heating/cooling terminal units, provide a field measurement to confirm the control system calibration of room temperature sensors. Perform this work in the presence of the controls installer. Record the measured value and observe and record the value sensed by the control system.

3.10 NOISE MEASUREMENTS

- A. Measure and report noise levels in those rooms listed below. Perform test with mechanical systems off to determine background levels and with mechanical system in the normal full load condition. Provide data in 8 octave bands, and indicate the associated NC curve and A weighted average.
 - 1. Provide noise level measurements in the following rooms:
 - a. All project locations, by office/open office area, and including MDF/IDF and Document storage. NC level not to exceed 35 in any areas.

3.11 RECORD AND REPORT DATA

- A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.
- B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.
- C. Modify standard forms or provide additional forms to record construction integrity results, controls commissioning results, and noise level results where these tasks are included as part of this specification.

END OF SECTION 23 05 93

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SECTION 23 07 00

MECHANICAL INSULATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.

1.02 SUMMARY

- A. Extent of mechanical insulation required by this Section is indicated on Drawings and by requirements of this Section.
- B. Types of mechanical insulation specified in this Section include the following:
 - 1. Piping & Plumbing Systems Insulation:
 - 2. Ductwork System Insulation:
 - 3. Equipment Insulation:
- C. Refer to Division-23 section “HANGERS AND SUPPORTS” for protection saddles, protection shields, and thermal hanger shields.
- D. Refer to Division-23 section “METAL DUCTWORK AND ACCESSORIES” for duct linings.
- E. Refer to Division-23 section “MECHANICAL IDENTIFICATION” for installation of identification devices for piping, ductwork, and equipment.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.
- B. Code Compliance: Submit manufacturers' code compliance data for 2-hour fire resistive rated kitchen grease duct enclosure systems.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 10 years.
- B. Installer's Qualifications: Firms with at least 5 years successful installation experience on projects with mechanical insulation systems similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.
- D. Energy Code: Insulate ductwork and piping systems in accordance with requirements of the applicable energy conservation standards.
 - 1. International Code Council Evaluation Service (ICCES).

2. 2015 International Mechanical Code (IMC).
3. ASTM E-84 Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E-814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 – PRODUCTS

2.01 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1, 'k' = 0.29 @ 150°F mean temperature. Provide with All Service Jacket (ASJ) with self-sealing lap. ASJ shall be white kraft bonded to aluminum foil, fiberglass reinforced and with PVC covers at fittings.
- B. Pipe fitting covers shall be one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations. Fiberglass inserts shall be provided with the PVC cover.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Johns Manville Products Corp.
 - b. Knauf Insulation GmbH.
 - c. Owens-Corning Fiberglas Corp.
- C. Staples and Adhesives:
 1. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
 2. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.02 PVC PIPE INSULATION COVER

- A. Provide 20 mil PVC sheets and pre-molded fitting covers to match. Provide in color selected by architect.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. Johns Manville Products Corp., Zeston 300 Series or Ceel-Co 300 Series PVC

2.03 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, Class B-4, 0.75 PCF density, out of package 'R' = 5.1 @ 1.5" thickness, 75°F mean temperature. Provide with Fiberglass reinforced foil and paper (FSK) facing with self-sealing lap or provide fully tapped seams.
 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. CertainTeed Corp.

- b. Johns Manville Products Corp.
 - c. Knauf Insulation GmbH.
 - d. Owens-Corning Fiberglas Corp.
- B. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1, 6.0 PCF density, 'R' = 6.6 @ 1.5" thickness, 75°F mean temperature. Provide with Fiberglass reinforced foil and paper (FSK) facing with self-sealing lap or provide fully tapped seams.
 - 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville Products Corp.
 - c. Knauf Insulation GmbH.
 - d. Owens-Corning Fiberglas Corp.
- C. Other Requirements:
 - 1. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
 - 2. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.04 EQUIPMENT INSULATION MATERIALS

- A. Rigid Fiberglass Equipment Insulation: ASTM C 612, Class 1, 6.0 PCF density, 'R' = 6.6 @ 1.5" thickness, 75°F mean temperature.
 - 1. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville Products Corp.
 - c. Knauf Insulation GmbH.
 - d. Owens-Corning Fiberglas Corp.
- B. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard.
- C. Equipment Insulation Finish: Provide a trowel or glove grade water based general purpose mastic suitable for interior or exterior applications. Color shall be white or light gray.
- D. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

2.05 EXTERIOR DUCTWORK WEATHERPROOF COVER

- A. Self adhering cover: Membrane shall be a pre-manufactured, foil-faced, self-adhering product with a UV resistant, stucco embossed facing. Water vapor transmission of the installed product shall be 0.020 perms or less. Product shall be suitable for continuous use in low temperatures of -10°F. Product is intended to be applied over fiberglass insulation.
 - 1. Manufacturers
 - a. Alumaguard 60, Polyguard Products, Inc.
 - b. Flex-Clad 400, MFM Building Products Corp.
 - c. Venture Clad, Venture Tape Corp.
- B. Insulation/Cover System: As an alternative to providing fiberglass insulation with the above specified covers,

exterior ductwork may be insulated with a thermoplastic rubber faced, closed cell elastomeric insulation system.

1. Manufacturers

a. Armacell ArmaTuff Plus

PART 3 – EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 HVAC AND PLUMBING PIPING INSULATION

- A. Insulate all HVAC and plumbing piping systems installed within the conditioned envelope of the building with fiberglass insulation (unless an alternative material is indicated) with thicknesses according to the following schedule:

Fluid Design Operating Temperature, °F	Minimum Pipe Insulation Thickness					
	Nominal Pipe Diameter (inches)					
	Runouts (≤4 ft, ≤1")	<1	1 → <1- ½	1-½ → <4	4 to <8	8 and up
>350	2.5	4.5	5.0	5.0	5.0	5.0
251→350	1.5	3.0	4.0	4.5	4.5	4.5
201→250	1.5	2.5	2.5	2.5	3.0	3.0
141→200	1.0	1.5	1.5	2.0	2.0	2.0
96→140	0.5	1.0	1.0	1.5	1.5	1.5
61→95	0	0	0	0	0	0
40→60(Note 5)	1.0	1.0	1.0	1.5	1.5	1.5
40→60(Note 6)	0.5	0.5	0.5	1.0	1.0	1.0
<40	1.0	1.0	1.0	1.5	1.5	1.5

- Where piping systems operate at differing temperatures (such as 2-pipe fan coil unit piping and water-side economizer condenser water piping, for example), insulation must be selected based on the worst case for all conditions and relative to both thermal and vapor condensation requirements.
- For piping installed outside the conditioned envelope, increase all indicated insulation thicknesses by 1.0 inch.
- Insulate cold condensate drains from refrigeration and air conditioning drain pans with 1" thick elastomeric insulation.
- Refrigerant piping shall be insulated as follows:
 - Indoor Refrigerant Piping: Insulate all refrigerant piping with 1-½" elastomeric insulation.
 - Exterior Refrigerant Piping: Insulate cold refrigerant lines (lines between evaporator and compressor) with 1-½" elastomeric insulation.
- Provide indicated thicknesses for mechanically chilled or cooled services.
- Provide indicated thicknesses for domestic cold-water service.

- B. Plumbing piping system insulation omitted on chrome plated exposed piping (except for handicapped fixtures), air chambers, unions, buried piping, fire protection piping, and pre-insulated equipment.
 - 1. Special Application Requirements: Insulate the following plumbing piping systems with fiberglass insulation:
 - a. Interior above-ground horizontal storm water piping, 1" thickness.
 - b. Plumbing vents within 6 lineal feet of roof outlet, 1" thickness.
 - 2. Special Application Requirements: Insulate all exposed piping under ADA compliant lavatories with a white, fitted antimicrobial pipe cover complying with ASME A112.18.9. Cover shall be designed to allow access to the stop valves. Covers shall have a flame spread index of not more than 25 and a smoke developed index of not more than 450 when tested in accordance with ASTM E 84.
 - a. Pro-Extreme; Plumberex Specialty Products
- C. HVAC piping system insulation shall be omitted on steam traps, on condensate piping between steam trap and union, hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; and on unions.

3.03 DUCTWORK SYSTEM INSULATION

- A. Ductwork installed within the conditioned envelope of the building (this includes above ceilings, within MER's and in chases) shall be insulated as follows. All duct insulation shall be flexible type except all ductwork exposed in MER's shall be rigid and all insulation on outside air ductwork and plenums in all locations shall be rigid. Exposed ductwork in finished spaces shall not be insulated.
 - 1. Supply air ductwork where minimum temperature is $<65^{\circ}$, provide 1-1/2" insulation with vapor barrier.
 - 2. Supply air ductwork where maximum temperature is $>85^{\circ}$, provide 1-1/2" insulation.
 - 3. Outside air ductwork and any associated plenums, provide 1-1/2" insulation.
 - 4. Exhaust ductwork that has been cooled by heat recovery, provide 1-1/2" insulation with vapor barrier.
 - 5. Exhaust ductwork and plenums from building envelope penetration to exhaust air motorized damper, provide 1-1/2" insulation.
- B. Ductwork installed in attics, crawl spaces or other protected spaces exposed to ambient temperature conditions:
 - 1. All supply air that is heated or cooled, all return air, any outside air that has been heated by heat recovery, and any exhaust air must be provided with 2" rigid insulation. Provide with vapor barrier where air in duct can be below 65°F .
- C. Ductwork exposed to exterior (such as ductwork installed exposed on the roof):
 - 1. All supply air that is heated or cooled, all return air, any outside air that has been heated by heat recovery, and any exhaust air must be provided with 2" rigid insulation. Coordinate with requirements for insulation cover/jacket.
 - 2. Provide 1-1/2" rigid or elastomeric insulation on any ductwork that is to receive a weatherproof cover to serve as a backing for the installation of the weatherproof cover. Coordinate with requirements for insulation cover/jacket.

3.04 EQUIPMENT INSULATION

- A. Application Requirements: Insulate the following cold (below ambient) equipment. Insulation may be field or

factory installed.

1. Refrigeration equipment, including chillers and tanks.
 2. Drip pans under chilled equipment.
 3. Cold water storage tanks.
 4. Water softeners.
 5. Cold and chilled water pumps.
 6. Roof drain bodies.
 7. Air separators.
- B. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
1. Fiberglass: 2" thick for cold surfaces above 35°F and 3" thick for surfaces 35°F and lower. Provide a vapor barrier cover of cloth and mastic or aluminum cover.
 2. Elastomeric: 3" thick for surfaces above 35° F and 4½" thick for surfaces 35°F and lower.
- C. Application Requirements: Insulate the following hot (above ambient temperature) equipment. Insulation may be field or factory installed.
1. Boilers.
 2. Hot water storage tanks.
 3. Water heaters.
 4. Heat exchangers.
 5. Air separators.
 6. Hot water pumps.
 7. Fuel oil heaters.
 8. Flash tanks.
- D. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
1. Fiberglass: 2" thick.
 2. Calcium Silicate: 3" thick except 4½" thick for low-pressure boilers and steam-jacketed heat exchangers.

3.05 INSULATION COVER/JACKET

- A. A vapor barrier jacket must be provided on all insulated piping, ductwork, or equipment whose operating temperature is less than 65°F or where otherwise specified.
1. Piping with elastomeric insulation does not require an additional vapor barrier.
- B. A weatherproof cover must be provided for all insulated and un-insulated ductwork that is exposed to the weather.
1. Exception: Ductwork that is stainless steel, aluminum, copper, or coated with a non-corrosive and UV resistant material, and does not otherwise require insulation.
- C. All piping w/ insulation that is exposed to the exterior must be protected with an aluminum pipe insulation cover.
- D. Provide a weather proof cover as specified for ductwork to protect any equipment insulation that is exposed to the weather.
- E. Where specifically indicated, provide a PVC cover for pipe insulation. Permanently seal all joints with a solvent welding adhesive in accordance with the manufacture's recommendations. In wet locations, make all joints drip proof; locate longitudinal joints in horizontal piping on the side of the pipe with the open edge of the seam turned down to shed water. Provide PVC insulation cover in the following locations:

3.06 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Do not install insulation on pipe systems until installation of heat tracing, painting, testing, and acceptance of tests have all been completed.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Special care must be made to maintain the vapor barrier at PVC fittings in cold piping systems.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations. At fire rated construction seal penetration with appropriate fire-stop for insulated piping systems to maintain fire rating.
- H. Cover exposed ends of fiberglass with a vapor retardant mastic.
- I. Elastomeric Insulation:
 - 1. Exterior elastomeric insulation shall be installed with the longitudinal seam on the bottom of the pipe and shall be protected with an ultra violet resistive paint.
 - 2. Glue the butt ends of insulation to each other to form a homogenous membrane maintaining the vapor barrier.
- J. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and over staples and seal joints with 3" wide vapor barrier tape or band.

3.07 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where penetrations go through fire rated construction.

3.08 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment and breechings/stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover fiberglass insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance including metal vessel covers, fasteners, flanges, frames and accessories.

3.09 EXISTING INSULATION REPAIR

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.

3.10 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.11 WEATHERPROOF COVERS

- A. Follow manufacturer's written directions for installation weatherproof cover products.

END OF SECTION 23 07 00

SECTION 23 08 00

HVAC COMMISSIONING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Purpose:

1. Verify operation and functional performance of HVAC systems for compliance with Design Intent, and compliance with DCAMM Landlords Improvement Specification 201844000.1
2. Document HVAC tests and inspections.
3. Schedule and conduct in a classroom setting training program which will include operation and maintenance of all mechanical equipment and controls.
4. Verify applications of operation and maintenance manuals, as-built (record) documents, spare parts, listing, special tools listing and other items as may be specified herein for support of HVAC systems and equipment.

B. General: Furnish labor and material to accomplish complete HVAC commissioning as specified herein. Complete interim commission of HVAC systems during winter season operation and follow-up commissioning of required HVAC systems during summer season operation.

C. Job Conditions: Commissioning is to begin by meeting with other trades and collecting necessary information such as as-built drawings, shop drawings, Operation and Maintenance Manuals, construction documents, etc.

D. Coordinate and renew the testing and balancing process.

1.02 QUALITY ASSURANCE

A. Reference: ASHRAE Guideline for HVAC commissioning, GPC-001.

1.03 DOCUMENTATION

A. The HVAC Commissioning Authority shall obtain the following.

1. Project plans and specifications (contract documents), authorized revisions, as-built drawings, HVAC shop drawings and submittals (approved), Test and Balance report, equipment start-up and certification reports, instrument calibration reports, etc.

1.04 SUBMITTALS

A. Submit to the Owner for review prior to starting the commissioning process.

1. Commissioning Plan (see typical plan herein, describe extent and delivery schedule).
2. Training Plan (describe extent of plan, expected duration of training, personnel involved, schedule, etc.).
3. Tool List

1.05 RESPONSIBILITIES OF OTHERS

General Contractor shall verify completeness of the building envelope, perimeter and interior items that effect proper operation and control of HVAC equipment and systems.

- A. The General Contractor will assure participation and cooperation of specialty contractors (electrical, mechanical, TAB, building management, etc.) under his jurisdiction as required for the commissioning process.
- B. Contractors Specialty: The contractor will be responsible for providing labor, materials, equipment, etc., required within the scope of his specialty to facilitate the commissioning process. The contractor will perform tests and verification procedures required by the commissioning process when requested.
- C. Owner/Operator: Owner/Operator will schedule personnel to participate in HVAC commissioning process.
- D. Owner/Operator will advise regarding changes in building occupancy and/or usage.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION

- A. Provide all instrumentation necessary for performing tests.

PART 3 – EXECUTION

3.01 PROCEDURE

- A. Prepare and submit to Owner after contract award, HVAC Commissioning plan which shall outline:
 - 1. Responsibility of each trade affected by HVAC Commissioning, as required by appropriate section of this specification.
 - 2. Requirement for documentation as listed elsewhere herein.
 - 3. Requirements for documentation of HVAC tests and inspections.
 - 4. Requirements for the HVAC Commissioning program during specified operational season, part and full loads as further delineated under "HVAC Commissioning" heading in this section.
 - 5. Format for training program for operation and maintenance personnel.

3.02 EXECUTION

- A. HVAC Commissioning shall begin after HVAC equipment and systems, along with related equipment, systems, structures and areas are complete.
 - 1. Verify TAB readings, such as:
 - a. Supply and return air flows and pressures
 - b. Fan performance
 - c. Hydronic performances
 - d. Branch duct readings
 - e. Refrigeration side performance
 - 2. Verify calibration of thermostats, pressure sensors and related controls, such as:
 - a. Terminal unit boxes
 - b. Damper settings
 - c. Valve positions
 - 3. Verify readings of remote data and facility management control systems, such as:
 - a. Static pressure
 - b. Temperature

- c. Air flow
 - d. Damper positions
 - e. Water pressure
 - f. Water temperature
 - g. Water flow
4. Verify operation of system modes, such as economy cycle, and in specific:
- a. Terminal unit tracking
 - b. Damper and fan operation
 - c. Smoke detector and damper response
 - d. Zone response
 - e. Variable speed pumps and fans
 - f. Lead lag operation
 - g. Safety controls
5. Verify that total HVAC system is performing to provide conditions as outlined below (For both seasons and under part and full load).
- a. Temperature
 - b. Humidity
 - c. Air Changes
 - d. Air Movement
 - e. Air quality
 - f. Zone Control
 - g. Energy Management
 - h. Pressurization
 - i. Control response

3.03 SUPPLY, RETURN, EXHAUST AIR FANS

A. Prior to functional Performance Test:

- 1. Fans in place, grouted, vibration isolation devices functional, blowers balanced and rotation verified.
- 2. Power available with motor protection, safeties, control systems and interlocks functional.
- 3. Duct system pressure tested, cleaned and report submitted. Dampers in plane and operational properly.
- 4. Pressure and temperature gauges installed and functional.
- 5. Air balance complete with design maximum flow, pressure obtained and report submitted.
- 6. FMS functional and fully connected.

B. Personnel present during functional performance test:

- 1. General Contractor, Mechanical Contractor, Controls Contractor, Electrical Contractor.
- 2. Owner's representative.

C. Functional performance test: Contractor shall demonstrate operation of fans per specifications including the following for each fan:

- 1. Activate fan start using control system command.

2. Verify pressure drop across coils and filters, filter is clean. Verify fan inlet/outlet pressure readings, compare to Test and Balance Report, fan design conditions and fan manufacturer's performance data. Operate fan at 50% and 100% load. Plot test readings on fan curve. Verify specified CFM is obtained.
3. Verify motor amperage each phase and voltage phase to phase and phase to ground.
4. Check and report unusual vibration, noise, etc.
5. Where fans operate parallel, both fans are to be checked separately and together Perform steps a-d.
6. In terminal unit systems, check pressure sensor operation and modify setting optimum energy efficiency.

D. Results:

1. Report results obtained in 3 above.
2. If specified equipment performance is not verified, report remedial action required and re-schedule Functional Performance Test.

E. Reports:

1. Submit reports of functional performance test (item 3 above) to Owner.

3.04 PUMP PERFORMANCE

A. Prior to Functional Performance Test

1. Pumps in place, grounded vibration isolation devices functional, pump alignment and rotation verified.
2. Power available with motor protection, safeties, control system contractors and interlocks functional.
3. Piping system pressure tested, cleaned, chemical water treatment complete and report submitted. Cooling tower basin filled and chemically treated.
4. Pressure and temperature gauges installed and functional.
5. Water balance complete with design maximum flow, pressures obtained and report submitted.
6. FMS functional and fully connected.

B. Personnel present during functional performance test:

1. General Contractor, Mechanical Contractor, Controls Contractor, Electrical Contractor.
2. Owner's representative.

C. Functional performance test: contractor shall demonstrate operation of pumps per specification including the following:

1. Activate pump start using control system command.
2. Verify pressure, drop across strainer, verify strainer is clean. Verify pump inlet/outlet pressure reading, compare to Test and Balance Report, pump design conditions, and pump manufacturer's performance data. Operate pump at shut-off, 50% and 100% flow. Plot test readings on pump curve. Verify specified flow is obtained.
3. Verify motor amperage each phase and voltage phase to phase and phase to ground.

4. Check and report unusual vibration, noise, etc.
5. For dual pumps, the above shall be done for each pump separately and where the system is designed for both pumps operating simultaneously, the above shall be done for simultaneous operation.
6. Verify control sequence of operation.

D. Results:

1. Report results obtained in 3 above.
2. If specified equipment performance is not verified, report remedial action required and re-scheduled Functional Performance Test.

E. Reports

1. Submit reports of functional performance test (item 3 above) to engineer.

3.05 TERMINAL UNIT DEVICES AND DUCTWORK PERFORMANCE

A. Prior to Functional Performance Test:

1. All terminal unit boxes are in place, ducted, connected to control systems, reheat coil, piping complete.
2. Ductwork complete, as-built shop drawings submitted, duct pressure and leakage test complete.
3. Duct static pressure sensor installed, calibrated and transmitting correct signal to fan speed controller, DDC controls system operational with input/output from each terminal unit box and thermostat verified, local controller functional and monitoring FMS functional.
4. Smoke/fire dampers installed as required with access, verify status as to open/closed position.
5. Test and balance operation is complete including each terminal unit box calibrated for maximum/minimum flow settings, low pressure duct and devices balanced at maximum flow conditions, heating terminal unit boxes fan speed setting/air flow adjusted

B. Personnel present design demonstration:

1. General Contractor and Mechanical, Controls and Electrical Contractor.
2. Owner's representative.

C. Functional Performance Test: Contractor shall demonstrate operation of terminal unit boxes as per specifications including the following:

1. Cooling only terminal unit boxes: with system supply air pressure available verify the following on each box:
 - a. Terminal unit box response to room temperature setpoint adjustment, at local controller and FMSC. Changes to be 78°F to 68°F, 72°F and 82°F.
 - 1) Check damper max/min flow settings.
 - b. Verify damper actuator response to control input changes and rate of response. Record room temperature change, rate of change and overshoot/undershoot of desired temperature.
 - c. Verify tracking when there is a corresponding terminal unit exhaust.

2. Cooling/heating terminal unit boxes: With system as described in item A) above perform all cooling only tests as noted. In addition, for space heating required demonstrate the following:
 - a. Terminal unit box response to sensor call for heating via setpoint adjustment, local controller and FMSC head end changes. Changes to be warmup from 55°F to 68°F, from 68°F to 74°F. Verify cooling circulate air, and upon further drop in space temperature (T-stat activation, deactivation and shut off on loss of air flow. Loss of air flow to demonstrated by interrupting interlock or manual air vane flow sensor adjustment. Record room temperature change, rate of change and overshoot/undershoot of setpoint temperature.
 - 1) Verify control sequencing and connection to FMS.
 - 2) Verify tracking response to companion unit.
3. Exhaust air terminal unit boxes: With system exhaust air pressure available, verify the following on each box:
 - a. Check damper max/min flow settings.
 - b. Verify damper actuator response to control input changes and rate of response.
 - c. Verify damper actuator response to control input changes and rate of response. Verify room pressure and tracking response of companion units.

D. Results:

1. Report results obtained in 3 above.
2. If specified equipment performance is not verified, report remedial action required and re-schedule Functional Performance Test.

E. Reports:

1. Submit reports of Functional Performance Test item 3 above to Engineers.

3.06 FMS/BMS POINT AND DYNAMIC PERFORMANCE

A. Prior to functional performance test:

1. All devices and sensors installed.
2. All wiring complete
3. Software programming complete and "debugged".

B. Personnel present during testing:

1. General Contractor and Mechanical Testing and Balancing Contractor, Controls and Electrical Contractors and Engineer, Control Contractor.
2. Commissioning Authority,
3. Owner's Representative.

C. Performance Test

1. Point Verification
 - a. Document that each terminal device functions properly.
 2. DI, DO devices automatically or manually tripped and at correct parameter.
 3. Analog Points: Document each AI point for correct FMS signal through full span of range, using actual temperature, pressure, etc. Artificially created.
 - a. Each AO point corresponds to FMS signal and controlled device functional through full span.
- D. Dynamic Test
1. Test each sub-sequence of all system components.
 2. Test total system sequence. All components shall work in a coordinated, dynamic, interactive total system manner as defined in sequence of controls.
 3. Test all emergency power sub-system components and generator start-up sequence.
- E. Reports
1. Submit Point Verification Report. Report shall include forms documenting:
 - a. Device Tag
 - b. Function
 - c. Date
 - d. System (Pump P-#, etc)
 - e. Type (AO, AI, DO, DI)
 - f. Model Number
 - g. Setpoint
 - h. Range
 - i. Input Signal (DI)Output Signal (DO)Input signals vs. Range (AI)
 - j. Output signals vs. Range (AO)
 - k. Test Participant Sign-off
 - l. Comments
 2. Dynamic Test Report
 - a. Submit dynamic test report indicating successful compliance with sequence of control. Identify the following:
 - 1) Specified sequence of control.
 - 2) Start up sequence
 - 3) full load run
 - 4) applicable demand limiting sequence
 - 5) Applicable emergency power sequence.
 - 6) Auto back-up equipment start-up upon failure sequence.
 - 7) Applicable fire alarm sequence.
 - 8) Shut-down sequence.
 - 9) "Off condition"
 - 10) Energy monitoring accounting process
 - 11) Signature of attendees.
 - 12) Comments

3.07 REPORTS

A. Prepare and submit to the Owner the following reports

1. Interim report: Submit after completion of initial commissioning. Report shall outline tests performed, comparison to TAB and other agency tests, and verification of compliance with "Design Intent" for ambient conditions under which initial commissioning was performed.
2. Final Report: Submit after completion of seasonal commissioning. Report shall compare and verify performance of HVAC equipment and systems during each seasonal commissioning process with data obtained during initial commissioning.
3. Verify compliance of HVAC systems with "Design Intent" for year around seasonal operation.

END OF SECTION 23 08 00

SECTION 23 21 13

HYDRONIC PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes piping systems for hot water heating, chilled water cooling, condenser water, make-up water for these systems, condensate drain piping, or any other HVAC water and/or glycol piping system. Piping materials and equipment specified in this Section include:
 - 1. Pipes, fittings, and specialties;
 - 2. Special duty valves;
 - 3. Hydronic specialties.
 - 4. Cleaning and water treatment chemicals.
 - 5. Pre-insulated underground hydronic piping, couplings, termination fittings and installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 23 Section “BASIC PIPING MATERIALS AND METHODS” for additional specifications and products which are common to multiple piping systems.
 - 2. Division 23 Section “HVAC VALVES” for valves.
- C. Test reports specified in Part 3 of this Section.
- D. Pre-insulated underground hydronic piping installation and testing certification as specified in Part 3 of this Section.

1.03 SUBMITTALS

- A. Product Data: Include rated capacities of selected models, operating weights, furnished specialties and accessories, flow and pressure drop curves, and installation instructions for each of the following:
 - 1. Pipe, including the intended use.
 - 2. Pipe fittings, including the intended use.
 - 3. Air vents (automatic and manual).
 - 4. Cleaning and water treatment chemicals and glycol.
- B. Reports and Certifications: Provide signed reports and certifications documenting test conditions, installation acceptance, treatment chemicals, concentrations and observations for the following:
 - 1. Pressure tests report for hydronic piping systems within buildings.
 - 2. Chemical treatment report for hydronic systems at completion of chemical treatment work.

- C. Grooved joint couplings and fittings product data shall specifically identify the applicable Victaulic style or series designation.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: comply with the provisions of the following:
1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 2. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
 3. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.
 4. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

PART 2 – PRODUCTS

2.01 PIPE, FITTING, AND JOINT MATERIALS

- A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of where the below materials are used.
- B. Annealed Temper Copper Tubing:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≤3"	B88 copper	Type L, drawn
Fittings	≤3"	Wrought copper or cast bronze	ANSI B16.22 & B16.18
Bolts	Per flange standard	A193, grade B7 carbon steel	Hex head (ANSI B18.2.1), B1.1, class 2A course thread
Nuts	Per flange standard	A194, Grade 2H, Carbon steel	Heavy hex (ANSI B18.2.2), B1.1, class 2B course thread
Gaskets	Per flange standard	1/16" Compound fiber	

- C. Steel Pipe: Threaded and welded ends.

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	all sizes	A53, grade B, type S or E	Schedule 40, ANSI B36.10
Fittings	≤2"	A197, Malleable Iron A126, class B cast iron	Standard, threaded, ANSI B16.3 (MALLEABLE) OR B16.4 (CAST IRON)
	>2"	A234, WPB, wrought carbon steel	Schedule 40, butt weld, ANSI B16.9
Flanges	≤2"	A105, forged carbon steel	Class 150, RF, threaded, ANSI B16.5
	>2"	A105, forged carbon steel	Class 150, RF, weld neck or slip on, ANSI B16.5
Bolts		A193, grade B7 carbon steel	Hex head (ANSI B18.2.1), B1.1, class 2A course thread

Nuts		A194, Grade 2H, Carbon steel	Heavy hex (ANSI B18.2.2), B1.1, class 2B course thread
Gaskets	Per flange standard	A304, stainless steel, Grafoil filled, spiral wound	Class 150, RF, ring style, ANSI B16.20

D. Steel Pipe: Grooved ends:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	≥2½"	A53, grade B, type S or E	Schedule 40, ANSI B36.10
Fittings	≥2½"	A536, ductile Iron	synthetic rubber gaskets
		A234, forged steel	
		A53, fabricated steel	

E. Vic-Press for Schedule 10S 304™ Stainless Steel Pipe System:

ITEM	SIZE	ASTM SPEC NO.	MATERIAL WEIGHT & TYPE
Pipe	½ - 2"	A312	Schedule 10, Type 304/304L stainless steel, full finished annealed, certified for use with Victaulic Pressfit products
Fittings	½" - 2"	A312	Type 304/304L, Grade "H" HBNR gaskets

F. Vic-Press 304™ Fittings: Precision, cold drawn, austenitic 304/304L stainless steel fittings, with Grade "E" EPDM O-ring seals.

G. Flexible Connectors: Stainless steel corrugated hose with woven flexible stainless-steel braid; minimum 150 psig working pressure, maximum 250 deg F operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected; and shall be capable of 3/4 inch misalignment.

1. Keflex, Div. of Flex-Weld, Inc.
2. Mason-Mercer, Mason Ind., Inc.
3. Metraflex Company
4. Twin City Hose, Inc.

H. Solder and Brazing Filler Metals: Refer to Division 23 Section, "BASIC PIPING MATERIALS AND METHODS".

I. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded and refer to Division 23 Section, "BASIC PIPING MATERIALS AND METHODS".

J. Grooved Mechanical Couplings: Consist of ductile iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure roll-grooved pipe and fittings.

1. Rigid Type Couplings: Housings cast with offsetting, angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style 07.
2. Flexible Type Couplings: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 75.

3. Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741.

- K. Vic-Press 304™: Precision, cold drawn, austenitic stainless steel, with EPDM O-ring seals.

2.02 GENERAL DUTY VALVES

- A. General duty valves (i.e., globe, check, ball, and butterfly valves) are specified in Division 23 Section "HVAC VALVES". Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

2.03 SPECIAL DUTY VALVES

- A. Pump Discharge Valves: 175 psig working pressure, 250°F maximum operating temperature, cast-iron body, bronze disc and seat with EPDM insert, stainless steel stem and spring, and "Teflon" packing. Valves shall have flanged connections and straight or angle pattern as indicated. Features shall include non-slam check valve with spring-loaded weighted disc, and calibrated adjustment feature to permit regulation of pump discharge flow and shutoff.
 1. Bell and Gossett - Triple Duty Valve
 2. Taco, Inc. - Plus One Multi Purpose Valve
 3. Armstrong Pumps, Inc. - FTV series
- B. Safety Relief Valves: 125 psig working pressure and 250°F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber. Select valve to suit actual system pressure and Btu capacity.
 1. Bell & Gossett
 2. Watts Regulator Co.
- C. Vic-Press Schedule 10S 304™ Piping System Ball Valves: Vic-Press Schedule 10S 316™ stainless steel ball valve with 316 SS body, full port ball, stem and handle, and PTFE seats. Vic-Press Schedule 10S connections, Victaulic Series 569.

2.04 HYDRONIC SPECIALTIES

- A. Manual "Coin" Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 225°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8" discharge connection and 1/2" inlet connection.
 1. Bell and Gossett – No. 4V
 2. Taco, Inc. – 417
- B. Automatic Air Vents: Cast iron body with stainless steel, brass, EPDM, and silicone rubber internal components, two stage air relief, 150 psig maximum pressure, and 250°F maximum temperature.
 1. Bell and Gossett – No.107A High Capacity Air Vent
 2. Taco – Hy-Vent

PART 3 – EXECUTION

3.01 PIPE APPLICATIONS

- A. All water and glycol systems with operating temperatures of 40° to 210°: Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 2" and smaller, above ground, within building. Install Type K,

annealed temper copper tubing for 2" and smaller without joints, below ground or within slabs, and with welded joints for 2½" and larger.

- B. All water and glycol systems with operating temperatures of 40° to 210°: Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 2" and smaller, above ground, within building. Install Type K, annealed temper copper tubing for 2" and smaller without joints, below ground or within slabs, and with grooved joints for 2½" and larger.

3.02 PIPING INSTALLATIONS

- A. General: Refer to Division 23 Section, "BASIC PIPING MATERIALS AND METHODS" for general piping installation requirements.
- B. Make reductions in pipe sizes at pump connections using eccentric reducer fitting installed with the level side up.
- C. Install dielectric waterway fittings or unions to join dissimilar metals, refer to Division 23 Section, "BASIC PIPING MATERIALS AND METHODS".
- D. Install flexible connectors at inlet and discharge to pumps (except inline pumps) and other vibration producing equipment.
 - 1. Three flexible type grooved joint couplings may be used in lieu of a flexible connector at equipment connections. Couplings shall be placed in close proximity to the source of the vibration.
- E. Use minimum three elbows to form a swing connection for supply and return runouts to risers and/or heating equipment.

3.03 HANGERS AND SUPPORTS

- A. General: Refer to Division 23 Section, "HANGERS AND SUPPORTS", for hangers, supports, and anchors.

3.04 PIPE JOINT CONSTRUCTION

- A. General: Refer to Division 23 Section, "BASIC PIPING MATERIALS AND METHODS" for welded, threaded, brazed, grooved and soldered requirements.
- B. Grooved Joints: Couplings, fittings, valves, and pipe shall be assembled in accordance with the latest published installation instructions from the manufacturer.
 - 1. Pipe: Verify that the pipe is sufficiently free of indentations, projections, grooves, weld seams, or roll marks on the pipe over the entire gasket area to insure a leak tight seat for the gasket. Insure the pipe ends are square cut and that the grooving is in accordance with the manufacturer's standards.
 - 2. Gasket: Check gasket style and material for proper application.
 - 3. Lubrication: Lubricate the gasket exterior including the lips and/or pipe ends and housing interiors to prevent pinching the gasket. Use the manufacturer's recommended lubricant or similar compatible material such as silicone. Petroleum based lubricants must not be used on grade 'E' or 'M' gaskets. A thin coat of lubricant shall be applied by brush as follows:
 - a. Brush on the gasket lips (ID) and the entire exterior of the gasket.
 - b. Brush lubricant on the pipe ends around the entire pipe circumference and inside the coupling housing.

3.05 VALVE APPLICATIONS

- A. General: Refer to Division 23 Section, "HVAC VALVES", for general duty valves.

- B. Install shut off duty valves at each branch connection to mains, at connection to each piece of equipment, and elsewhere as indicated.
- C. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, elsewhere as indicated.
- D. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

3.06 HYDRONIC SPECIALTIES INSTALLATION

- A. Install air vents at high points in the system, heat transfer coils, and elsewhere as required for system air venting.
- B. Install balancing valves per the manufacturer's written instructions and the following criteria:
 - 1. A minimum of 5 pipe diameters upstream and 2 pipe diameters downstream of the balancing valve to a pipe fitting or another valve.
 - 2. A minimum of 10 pipe diameters upstream of the valve to a pump and a minimum of 5 pipe diameters downstream of the valve to a pipe fitting or another valve when the balancing valve is downstream to a pump.

3.07 FIELD QUALITY CONTROL

- A. Preparation for testing: Prepare hydronic piping in accordance with ASME B-31.9 and as follows:
 - 1. Leave joints including welds uninsulated and exposed for examination during the test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.
 - 3. Flush system with clean water. Clean strainers.
 - 4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.
 - 5. Install relief valve set at a pressure no more than 25% higher than the test pressure, to protect against damage by expansion of liquid or other source of over pressure during the test.
- B. Testing: Test hydronic piping as follows:
 - 1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.
 - 2. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.
 - 3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low-pressure filling lines are disconnected.
 - 4. Subject piping system to a hydrostatic test pressure of 125 psig. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90% of specified minimum yield strength, or 1.7 times the "SE" value in Appendix A of ASME B31.9, Code For

Pressure Piping, Building Services Piping.

5. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks and pressure holds for a period of four hours. Contractor to complete test report for signature by Owner. Coordinate with Owner for witnessing the test.

3.08 ADJUSTING AND CLEANING

- A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
- B. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

3.09 INSTALLATION OF WATER TREATMENT

- A. General: Furnish chemicals recommended by water treatment system manufacturer for treating hydronic systems. Provide only chemicals that are compatible with materials of hydronic systems and equipment. Install water treatment in accordance with chemical treatment manufacturer's written instruction.
- B. Hydronic system:
 1. Provide chemical treatment analysis and findings report of the existing hot water system fluid prior to the new construction work of this Project.
 2. After system has been tested for leaks, and piping systems flushed clean of all grit, fillings, dope, etc., add cleaner at the recommended rate and concentration. Heat to 140 to 180 F and circulate for eight hours. Dump product to drain and flush until pH is +/- 0.3 of the raw water.
 3. After cleaning hydronic system, add passivator and circulate as recommended by the chemical treatment company.
 4. After passivating the hydronic system add sufficient corrosion inhibitor to maintain a molybdate level of 40-60 ppm or as recommended by chemical treatment company for glycoled hydronic systems.
 5. Add sufficient propylene glycol for 30% glycol solution by weight. Propylene glycol shall be inhibited and specifically designed for use in hydronic systems, DOWFROST or approved equal.

3.10 COMMISSIONING

- A. Fill system and perform initial chemical treatment.
- B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
- C. Before operating the system perform these steps:
 1. Open valves to full open position.
 2. Close coil bypass valves.
 3. Remove and clean strainers.
 4. Check pump for proper rotation direction and correct improper wiring.
 5. Set automatic fill valves for required system pressure.

6. Check air vents at high points of systems and bleed air completely.
7. Set temperature controls so all coils are calling for full flow.
8. Check operation of automatic bypass valves.
9. Check and set operating temperatures of heating system to design requirements (refer to drawing schedules).
10. Lubricate motors and bearings.
11. Verify 30% Glycol concentration, where applicable.

END OF SECTION 23 21 13

SECTION 23 30 00

METAL DUCTWORK & ACCESSORIES

PART 1 GENERAL

3.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.

3.2 SUMMARY

- A. This Section includes metal ductwork and accessories. The scope of metal ductwork and accessories requirements is indicated on Drawings and schedules, and by requirements of this Section.
- B. Drawings: The intent of the Specifications and Drawings is to have a “complete” system which operates as described and required. The Drawings should not be considered as complete with every detail, coordination and method of installation. Provide all work and coordination with all other building services as required for a complete project.

3.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for the following:
 - 1. Manual dampers.
 - 2. Control dampers.
 - 3. Fire dampers.
 - 4. Smoke dampers.
 - 5. Combination fire and smoke dampers.
 - 6. Ceiling radiation dampers.
 - 7. Relief dampers.
 - 8. Turning vanes.
 - 9. Duct hardware.
 - 10. Duct access doors.
 - 11. Flexible connections.
 - 12. Registers, grilles and diffusers.
 - 13. Louvers.
 - 14. Duct liner.
 - 15. Flexible ductwork.
 - 16. Duct sealant.
 - 17. Air terminals.
- B. Sheet Metal Shop Standards: Submit ductwork Fabrication Shop Standards Manual indicating materials, gauges, reinforcing, and similar information for ductwork, fittings, accessories, etc., for the required sizes and static pressure classes to fully demonstrate compliance with SMACNA “HVAC Duct Construction Standards, Metal and Flexible, Third Edition (2005)”. The Manual shall be shop specific.
- C. Duct Leakage Testing:
 - 1. Procedures and Qualifications: The first submittal, to be made in a timely manner to allow review by Architect/Engineer in advance of commencement of actual testing. The first submittal shall consist of the following:
 - a. Procedures and Agenda: Submit a synopsis of the testing procedures and agenda

proposed to be used for this project.

- b. Sample Forms: Submit sample test report forms.
 - c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, and within the device manufacturer's published calibration period prior to starting the project.
 - d. Contractor qualifications: Submit evidence of testing agency qualifications to complete the required testing.
2. Test Reports: The second submittal, to be made after the first submittal has been satisfactorily reviewed, shall be made after the testing work has been performed.
- a. Certified Reports: Submit testing reports bearing the signature of the test lead technician. The reports shall be certified proof that the systems have been tested in accordance with the referenced standards and are an accurate representation of the leakage rates observed. Final reports shall be type written, organized and formatted as specified below.
 - b. Report Format: Report forms shall be those included in the first submittal. Bind report forms complete with schematic systems diagrams and other data.
 - c. Report Contents: Inside cover sheet to identify testing agency, Contractor, Owner, Architect, Engineer, and Project; including addresses, contact names, and telephone numbers. Provide a listing of the instruments used for the procedures along with the proof of calibration. The remainder of the report shall contain the report forms for each respective item and system. Prepare a schematic diagram for each tested section of the duct system to accompany each respective report form.

3.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork, products and accessories of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for the project.
- C. Codes and Standards:
 - 1. SMACNA Standards:
 - a. Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible, Third Edition (2005)" for fabrication and installation of metal ductwork.
 - b. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for sealing requirements of metal ductwork.
 - c. Comply with SMACNA "Duct Cleanliness for New Construction Guidelines" (latest edition).
 - d. Comply with SMACNA "Guideline on Through-Penetration Fire-stopping (latest edition).
 - e. Comply with SMACNA "Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems" (latest edition).
 - 2. ASHRAE Standards: Comply with ASHRAE Handbook, "Systems and Equipment", Latest

Edition, "Duct Construction", for fabrication and installation of metal ductwork and accessories.

3. NFPA Standards:

- a. Comply with NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems".
- b. Comply with NFPA 96, "Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations."
- c. Comply with NFPA 80, Standard for Fire Doors and Other Opening Protectives.
- d. Comply with NFPA 105, Standard for Smoke Door Assemblies and Other Opening Protectives.

4. ANSI/UL Compliance:

- a. Construct, test, and label fire dampers in accordance with ANSI/UL Standard 555 "Standard for Safety: Fire Dampers," latest Edition.
- b. Construct, test and label ceiling radiation dampers in accordance with ANSI/UL Standard 555C, "Standard for Safety Ceiling Dampers", latest Edition.
- c. Construct, test and label smoke dampers in accordance with ANSI/UL Standard 555S, "Standard for Safety Smoke Dampers", latest Edition.
- d. Construct, test and label flexible air ducts in accordance with ANSI/UL Standard 181 "Standard for Safety Factory-Made Air Ducts and Connectors", latest Edition.
- e. Construct, test and label factory-built grease ducts and grease duct assemblies in accordance with UL 1978 "Grease Ducts."
- f. ANSI/UL 181, "Standard for Safety Factory-Made Air Ducts and Air Connectors."
- g. ANSI/UL 181A, "Standard for Safety Closure Systems for Use with Rigid Air Ducts."
- h. "ANSI/UL 181B, "Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors."

5. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650, "Standard for Air Outlets and Inlets".

6. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70, "Method of Testing the Performance of Air Outlets and Inlets".

7. ADC Standards: Install flexible ducts in accordance with the "Flexible Duct Performance and Installation Standards", latest Edition.

8. AMCA Compliance: Test and rate louvers in accordance with AMCA 500-L-12, "Laboratory Methods of Testing Louvers for Rating."

3.5 DELIVERY, STORAGE, AND HANDLING

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, air devices, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ductwork and accessories.

- B. Storage: Store ductwork and accessories inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof and dustproof wrapping.
- C. All ductwork shall be fabricated, transported, stored, handled, installed, and protected in accordance with the recommendations and requirements set forth in the SMACNA Duct Cleanliness for New Construction Guidelines. The Mechanical and Sheet-metal Contractors shall be responsible to ensure that every effort is made to maintain cleanliness throughout the ductwork systems.

3.6 DESIGN CRITERIA

- A. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:
 - 1. Supply ducts and other ducts at discharge side of fans: 3" water gauge, positive pressure.
 - 2. Return ducts at inlet side of fans: 3" water gauge, negative pressure.
 - 3. Exhaust ducts at inlet side of fans: 3" water gauge, negative pressure.
- B. Seal Class – New Ducts: Seal all new sheet metal ducts to SMACNA Seal Class ‘A’.
- C. Seal Class – Existing Ducts: Seal all existing sheet metal ducts to SMACNA Seal Class ‘A’.

PART 2 PRODUCTS

3.1 DUCTWORK MATERIALS

- A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials that are free from visual imperfections including pitting, seam marks, roller marks, oils, stains and discolorations, and other imperfections, including those that would impair painting.
- B. Sheet Metal: Except as otherwise indicated or specified fabricate ductwork from galvanized sheet steel complying with ASTM A 924 and A 653, lock-forming quality, with G 90 zinc coating in accordance with ASTM A 90.
 - 1. Ductwork to be installed in exposed locations shall be phosphatized per ASTM D2092 or otherwise prepared and treated as necessary to ensure proper paint adhesion.

3.2 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Duct Sealant - General: ANSI/UL 181A or ANSI/UL 181B listed, low V.O.C, non-hardening, non-migrating water-based mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
 - 1. Hardcast: Flex Grip
 - 2. United McGill: United Duct Sealer
- C. Duct Sealant, Two Part System: ANSI/UL 181A or ANSI/UL 181B listed, low V.O.C., two-part system consisting of an adhesive activator and a gypsum impregnated fiber tape. Materials shall be suitable for use outdoors, and recommended by manufacturer specifically for sealing joints and seams in ductwork.

1. Hardcast: DT-5300 tape and RTA-50 adhesive
 2. United McGill: Uni-cast
- D. Duct Sealant, Flange Type: Continuous butyl rubber extrusion specifically designed for use in flanged duct joints. Product shall be listed by ANSI/UL to have a flame spread rating of less than 25 and smoke developed rating of less than 50.
1. Hardcast: Flange Grip #1902-FR
- E. Ductwork Support Materials: Provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

3.3 DUCT LINER

- A. General: Comply with NFPA Standard 90A and NAIMA Fibrous Glass Duct Liner Standard.
- B. Materials: ASTM C 1071, Type I, with coated surface exposed to air stream to prevent erosion of glass fibers. Surface shall be treated with an EPA registered anti-bacterial agent to prohibit the growth of fungus and bacteria. Duct facing shall be designed to resist damage from common dry duct cleaning processes as recommended by the North American Insulation Manufacturers Association (NAIMA) Duct Cleaning Guide.
1. Thickness: 1"
- C. Thermal Performance: "K-Factor" equal to 0.25 or better, "R-Factor" equal to 4.0 or better, at a mean temperature of 75° F.
- D. Sound Absorption Coefficients: Minimum sound absorption ratings per the following schedule as tested using the ASTM C423 method:

Sound Absorption Coefficient @ Frequency (Cycles Per Second)							
Thickness	125	250	500	1000	2000	4000	NRC
1"	.04	.24	.69	.96	1.05	1.01	.75
2"	.16	.51	.9	1.05	1.06	1.01	.9

- E. Nosings: Provide sheet metal nosings securely installed over transversely oriented liner edges exposed to the air stream. This is required for all duct velocities.
- F. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.
- G. Products: Provide products of the following manufacturers:
1. Johns Manville: Permacote Linacoustic HP
 2. Owens Corning : Quiet R® Textile Duct Liner
- H. Liner Adhesive: Comply with NFPA Standards 90A, 90B, and ASTM C 916. Product shall have flame spread and smoke developed ratings of less than 25 when dry.
1. Hardcast: Glass Grip #GG-901
 2. United McGill: Uni-Grab Duct Liner Adhesive
 3. Duro Dyne: WIT
- I. Mechanical Fasteners: Galvanized steel, suitable for welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and

will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall. Fastener pin length shall be as required for thickness of insulation, and without projecting more than 1/4" into the air stream.

1. DuroDyne: Spotter pins with PC metal washers.

3.4 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards" Tables 2-1 through 2-49, including associated details. Fabricate rectangular ducts with aluminum sheet, in accordance with SMACNA "HVAC Duct Construction Standards", Tables 2-1 through 2-52, including associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
- B. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, oils, stains, and discoloration.
- D. Cross Breaking or Cross Beading: Cross break or bead duct sides that are 11" and larger and are 20 gauge or less, with more than 4 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 2-9, regardless of insulation.
- E. Fittings: Provide long radius type fittings, radius to centerline of duct is 1 ½ times duct width.
- F. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," Figures 4-1 through 4-9, with the following modifications:
 1. Figure 4-2
 - a. Type RE1 – Square throat is not permitted.
 - b. Types RE4, 6, 7, 8, 9, & 10 are not permitted.
 2. Figure 4-3
 - a. Use single thickness vanes with trailing ends, SP=1½".
 3. Figure 4-7
 - a. Offset types 1 & 2 are not allowed.
 - b. Minimum bell mouth radius shall be 1½".
 4. Figure 4-8
 - a. Figures A & C are not allowed.
- G. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- H. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.
- I. Duct joining system shall be Ductmate, Ward Industries, Carlisle, MEZ Industries or equal Transverse Duct Connection (TDC) for all ducts with longest side over 24". Above systems are optional for smaller duct systems. Above systems are to be used with galvanized sheet steel and aluminum sheet. Ducts fabricated of stainless steel shall have welded joints.

- J. Button punch snap lock (figure 2-2, type L-2) and internal standing seam joints (figure 2-7) are not allowed.
- K. Duct sizes indicated on the Drawings are the net free area. Where duct liner and/or double wall ductwork is installed, increase the duct size accordingly.

3.5 ROUND AND SPIRAL DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate round ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 3-1 through 3-14 and figures 3-1 through 3-6. Conform to the requirements in the referenced standard for metal thickness and joint types. Modify the above tables and figures as follows:
 - 1. Table 3-1
 - a. All elbows, regardless of duct velocity, shall be 1½ radius to duct diameter.
 - 2. Figure 3-2
 - a. Seam types RL-3, 6A, 6B and 7 are not allowed.
 - 3. Figure 3-4
 - a. Adjustable elbows are not allowed.
 - 4. Figure 3-5
 - a. Non lateral taps may be used only where spatial conditions do not allow lateral taps.
 - 5. Figure 3-6
 - a. Replace the transition length formula listed ($L_2=A-B$) with the following: Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- B. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, oils, stains, and discoloration.
- C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.
- D. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- E. Fitting Gauges: One gauge heavier than the duct size requirement, 22 gauge minimum.
- F. Manufacturers: Subject to compliance with requirements, provide spiral ductwork of one of the following:
 - 1. Semco Mfg., Inc.
 - 2. United Sheet Metal Div., United McGill Corp.
 - 3. Spirosafe, division of Lindlab
 - 4. Spiro Metal, Inc.

3.6 DAMPERS

- A. Manual Dampers: Provide dampers of single blade type or multi blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards", Figures 7-4 and 7-5, amended as follows:

1. Figure 7-4
 - a. Figure A is not allowed, use only figure B regardless of duct size.
- B. Provide end bearings for all systems requiring Seal Class A regardless of pressure class.
- C. Control Dampers:
 1. Provide dampers with parallel blades for 2 position control, or opposed blades for modulating control. Construct blades of 16 gauge steel, provide heavy duty molded self lubricating nylon bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1/4" x 16 gauge channel for face areas over 25 sq. ft. Provide galvanized steel finish.
 2. Motor operated control dampers shall be furnished by the automatic temperature controls contractor and installed by the sheet metal contractor.
 3. Manufacturers: Subject to compliance with requirements, provide dampers of one of the following:
 - a. Air Balance, Inc.
 - b. American Warming & Ventilating, Inc.
 - c. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - d. Greenheck Fan Corp.
 - e. Louvers & Dampers, Inc.
 - f. Ruskin Mfg. Co.
- D. Backdraft Dampers:
 1. Unless otherwise noted on Drawings, provide aluminum construction backdraft dampers with 0.09" thick extruded aluminum frame, 0.025" thick formed aluminum blades extruded vinyl edge seals, synthetic bearings, linkage concealed in frame and mill finish. Dampers shall be Ruskin BD2 series or equal.
 2. Where noted on Drawings, provide 304 stainless steel construction backdraft dampers with 16 gauge stainless steel channel frame, 26 gauge formed stainless steel blades, full length stainless steel axles, nylon bearings, stainless steel linkage and mill finish. Dampers shall be Ruskin S2SS series or equal.
 3. Manufacturers: Subject to compliance with requirements, provide backdraft dampers of one of the following:
 - a. Air Balance, Inc.
 - b. American Warming & Ventilating, Inc.
 - c. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.
 - d. Greenheck Fan Corp.
 - e. Louvers & Dampers, Inc.
 - f. Ruskin Mfg. Co.

3.7 DUCT HARDWARE

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
- B. Quadrant Locks: Provide for each manually controlled damper, quadrant lock device on one end of shaft; and end bearing plate on other end. Provide extended quadrant locks and extended end bearing plates for externally insulated ductwork.

C. Manufacturers: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Duro Dyne National Corp.
2. Ventfabrics, Inc.
3. Young Regulator Co.

3.8 DUCT ACCESS DOORS

A. General: Provide where indicated, duct access doors per the following schedule (adjust as required to suit specific equipment needs):

Access Door Schedule	
duct size (exposed width)	door size
<10"	2" less than duct size
10" - 18"	8" x 8"
19" - 30"	12" x 12"
>30"	18" x 18"

1. Access doors intended to allow entrance of an individual shall be a minimum of 24" x 16".

B. Construction: Construct per the requirements of SMACNA HVAC Duct Construction Standards, Figures 7-2 & 7-3. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with latching devices per the SMACNA schedule.

C. Manufacturers: Subject to compliance with requirements, provide duct access doors of one of the following:

1. Air Balance Inc.
2. Buckley Associates
3. Duro Dyne Corp.
4. Register & Grille Mfg. Co., Inc.
5. Ruskin Mfg. Co.
6. Ventfabrics, Inc.

3.9 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of Durodon base, Hypalon coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. The fabric shall remain serviceable from -40°F to 250°F, and shall be resistant to mildew and ultraviolet rays. Minimum fabric weight is 24 ounces per square yard. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment. The connector width shall be 3" of 24 gauge (min) sheet metal, 3" of fabric, and 3" of 24 gauge (min) sheet metal.

B. Manufacturers: Subject to compliance with requirements, provide flexible connections of one of the following:

1. Duro Dyne National Corp.
2. Ventfabrics, Inc.
3. Young Regulator Co.

3.10 REGISTERS, GRILLES, AND DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard diffusers, registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

- B. Performance: Provide diffusers, registers and grilles that have, as minimum, throw, pressure drop, and noise criteria ratings for each size device as listed in manufacturer's current data. The products specified on the Drawings are the basis of the design for this project, products of alternate manufacturers must meet the basis of design. All performance data must be per requirements of ARI 650 and ASHRAE Standard 70.
- C. Compatibility: Provide diffusers, registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and ceiling construction that will contain each type of register, grille, and diffuser. It is the Contractor's responsibility to fully coordinate installation requirements for various surfaces.
- D. Types: Provide diffusers, registers and grilles of type, capacity, and with accessories and finishes as listed on the Drawing schedule and as described here.
- E. Directional Face Ceiling Supply Diffuser: Square face and neck, aluminum with aluminum extension panel for installation in ceiling grid system. Provide with 24 gauge neck adaptor where indicated. Finish shall be white unless otherwise scheduled.
 - 1. Metalaire Series 5500
 - 2. Titus Series TDC-AA
 - 3. Anemostat Type XD
 - 4. Price Series AMD
 - 5. Nailor Model 6200
 - 6. Tuttle & Bailey Series AM
- F. Louver Face Ceiling Supply Diffuser: Square face and neck, stamped steel with steel extension panel for installation in ceiling grid system (where required). Face must include 4 cones except 3 cones on 12 x 12 units. Finish shall be off white baked enamel unless otherwise scheduled.
 - 1. Metalaire Series 5800
 - 2. Carnes Series SF
 - 3. Price Series SCD
 - 4. Nailor Model RNS
 - 5. Anemostat Series E
 - 6. Tuttle and Bailey Series DA/DF
- G. Round Ceiling Diffuser: Round face and neck, aluminum construction, adjustable inner assembly with a minimum of 2 cones, flush surface mount, maximum depth from ceiling in open position is 3 inches. Provide with opposed blade or butterfly damper.
 - 1. Metalaire Series 3100
 - 2. Titus Series TMRA-AA
 - 3. Anemostat Series C
 - 4. Price Series RCD
 - 5. Nailor Model 6300R
 - 6. Tuttle & Bailey Series VJR
- H. Linear Slot Diffuser: Extruded aluminum construction, concealed surface mount, auxiliary subframe, laterally adjustable 180° air pattern, hanger bracket, leveling screw. Provide with insulated boot plenum. Coordinate arrangement of boot plenum with drawings.
 - 1. Metalaire Series 6000
 - 2. Titus Series ML
 - 3. Anemostat Series LBD
 - 4. Price Series SDS

5. Nailor Model 5000
 6. Tuttle & Bailey Series 6000
- I. Linear Bar Grille: Extruded aluminum construction. Provide with opposed blade damper only where indicated.
1. Metalaire Series 2000
 2. Titus Series CT
 3. Anemostat Series AL
 4. Price Series LBP
 5. Nailor Model 4900
 6. Tuttle & Bailey Series T
- J. Cube Core Ceiling Return/Exhaust: Square face, all aluminum construction with ½" x ½" x ½" grid design, 80% minimum free area. Provide with opposed blade damper (where scheduled) with operator accessible through face. Where round connection to ductwork are indicated, provide with field or factory applied round neck transition. Provide off white finish unless otherwise scheduled.
1. Metalaire Series CC5D
 2. Titus Series Model 50
 3. Anemostat Series GC
 4. Price Series 80FF
 5. Nailor Model 51C
 6. Tuttle & Bailey Series CRE 500
- K. Double Deflection Sidewall Return/Exhaust: Extruded aluminum with front blades vertical. Blades at 0° angle, spaced at approximately 0.666" o/c. Provide with opposed blade damper (where scheduled) with operator accessible through face. Where round connections to ductwork are indicated, provide with field or factory applied round neck transition. Finish shall be off white unless otherwise scheduled.
1. Metalaire Series V4004
 2. Titus Series 300
 3. Anemostat Series X
 4. Price Series 620
 5. Nailor Model 51
 6. Tuttle & Bailey Series A60

3.11 LOUVERS

- A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
- B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.
- C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.
- D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners. Louver finish shall be as scheduled on the Drawings.
- E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Manufacturers: Subject to compliance with requirements, provide louvers of one of the following:

1. American Warming & Ventilating Inc.
2. Arrow United Industries, Inc.
3. Construction Specialties, Inc.
4. Louvers & Dampers, Inc.
5. Greenheck Fan Corp.
6. Ruskin Mfg. Co.

3.12 FIRE, SMOKE AND CEILING RADIATION DAMPERS

A. Fire Dampers – Curtain Type: Provide curtain type fire dampers of sizes indicated and which are constructed, tested and labeled in accordance with UL555. Dampers shall have a 1½ or 3 hour fire rating as indicated. All fire dampers must be dynamic rated for the design class of the duct system and the air flow, with a minimum UL555 differential pressure rating of 4" w.g. in the fully closed positions and a minimum velocity rating of 2000 fpm. Dampers shall be rated for mounting vertically with downward curtain travel or horizontally. Fire damper shall have the following additional features:

1. Fusible link rated at 165°F unless otherwise indicated or a higher temperature rating is required.
2. Stainless steel closure spring and positive lock in closed position.
3. Frame constructed of galvanized steel in gauges as required by manufacturer's UL listing.
4. Each damper shall be supplied as a single assembly with a factory sleeve of suitable length and gauge as required.
5. Curtain constructed of galvanized steel and completely out of the air stream when the damper is open.

B. Smoke Dampers: Provide motor driven smoke dampers in types and sizes indicated and which are constructed, tested and labeled in accordance with UL555S. Dampers shall have a UL555S leakage rating of Leakage Class I (8 CFM/FT² at 4" w.g.) and an elevated temperature rating of 350°F. Dampers shall have a minimum differential pressure rating of 4" w.g. and a minimum velocity rating of 2000 feet per minute. Dampers shall be rated for mounting vertically with blades running horizontal or mounted horizontally. Smoke dampers shall have the following additional features:

1. Damper Frame: 16 gauge galvanized steel formed into structural hat channel shape with reinforced corners.
2. Damper Blades: 16 gauge galvanized steel with longitudinal reinforcement and symmetrical design relative to their axle pivot points.
3. Actuator: Electric type for (24) (120) volt AC operation, 2-position, fail close, open and closed position end switches, furnished with the damper, mounted external to ductwork.
4. Blade Axles: Plated steel.
5. Linkage: Plated steel, out of airstream and concealed in jamb.
6. Bearings: Sintered bronze sleeve type.
7. Blade Edge Seals: Extruded silicone rubber permanently bonded to the appropriate blade edges.

8. Jamb Seals: Flexible 304 stainless steel compression type.
 9. Floor/Wall Sleeve: Galvanized steel.
 10. Performance: Damper air performance data shall be developed in accordance with AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- C. Combination Fire/Smoke Dampers: Provide motor driven combination fire/smoke dampers in types and sizes indicated and which are constructed, tested and labeled in accordance with UL 555 and UL555S. Dampers shall have a 1½ or 3 hour fire rating as indicated. Dampers shall have a UL555S leakage rating of Leakage Class I (8 CFM/FT2 at 4" w.g.) and an elevated temperature rating of 350°F. Dampers shall have a minimum differential pressure rating of 4" w.g. and a minimum velocity rating of 2000 feet per minute. Dampers shall be rated for mounting vertically with blades running horizontal or mounted horizontally. Combination fire/smoke dampers shall have the following additional features:
1. Factory installed heat responsive device rated to close at 165°F unless otherwise indicated or a higher temperature rating is required.
 2. Damper Frame: 16 gauge galvanized steel formed into structural hat channel shape with reinforced corners.
 3. Damper Blades: 16 gauge galvanized steel with longitudinal reinforcement and symmetrical design relative to their axle pivot points.
 4. Actuator: Electric type for (24) (120) volt AC operation, 2-position, fail close, open and closed position end switches, furnished with the damper, mounted external to ductwork.
 5. Blade Axles: Plated steel.
 6. Linkage: Plated steel, out of airstream and concealed in jamb.
 7. Bearings: Sintered bronze sleeve type.
 8. Blade Edge Seals: Extruded silicone rubber permanently bonded to the appropriate blade edges.
 9. Jamb Seals: Flexible 304 stainless steel compression type.
 10. Floor/Wall Sleeve: Galvanized steel.
 11. Performance: Damper air performance data shall be developed in accordance with AMCA Standard 500-D. Dampers shall be labeled with the AMCA Air Performance Seal.
- D. Ceiling Radiation Dampers: Provide ceiling radiation dampers in types and sizes indicated. Dampers shall be constructed, tested and labeled in accordance with UL555C for protection of ceiling openings in fire-rated floor/ceiling assemblies with fire resistance rating of 3 hours or less. Ceiling radiation dampers shall have the following additional features:
1. Fusible link rated at 165°F unless otherwise indicated or a higher temperature rating is required.
 2. Damper Frame: Galvanized steel in gauges as required by UL listing.
 3. Damper Blades: Galvanized steel in gauges as required by UL listing for round butterfly type. UL classified non-asbestos ceramic blanket damper for curtain type.

- E. Manufacturers: Subject to compliance with requirements, provide fire, smoke, combination fire/smoke and ceiling radiation dampers of one of the following:

1. Air Balance, Inc.
2. Greenheck Fan Corp.
3. Ruskin Mfg. Co.
4. Prefco Air Control, Inc.

3.13 FLEXIBLE DUCTWORK

- A. General: Flexible ductwork may be used to provide minor alignment of branch ducts with diffusers and grilles.
- B. Construction: Inner liner shall be a trilaminate of aluminum foil, fiberglass, and aluminized polyester reinforced with a mechanically attached galvanized steel helix. The outer facing shall be a polyethylene material. Fiberglass insulation with an R6 rating shall be factory installed between the liner and the outer facing. The entire assembly shall conform to NFPA 90A, be constructed in accordance with ANSI/UL 181, Class 1 Air Duct, and have a vapor barrier permeance of less than 1 when tested in accordance with ASTM E96, Procedure A. Operating pressure ratings shall be 12" w.g. positive, 10" w.g. negative on sizes $\leq 12"$ Ø, 12" w.g positive, 5" w.g. negative on sizes 14" & 16".
- C. Manufacturers: Provide flexible ductwork from one of the following:
1. Buckley Associates – Flexmaster Type 5B
 2. ATCO Rubber Products, Inc.

3.14 AIR TERMINALS (VAV BOXES)

- A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on the Drawing schedule.
- B. Casings: Casing shall be constructed of not less than 22 gauge galvanized steel with round collars and rectangular slip and drive discharge openings. Provide access panel in casing.
- C. Provide hanger brackets for attachment of supports.
- D. Lining: Interior of unit casing shall be lined with not less than 1/2", 1½ pcf dual density fiberglass insulation which complies with ANSI/UL 181 and NFPA 90A. All exposed insulation edges shall be coated with an NFPA 90A approved sealant to prevent the entrainment of fibers into the airstream.
- E. Leakage: Construct unit casings to Leakage Class 4 requirements and seal unit casings per Seal Class A requirements. Construct air dampers such that when subjected to 5" w.g. inlet pressure with damper closed, total leakage does not exceed 2% of specified air flow capacity.
- F. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor periodic servicing. Provide mechanism to vary air volume through damper for minimum to maximum, in response from signal from thermostat. Linkage must be external to the box; internal linkage is not acceptable.
- G. Controls: Provide controls for air terminals in accordance with Division 23 Section, "FACILITY MANAGEMENT SYSTEM". Furnish air terminals with the following devices:
1. Multi-point, center-averaging flow sensor in inlet.
 2. Unit shall be compatible with building controls as indicated on the Drawings. Damper actuator shall be furnished and installed by the building controls contractor.
- H. Identification: Provide label on each unit indicating Plan Number, cfm range, cfm factory setting, and calibration curve (if required).

- I. Hot Water Heating Coils: Provide heating coils constructed of copper tubes and aluminum fins with galvanized steel casing.
- J. Manufacturers: Subject to compliance with requirements, provide air terminals of one of the following:
 - 1. Titus
 - 2. Tuttle & Bailey
 - 3. Price
 - 4. Enviro-Tec by Johnson Controls

PART 3 EXECUTION

3.1 GENERAL

- A. Inspection: Examine areas and conditions under which metal ductwork, air inlets and outlets and accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Coordination: It is the responsibility of the sheet metal contractor to coordinate the work of his trade with all other trades prior to the commencement of construction. Any conflicts must be brought to the attention of the Architect/Engineer. Any work requiring removal and reinstallation due to the lack of coordination shall be the responsibility of the Contractors with no additional cost to the Owner.
- C. Offsets: The HVAC duct drawings are schematic in nature and do not indicate all fittings. It is the responsibility of the Contractor to provide all necessary offsets, fittings, and transformations to provide a complete project at no additional cost to the Owner.
- D. Ductwork which is dented, deformed, skewed, elongated or out-of-round, buckled, deflected, heavily marred, corroded or otherwise damaged, will be considered unacceptable. Such ductwork will be removed from the project site and replaced at no additional cost or delay to the project.
- E. Ductwork which has been exposed to weather or water and exhibits "white rust", rust, corrosion, oxidization, or other damage or deterioration shall be considered unacceptable, and shall be removed and replaced at no additional cost to the Owner.

3.2 INSTALLATION OF METAL DUCTWORK

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Ductwork shall be supported independently of others system components and other systems. Support vertical ducts at every floor.
- B. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by drawings, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

- C. Branch takeoffs shall be flange-mounted 45-degree lateral wye, conical tee, or bell-mouth, "mini" bell-mouth, or square-to-round dovetail type. Other takeoff types shall not be used except by written permission from the Architect/Engineer.
1. Spin-in take-offs are not acceptable.
 2. "Cut-and-tabbed over" connections are not acceptable.
 3. "Straight-taps" are not acceptable.
 4. All branch take-offs shall be sealed with appropriate gasket and/or sealant for an air-tight connection.
- D. As a minimum, seal all transverse and longitudinal joints, seams and ductwall penetrations (except continuously welded joints, and gasketed jointing system) in all ductwork in accordance with the Seal Class indicated in Part 1 and as defined in the SMACNA HVAC Duct Construction Standards.
- E. Clearance to Combustible Materials: Maintain a minimum ½" clearance from metal air ducts used for heating to assemblies constructed of combustible materials in accordance with NFPA 90A.
- F. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures. Do not locate ductwork above electrical equipment within clear spaces as required by the electrical code.
- G. Penetrations: Where ducts pass through non-fire rated interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1½". Fasten to duct or substrate.
- H. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- I. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards. Provide all auxiliary steel for attachment of duct supports to the building structure.
- J. Volume Dampers: Prior to the installation of the sheet metal ducts, the sheet metal contractor shall coordinate with the balancing contractor to ensure volume dampers are located in locations where the balancing contractor can effectively perform his trade.
- K. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- L. Test Holes: Drill test holes in ducts as required for testing and balancing and adjacent to control system sensors and probes in order to facilitate testing and calibration of the sensors and probes. Plug with red plastic plugs to permit easy locating.

3.3 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. General: Duct sizes indicated on Drawings are free area sizes, the Contractor shall make allowance for the duct liner where a duct liner is specified or indicated.
- B. Adhere a single layer of specified thickness of duct liner with 90% coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve specified thickness is prohibited.
- C. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

- D. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
- E. Secure liner with mechanical fasteners 4" from corners and at intervals not exceeding 12" transversely around perimeter; at 3" from transverse joints and at intervals not exceeding 18" longitudinally.
- F. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Sections of lined duct adjoining unlined duct or duct mounted devices.
- G. Terminate liner at duct build outs installed in ducts to attach dampers, turning vane assemblies, and other devices. Secure fabricated build outs (metal hat sections or other approved build out means) to the duct wall with screws or welds. Terminate liner at fire dampers at ductwork side of connections to fire damper sleeve through fire separation.

3.4 INSTALLATION OF FLEXIBLE DUCTS

- A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6'-0" extended length.
- B. Installation: Install in accordance with Section III of SMACNA's, "HVAC Duct Construction Standards", and ADC "Standard for Safety Factory-Made Air Ducts and Connectors."
 - 1. Bends shall be made with not less than 1 duct diameter centerline radius.
 - 2. Duct shall be supported at the manufacturer's recommended intervals but not less than 5 feet. Maximum permissible sag of 6" between supports.
 - 3. Duct hangers in contact with the flexible duct shall not be less than 1" wide and shall not reduce the internal diameter of the duct.
 - 4. Factory installed suspension systems that are integral to the flexible duct are acceptable for hanging when the manufacturer's procedures are followed.
 - 5. Install flexible ducts as directly as possible without unnecessary loops and bends.
 - 6. Attach flexible duct to metal duct and end terminals with drawbands. For insulated type flexible ducts, install drawbands on both the inner sleeve and the outer jacket.
- C. Install insulated type flexible ducts on all air conditioning air handling unit supply air systems. Install non-insulated type flexible ducts on all H & V (non air conditioned) air handling unit systems (supply and return air); and on all air conditioning air handling unit return air systems.

3.5 EQUIPMENT CONNECTIONS

- A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators and/or equipment containing rotating machinery. Provide access doors as indicated.

3.6 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install turning vanes in square or rectangular 90° elbows in supply and exhaust air systems, and elsewhere as

indicated.

- C. Install access doors with latches operable from either side, except outside only where duct is too small for person to enter. Install access doors at all fire dampers, smoke dampers, motor operated dampers, humidifiers, duct mounted coils, smoke detectors and similar devices requiring access. Install access doors every 20' on return and exhaust air systems. Label access doors in accordance with Division 23 Section "MECHANICAL IDENTIFICATION."
- D. Provide access doors at all plenums and connections to louvers and exterior vents. Suitably size access doors to facilitate thorough inspection and cleaning of the plenums and/or louvers and vents.
- E. Access doors should be located as close as practicable to the devices being accessed. Access doors shall be located at the underside of the duct rather than the side of the duct if the device being accessed can be more easily and readily accessed in this manner.
- F. Generally, duct access doors are not shown on the Drawings, but they shall be provided in accordance with the above requirements, and as necessary to properly service, clean, maintain and operate systems and equipment.
- G. Install all components provided by other trades for installation in metal ducts (temperature sensors, pressure sensors, smoke detectors, etc.) in accordance with the component manufacturer's requirements.
- H. Where drain fittings are indicated or provided at the bottom of intake, exhaust and/or relief air plenums, install $\frac{3}{4}$ " drain fittings and trapped drain piping, routed to the nearest floor drain. Pitch the bottom of the plenums for proper drainage. Reinforce the plenums as required for a rigid installation.

3.7 INSTALLATION OF AIR INLETS AND OUTLETS

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.
- B. Coordinate with other work, as necessary to interface installation of air outlets and inlets with other work.
- C. Locate diffusers, registers, and grilles, as indicated. Unless otherwise indicated, locate units in center of acoustical ceiling module.
- D. Where required by Drawing details, provide sheet metal elbows when connecting ceiling diffusers with flexible ducts.

3.8 INSTALLATION OF AIR TERMINALS (VAV BOXES)

- A. Install air terminals level and with the manufacturer's recommended straight run of ductwork at inlet and outlet. Install so that damper operator, damper actuator, and hot water control valve actuator (where provided) can be readily serviced. Connections to the inlet and outlet of terminal boxes shall not be by flexible duct, except at fan powered units.

3.9 INSTALLATION OF FIRE DAMPERS

- A. Install fire dampers in strict accordance with manufacturer's and/or U.L. instructions.
- B. All trades (including, but not limited to, the Construction Manager, the Mechanical Contractor, the Sheet-metal Contractor, the Mason and the Wall Framer/Gypsum Board Contractor) must carefully coordinate to ensure fire dampers are properly installed and functional.
- C. Proper installation includes, but is not limited to:
 - 1. Opening sized and constructed specific to the dampers provided;
 - 2. Appropriate sleeve lengths, sizes, gauges and clearances for the installed conditions;

3. Appropriate damper expansion space (maintain required thermal expansion gaps);
 4. Appropriate retaining angles around the perimeter of the dampers and sleeves;
 5. Appropriate wall construction (filled and sealed block; wall framing on all sides of opening);
 6. Appropriately located and installed fire stopping and insulation.
 7. Appropriate duct connections to dampers (break-away or non-break-away as per duct size and gauge);
 8. Provision of serviceable access doors in ducts and general construction (appropriately sized and located doors which allow proper damper servicing);
 9. Other requirements of the manufacturer's instructions and U.L.-listing.
- D. Do not attach/fasten retaining angles to wall or other construction, unless specifically required or directed to do so by the manufacturer's installation instructions.
- E. In addition to the requirements set forth elsewhere in these Specifications, sleeves and penetrations at fire rated construction shall be in accordance with the details and recommendations included in the SMACNA Guideline on Through-Penetration Firestopping.
- F. Where fire dampers exist at "angled" walls (i.e. where ducts cross rated walls which are not perpendicular to the duct axis) provide extended sleeves, and/or coordinate with the wall/framing contractor to build out the wall so that the damper can be installed squarely within the wall rating.

3.10 CLEANING EXISTING DUCTWORK

- A. Refer to specification section 23 01 30

3.11 FIELD QUALITY CONTROL

- A. Leakage Tests: Provide selective duct leakage testing of new ductwork as follows:
1. Duct systems in comfort air conditioning systems designed to operate at static pressures equal to or greater than 3" w.g. require leakage tested.
 2. When testing is required, representative duct sections totaling a minimum of 25% of the duct area of each supply and return air system are to be tested.
 3. Testing shall be performed in accordance with applicable SMACNA standards, and leakage shall be less than or equal to the maximum allowable leakage described in the energy efficiency standards for the jurisdiction.
- B. It is imperative that all effort is made to fabricate and install ductwork in such a manner as to minimize duct leakage. If any new HVAC system demonstrates inadequate performance, and this performance is potentially attributed to excessive duct leakage, the Architect/Engineer will require additional duct leakage testing.
- C. Duct leakage testing shall be provided at no additional cost to the Owner.
- D. Duct leakage testing shall be performed by an independent testing agency, in accordance with recognized procedures and standards published by SMACNA, ASHRAE, AABC, NEBB etc.
- E. The Mechanical Contractor, in conjunction with the Leakage Testing Agency, shall provide all materials, labor,

equipment, tools, etc., necessary to perform the required tests. This includes isolating equipment, providing temporary caps, making duct connections, wiring fans, etc., as required by the test procedures.

- F. In accordance with the recognized procedures and standards, leakage test reports shall be submitted to the Architect/Engineer for review. Test reports shall include acceptable performance according to the standards, and actual test results.
- G. If duct leakage is found to exceed acceptable limits, the Contractor shall make all necessary repairs, and re-test the failed ductwork, until the ductwork achieves the required performance. Repairs to, and retesting of, failed ductwork shall be made in a timely manner, and at no additional cost to the Owner.
- H. Operate installed ductwork and accessories to demonstrate compliance with requirements. Check for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and quiet performance.

3.12 EXTRA STOCK

- A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range.
- B. Furnish to Owner, three (3) operating keys for each type of air outlet and inlet that require them.

3.13 ADJUSTING AND CLEANING

- A. Clean ductwork internally, section by section as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.
- C. Verify all temporary closures have been removed.
- D. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- E. Adjust ductwork and accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- F. Final positioning of manual dampers is specified in Division-23 Section "TESTING, ADJUSTING, AND BALANCING".
- G. Balancing: Provide sufficient on-site manpower to assist the balancing contractor during balancing of air systems. Provide the necessary temporary caps and install dampers as required.

3.14 ACCEPTANCE TESTING

- A. At the completion of construction and prior to occupancy, perform acceptance tests to determine that all fire, heat and smoke protective devices function as intended and required to restrict the spread of fire and smoke under normal operating conditions. Identify and correct all deficiencies. Submit a written report of acceptance test procedures and findings. Verify the following:
 - 1. Protective device is installed in full compliance with the requirements of its listing and the manufacturer's instructions.
 - 2. For fire dampers, that the blades or curtains travel freely without binding or interferences throughout the normal path.
 - 3. For motor actuated devices, that the correct actuation occurs upon receipt of the actuation signal

and that the actuation signal is correctly provided as described in the sequence of operation for the device.

4. Proper duct access doors and general construction access doors, if required, have been installed, located and are of a size suitable to permit the inspection and servicing of the device.

END OF SECTION 23 30 00

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SECTION 23 34 00

FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following types of fans:

- 1. Power Roof Exhauster (PRE)

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
 - 1. Product data for selected models, including specialties, accessories, and the following:
 - a. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound power ratings in all octave bands (including 63 Hz) for the following:
 - a. Fan inlet.
 - b. Fan discharge.
 - c. Radiated casing.
 - 3. Motor ratings and electrical characteristics plus motor and fan accessories.
 - 4. Materials gages and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
- B. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
- C. Maintenance data for fans, for inclusion in Operating and Maintenance Manual.

1.04 QUALITY ASSURANCE

- A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- B. UL Compliance: Fans and components shall be UL listed and labeled. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code", and the requirements of Division 23 05 30, "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT".

- E. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data". Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating". Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
- F. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Lift and support units with the manufacturer's designated lifting or supporting points.
- B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.
- C. Deliver fan units as a factory assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolts into pad.
- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations specified in Division 07.
- C. Coordinate the size and location of structural steel support members.

1.07 EXTRA MATERIALS

- A. Furnish one additional complete set of belts for each belt driven fan.

PART 2 PRODUCTS

2.01 GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.
- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
- C. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70% of the first critical speed at the top of the speed range of the fan's class.
- D. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
- E. Service Factor: 1.4.
- F. Belts: Oil-resistant, non-sparking, and non-static.
- G. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
- H. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

2.02 POWER ROOF/WALL EXHAUSTERS (PRE, PWE, PRE-U)

- A. General Description: Belt or direct drive (as scheduled on the Drawings) fans for roof or wall mounting with integral domed housing. Motor assembly shall be mounted on vibration isolators.
- B. Materials: Housing shall be seamless spun aluminum, fan shall be aluminum.
- C. Fan Wheel: Backward inclined (BI).
- D. Bearings: Pillow block type with minimum (L50) life of 200,000 hours.
- E. Finish: None required.
- F. Accessories:
 - 1. Disconnect Switch: NEMA 1 enclosure within motor compartment.
 - 2. Provide upblast discharge where indicated.
 - 3. Provide motorized or gravity backdraft damper as indicated on the Drawings.
 - 4. Where grease exhaust service is scheduled on the Drawings, provide NEMA 3R external disconnect, grease collection, and other accessories as required to meet UL 762 listing and the requirements of NFPA 96.
- G. Manufacturers:
 - 1. Greenheck Model G, CU series.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 23 Section "VIBRATION CONTROLS".
- B. Secure roof mounted fans to roof curbs with cadmium plated hardware.
 - 1. Installation of roof curbs is specified in Division 07.
- C. Arrange installation of units to provide access space around fans for service and maintenance.

3.03 CONNECTIONS

- A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in Division 26.
2. Temperature control wiring and interlock wiring are specified in Division 23 Section "FACILITY MANAGEMENT SYSTEM".

C. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 ADJUSTING, CLEANING, AND PROTECTING

- A. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.05 COMMISSIONING

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory recommend lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full open position.
7. Disable automatic temperature control operators.

- B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Replace fan and motor pulleys as required to achieve design conditions.
3. Measure and record motor electrical values for voltage and amperage.
4. Shut unit down and reconnect automatic temperature control operators.

- C. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING" for procedures for air handling system testing, adjusting, and balancing.

END OF SECTION 23 34 00

SECTION 23 82 00

HEATING TERMINAL UNITS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this Section.

1.02 SUMMARY

- A. Extent of terminal unit work is indicated by Drawings and schedules, and by requirements of this Section.
- B. Types of terminal units required for project include the following:
 - 1. Duct reheat coils.
- C. Refer to other Division-23 sections for piping; ductwork; and testing, adjusting and balancing of terminal units; not work of this Section.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.
- B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
- D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
 - 1. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced-Circulation Air Cooling and Air Heating Coils".
 - 2. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
 - 3. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not

install damaged terminal units or components; replace with new.

- B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 – PRODUCTS

2.01 DUCT REHEAT COILS (WATER)

- A. General: Provide coils of size and in location indicated, and of capacities and having performance data as scheduled. Certify coil capacities, pressure drops, and selection procedures in accordance with ARI 410.
- B. Heating Coils:
 - 1. Fins: Construct of continuous aluminum smooth plate-fin type with full fin collars for accurate spacing and maximum fin-tube contact.
 - 2. Tubes: Construct of minimum 1/2" copper tubing, expanded into fin collars for permanent fin-tube bond and brazed to the header for permanent leaktight joint.
 - 3. Headers: Construct of round seamless copper tube. Hydrostatically test to 400 psi before assembly
 - 4. Casings: Construct of 16 gauge continuous coated galvanized steel with fins recessed into channels to minimize air bypass.
 - 5. Coil Types: Provide the following coil types as indicated, and as scheduled.
 - a. Hot Water to 200 psi, 220°F: Provide multi-row (as scheduled), same end connection coil.
- C. Manufacturer: Subject to compliance with requirements, provide coils of one of the following:
 - 1. Carner Corp.
 - 2. McQuay, Inc. – E-F5 series
 - 3. Temtrol Inc.
 - 4. Trane (The) Co. – 'T', 'TT', 'W', & 'WC' series
 - 5. USA Coil

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF COILS

- A. General: Install coils as indicated, and in accordance with manufacturer's installation instructions.
- B. Mount coils on independent supports hung from structure, refer to details on the Drawings.
- C. Pitch coil casings for drainage, not less than 1/2" toward return connections, except where drainage feature is included in coil design.

- D. Provide for each hot or chilled water coil unit, water supply, return connection, strainer, isolation valves, automatic temperature regulating valve, balancing device, as indicated.

3.03 ADJUSTING AND CLEANING

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION 23 82 00

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SECTION 26 0000

BASIC ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 SUMMARY

- A. This Section covers the basic requirements which are applicable to all electrical work and the testing of the completed electrical systems.
- B. Division 26 covers, in broad detail, the extent of the electrical work and the equipment to be provided and shall not be construed as a complete description of all of the details of design and construction required.
- C. The Contractor shall be responsible for reviewing all Contract Drawings and Specifications relating to the project to insure the fact that all related electrical work associated with other trades will be coordinated. No extra compensation will be allowed for his lack of compliance herewith.
- D. Provide all labor, materials, equipment, appliances and tools and perform all work necessary for the complete execution of the electrical work as shown on the Drawings, required by the Specifications and work not specifically shown or specified, yet required to insure proper and complete operation of all systems and to satisfy the design intent inherent in the work and to comply with all applicable codes and regulations. All electrical equipment shall be rated for the environment in which it is installed.

1.03 QUALITY ASSURANCE

- A. All materials, equipment, sizes, capacities and installation of electrical work shall conform to the latest requirements of the National Electrical Code, National Electrical Safety Code, the National Electrical Manufacturers Association, the board of Fire Underwriters, the Underwriter's Laboratories, Inc., the Institute of Electrical and Electronics Engineers, the prevailing State and Local Electrical Codes and EIA/TIA Telecommunications standard.
- B. Secure and pay for all permits and inspections required by any of the foregoing authorities. The electrical inspection shall be made and approved by the State and/or Local authority having jurisdiction.
- C. All electrical work shall be performed by duly licensed electricians who are qualified to do such work, and who are normally engaged in this type of work. Because of the complexity of the electrical work, unskilled labor is not permitted.

1.04 GUARANTEE

- A. Contractor shall guarantee all equipment and workmanship free from mechanical and electrical defects for a period of one year from the date of final acceptance. Any replacement of parts or adjustments, including labor made necessary by such defects or adjustments, shall be rectified without cost to the Owner.

1.05 SUBMITTALS

- A. Provide standard catalog cuts and shop Drawings of all materials and equipment. Shop Drawings shall indicate all sizes, rating, mechanical, electrical and functional features. Poor quality reproduced Shop Drawings will be rejected.

- B. Provide installation instructions and operation and maintenance manuals for all equipment.
- C. All submittals shall bear a stamp which indicates the Contractor has reviewed the submittals for compliance with the specifications. Stamp shall include contractor name, project title and date.
- D. Provide complete listing of all tests performed and copies of the certified test results.

1.06 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate installed conditions for:
 - 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - a. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - b. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.
- B. Properly store all materials and equipment in accordance with the manufacturers' recommendations and as required to protect them from damage and corrosion.
- C. Temporarily close all openings to prevent obstruction, damage or the intrusion of foreign materials.
- D. Before presenting a bid for the project, verify that all electrical equipment will be manufactured and delivered in a timely manner. Notify Engineer if any electrical equipment has an excessive lead time which may lead to construction delay.

1.08 SCHEDULING/SEQUENCING

- A. Notify Engineer at least one (1) week in advance of all testing so that he may witness the tests and testing procedures.

1.09 SITE VISITATION

- A. The Contractor shall visit the site and shall examine all existing conditions which may affect his work under this Contract. No claims for extra compensation will be allowed because of his lack of compliance herewith.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 – EXECUTION

3.01 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.02 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment.
- B. Coordinate electrical systems, equipment, and materials installation with other building components. Comply with the following requirements:
 - 1. Verify all dimensions by field measurements.
 - 2. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 3. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 6. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 7. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form.
 - 8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 9. Panelboards, switches, receptacles, control stations and other control and wiring devices shall be "flush mounted", complete with cover plates or doors, as applicable, unless otherwise shown or specified.
- C. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

3.03 INSPECTION

- A. Prior to performing work required under Division 26, carefully inspect all existing conditions and the installed work of all other trades and verify that all conditions and all such work is complete to the point where the electrical work may properly commence.

3.04 PERFORMANCE

- A. The Drawings indicate the general arrangement of electrical equipment, conduits and other work. Field verification of all dimensions is required. Specifications and Drawings are for assistance and guidance, but exact locations, distances and levels shall be governed by actual field conditions. Conduit runs and grounding are shown diagrammatic only, and the layout does not necessarily show the total number of conduits for the circuit required, nor is the location of indicated runs intended to show the actual routing of conduits.
- B. If any departures from the Drawings are deemed necessary by Contractor in order to furnish an efficient, complete and satisfactory installation, details of such departures and the reasons therefore shall be brought to the attention of Engineer.

3.05 FIELD QUALITY CONTROL

- A. Provide all labor, materials, testing equipment, electricity, fuel, lights, lubricants, equipment instruments and all other materials required for conducting all tests.
- B. Check for proper phase sequence and test all parts of the electrical system before placing them in service.
- C. All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show insulation resistance between phase conductors and ground of not less than that required by NEC, or as specified herein.
- D. Insulation test equipment, motors, cables, etc., shall pass the Standard Insulation Test established by the IEEE and shall be made before and after all required high potential tests. All insulation testers shall be of the motor driven, direct reading type, unless otherwise noted.
- E. Check all motors for proper rotation.

3.06 ADJUST AND CLEAN

- A. Clean all exposed electrical work and remove all unnecessary labels, soil, markings, and foreign materials. Do not remove labels required by the specifications, laws, regulations and codes (e.g.: UL Labels) or special labels warning of hazards, denoting special operating and maintenance procedures or labels with important or meaningful messages, directions or warnings.
- B. Replace all electrical appliances or equipment which have been damaged.

3.07 PROTECTION

- A. Contractor shall be responsible for proper protective and safety measures when working under the provisions of the Contract.

3.08 CUTTING AND PATCHING

- A. Refer to specification section 010450 for requirements.

END OF SECTION

SECTION 26 0100

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements"

1.02 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with electrical installations as follows:
 - 1. Selective demolition including:
 - a. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
 - b. Dismantling electrical materials and equipment made obsolete by these installations.
 - 2. Excavation for underground utilities and services, including underground raceways, vaults, and equipment.
 - 3. Miscellaneous metals for support of electrical materials and equipment.
 - 4. Joint sealers for sealing around electrical materials, equipment and for sealing penetrations floors and walls.
 - 5. Firestopping materials for sealing penetrations in fire and smoke barriers, floors and foundation walls.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for electrical materials and equipment.
- C. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of electrical service, and details for dust and noise control.
 - 1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver joint sealer and firestopping materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle joint sealer and firestopping materials in compliance with the manufacturers' recommendations

to prevent their deterioration and damage.

1.05 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
3. The contractor shall maintain any process equipment, utility, etc., necessary to maintain continuous treatment. Any such equipment that must be relocated, either temporarily or permanently, or any process equipment, utilities, etc., that must be installed, either temporarily or permanently, to maintain wastewater or sludge treatment shall be the responsibility of the Contractor. The Contractor shall include the cost of all temporary facilities required to maintain treatment, meeting secondary standards, during the construction period in his bid prices. The cost shall include the cost of all labor, tools, equipment and materials necessary.

B. Conditions Affecting Excavations: The following project Conditions apply:

1. It is the responsibility of the Contractor to maintain and protect existing building services which passes through the area affected by selective demolition. Contractor shall include in his bid price all costs (material, labor, etc.) associated to maintain these services and/or temporarily refeed.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
3. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
4. Remove existing underground utilities indicated to be removed.
5. Uncharted or Incorrectly Charted Utilities: Contact utility owner immediately for instructions.
 - a. Provide temporary utility services to affected areas. Provide minimum of 48-hour notice to owner prior to utility interruption.

1.06 EXISTING ELECTRICAL SYSTEM

- A. In general, the existing electrical system shall be removed, unless noted otherwise on the drawings, in areas of remodeling and renovation.
- B. All electrical work shall be removed in areas where alterations and modifications are to be performed.
- C. Any device which is to remain but becomes de-energized by removal of existing work shall be rewired and/or reconnected as required to maintain service to the device in question.

1.07 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical service with the Owner and the utility company.
- B. Notify the Owner at least 5 days prior to commencing demolition operations.

- C. Perform demolition in phases as indicated.

1.08 CONTINUITY OF SERVICE

- A. The Contractor shall guarantee continuance of electrical service to all areas of the project presently receiving electrical service which are not designated as construction areas. The Contractor shall schedule, with the Owner, power shutdowns one (1) week in advance.

1.09 PENETRATIONS

- A. Except where absolutely necessary, do not penetrate roofs and waterproof surfaces. Where required, make penetrations prior to the application of roofing and waterproofing materials and provide all sleeves, pitch-pockets and other acceptable items. Advise Architect in advance before making such penetrations, even where such penetrations are shown on the Drawings.
- B. All penetrations through rated assemblies shall maintain the requirements of the assembly rating.

1.10 FIELD PAINTING

- A. Unless otherwise specified, paint all exposed electrical work in accordance with the requirements set forth in Division 01, except for the following:
 - 1. Contractor shall touch up all painted surfaces of equipment supplied that have been damaged during the construction process. Touch-up paint shall match finish coat.
 - 2. Where touch-ups do not blend in with adjacent surfaces, as determined by Architect, replace or completely repaint the entire piece in question.

PART 2 – PRODUCTS

2.01 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners: Zinc-coated, type, grade, and class as required.

2.02 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Elastomeric Joint Sealers: Provide the following types:
 - 1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.

2. One part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
3. Products: Subject to compliance with requirements, provide one of the following:
 - a. One-Part, Nonacid-Curing, Silicone Sealant:
 - 1) "Chem-Calk-N-Cure 1200," Bostic Construction Products Div. "Dow Corning 790," Dow Corning Corp.
 - 2) "Silglaze N SCS 2501," General Electric Co.
 - 3) "Silpruf SCS 2000," General Electric Co.
 - 4) "864," Pecora Corp.
 - 5) "Spectrum 1," Tremco, Inc.
 - 6) "Spectrum 2," Tremco, Inc.
 - 7) "Dow Corning 795," Dow Corning Corp.
 - 8) "Omniseal," Sonneborn Building Products Div.
 - 9) "Chem-Calk 2200," Bostik Construction Products Div.
 - 10) "Gesil N SCS 2600," General Electric Co.
 - b. One-Part, Mildew-Resistant, Silicone Sealant:
 - 1) "Dow Corning 786," Dow Corning Corp.
 - 2) "SCS 1702 Sanitary," General Electric Co.
 - 3) "863 #345 White," Pecora Corp.
 - 4) "Proglaze White," Tremco Corp.
 - 5) "OmniPlus," Sonneborn Building Products Div.
- D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremco Acrylic Latex 834," Tremco, Inc.

2.03 FIRESTOPPING

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of joint sealers. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers and Firestopping Materials: Clean surfaces of joints immediately before applying joint sealers and firestopping materials to comply with recommendations of manufacturer.
- B. Apply primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing seal.

3.03 SELECTIVE DEMOLITION

- A. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
 - 1. All electrical equipment designated by drawings or by the owner to be kept, shall be turned over to the Owner at a location on the premises.
- C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged. All other material shall be removed off site by the contractor at no additional cost to the owner.
- D. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete raceway systems, controls, and fixtures.
 - a. Raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings.
 - 2. Perform cutting and patching required for demolition in accordance with Division 01.

3.04 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.05 APPLICATION OF JOINT SEALERS AND FIRESTOPPING MATERIALS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

END OF SECTION 26 0100

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SECTION 26 01 01

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. Requirements specified in Division 26 Section "Basic Electrical Requirements" and Division 26 Section "Basic Electrical Materials and Methods" apply to this Section, and is part of each Division 25 and 26 section making reference to electrical connections for equipment specified herein.

1.02 DESCRIPTION OF WORK

- A. Extent of electrical connections for equipment is indicated by drawings and schedules. Electrical connections are hereby defined to include connections used for providing electrical power to equipment.
- B. Applications of electrical power connections specified in this section include the following:
 - 1. To resistive heaters.
 - 2. From electrical source to motor starters.
 - 3. From motor starters to motors.
 - 4. To lighting fixtures.
 - 5. To converters, rectifiers, transformers, inverters, rheostats, and similar current adjustment features of equipment.
 - 6. To grounds including earthing connections.
 - 7. To master units of communication, signal, alarm, clock, public address, sound, and video systems.
- C. Motor starters and controllers, not furnished as integral part of equipment, are specified in applicable Division-26 sections, and are work of this section.
- D. Refer to Division-25 sections for motor starters and controllers furnished integrally with equipment; not work of this section.
- E. Junction boxes and disconnect switches required for connecting motors and other electrical units of equipment are specified in applicable Division-26 sections, and are work of this section.
- F. Refer to sections of other Divisions for specific individual equipment power requirements, not work of this section.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of electrical connectors and terminals, of types and ratings required, and ancillary connection materials, including electrical insulating tape, soldering fluxes, and cable ties, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. NEC Compliance: Comply with applicable requirements of NEC as to type products used and installation of electrical power connections (terminals and splices), for junction boxes, motor starters, and disconnect switches.

- C. ANSI Compliance: Comply with applicable requirements of ANSI/NEMA and ANSI/EIA standards pertaining to products and installation of electrical connections for equipment.
- D. UL Compliance: Comply with UL Std 486A, "Wire Connectors and Soldering Lugs for Use With Copper Conductors" including, but not limited to, tightening of electrical connectors to torque values indicated. Provide electrical connection products and materials which are UL-listed and -labeled.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver electrical connection products wrapped in proper factory-fabricated type containers.
- B. Store electrical connection products in original cartons and protect from weather, construction traffic and debris.
- C. Handle electrical connection products carefully to prevent breakage, denting, and scoring finish.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following (for each type of product):
 - 1. Adalet-PLM
 - 2. AMP Incorporated.
 - 3. Appleton Electric Co.
 - 4. Arrow-Hart Div, Crouse-Hinds Co.
 - 5. Buchanan Construction Products
 - 6. Burndy Corporation.
 - 7. Eagle Electric Mfg Co., Inc.
 - 8. Electroline Mfg Co.
 - 9. General Electric Co.
 - 10. Gould, Inc.
 - 11. Hubbell Inc.
 - 12. Ideal Industries, Inc.
 - 13. Neer Manufacturing
 - 14. Pyle National Co.
 - 15. Reliable Electric Co.
 - 16. Square D Co.
 - 17. Thomas and Betts Corp.
 - 18. 3M Electrical Products Division

2.02 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Metal Conduit, Tubing and Fittings:
 - 1. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) indicated for each type service. Where types and grades are not indicated, provide proper selection as determined by Installer to fulfill wiring requirements and comply with NEC requirements for raceways. Provide products complying with Division-26 basic electrical materials and methods section "Raceways".

C. Wires, Cables, and Connectors:

1. General: Provide wires, cables and connectors complying with Division-26 basic electrical materials and methods section "Wires and Cables".
2. Connectors and Terminals: Provide electrical connectors and terminals which mate and match, including sizes and ratings, with equipment terminals and are recommended by equipment manufacturer for intended applications.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect area and conditions under which electrical connections for equipment are to be installed and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Install electrical connections as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Coordinate with other work, including wires/cables, raceway and equipment installation, as necessary to properly interface installation of electrical connections for equipment with other work.
- C. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment.
- D. Cover splices with electrical insulating material equivalent to, or of greater insulation resistivity rating, than electrical insulation rating of those conductors being spliced.
- E. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Also avoid "ringing" copper conductors while skinning wire.
- F. Trim cables and wires as short as practicable and arrange routing to facilitate inspection, testing and maintenance.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers published torque tightening values for equipment connectors. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Where manufacturer's torquing requirements are not available, tighten connectors and terminals to comply with torquing values contained in UL's 486A.

3.03 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source, test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

END OF SECTION 26 01 01

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SECTION 26 05 33

RACEWAYS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this Section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"
 - 3. "Supporting Devices" for raceway supports

1.02 SUMMARY

- A. This Section includes raceways for electrical wiring. Types of raceways in this section include the following:
 - 1. Electrical metallic tubing.
 - 2. Flexible metal conduit.
 - 3. Intermediate metal conduit.
 - 4. Liquid tight flexible conduit.
 - 5. Rigid metal conduit.
 - 6. Surface raceways.
 - 7. Wireway.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product Data for the following products:
 - a. Surface raceway and fittings.
 - b. Wireway and fittings.

1.04 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL, ETL, or CSA.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate with other Work, including metal and concrete deck installation, as necessary to interface installation of electrical raceways and components with other Work.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Conduit:
 - a. Allied Tube & Conduit Co.
 - b. LTV Steel
 - c. Robroy Inc.
 - d. Triangle PWC, Inc.
 - e. Wheatland Tube Co.
2. Conduit Bodies:
 - a. Adalet-PLM
 - b. Appleton Electric Co.
 - c. Crouse-Hinds Division, Cooper Industries, Inc.
 - d. Killark Electric Mfg. Co.
 - e. O-Z/Gedney
 - f. Spring City Electrical Mfg. Co.
3. Wireway:
 - a. Anchor Electric Co.
 - b. Circle AW Products.
 - c. Cross Brothers, Inc.
 - d. Erickson Electric Equipment Co.
 - e. GS Metals Corp.
 - f. Hoffman Engineering Co.
 - g. Square D Co.
4. Surface Raceway:
 - a. Carlon, Inc.
 - b. Hubbell Co.
 - c. The Wiremold Co.

2.02 METAL CONDUIT AND TUBING

- A. General: Minimum conduit size shall be 3/4" for interior installation and 1" for exterior underground installations.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Intermediate Steel Conduit: UL 1242.
- D. Electrical Metallic Tubing: ANSI C80.3.
- E. Flexible Metal Conduit: UL 1, zinc-coated steel.
- F. Liquidtight Flexible Metal Conduit: UL 360.

2.03 CONDUIT BODIES

- A. General: Types, shapes, and sizes as required to suit individual applications, NEC requirements and NEC

bending radius. Provide matching gasketed covers secured with corrosion-resistant screws.

- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways. Conduit bodies used with rigid metal conduit shall have malleable iron bodies and stamped steel covers. Use gaskets in all damp and wet locations. Conduit bodies shall have threaded hubs. Conduit bodies shall be standard type for 2-inch size and under, long body type for sizes over 2 inches.

2.04 CONNECTORS AND FITTINGS

- A. Of indicated types, sizes, and NEMA classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with accessories required for the intended use. Provide gaskets for units in damp or wet locations. All connectors and fittings shall comply with applicable provisions of NEC Article 314 and be listed for their intended use. Furnish and install raceway expansion fittings at all building expansion joints, where indicated on the architectural drawings.
 - 1. Metal Conduit: Termination for threaded conduit shall be double locknut with bushings. Use watertight type locknut in all damp or wet locations. Bushings shall be plastic or insulated metal.
 - 2. Electrical Metal Tubing: Connectors and couplings shall be die-cast set screw type for conduit over 1" diameter and compression type for conduit 1" and smaller.
 - 3. Flexible Metal Conduit: Anti-short bushings shall be installed at all ends of flexible metal conduit.

2.05 WIREWAYS

- A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.
- B. Wireway covers shall be hinged type, unless otherwise noted.

2.06 SURFACE RACEWAYS

- A. General: Sizes and channels as indicated. Provide fittings that match and mate with raceway. Raceways shall comply with applicable UL 5 requirements.
- B. Surface Metal Raceway: Construct of galvanized steel with removable covers. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application and all required components for a complete system.
 - 1. Wiremold - 2100, 3000, 4000 or 6000 series.
- C. Surface Single Channel Raceway: Low-profile single channel metallic raceway with base and removable cover furnished as a preassembled unit.
 - 1. Wiremold - V200, V500 or V700 series.
 - 2. Hubbell - Media Track MT1, MT3 or MT4 series.
 - 3. Carlon - SC series.

PART 3 – EXECUTION

3.01 WIRING METHOD

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: rigid metal conduit.

2. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: Liquid tight flexible metal conduit.
- B. Indoors: Use the following wiring methods:
 1. Connection to Vibrating Equipment in Dry Locations: Including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: flexible metal conduit.
 2. Connection to vibrating equipment and hydraulic, pneumatic, or electric solenoid or motor-driven equipment in moist or humid location or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: Liquidtight flexible metal conduit.
 3. Exposed:
 - a. In unfinished areas: electrical metallic tubing, unless otherwise noted.
 - b. In mechanical and electrical rooms: electrical metallic tubing, unless otherwise noted.
 - c. In Finished spaces on existing masonry construction: Surface metal raceway .
 4. Concealed: electrical metallic tubing.

3.02 INSTALLATION

- A. General: Install electrical raceways in accordance with manufacturer's written installation instructions and applicable requirements of NEC.
- B. Conceal Conduit and EMT, unless indicated otherwise, within finished walls, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.
- C. Elevation of Raceway: Install horizontal raceway runs above water and steam piping.
- D. Provide supports for raceways as specified elsewhere in Division 26.
- E. Prevent foreign matter from entering raceways by using temporary closure protection.
- F. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- G. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- H. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.
- I. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors.
- K. Prior to locating and installing conduits, check the Contract Drawings and the work of other trades to be sure that the locations of all conduits and boxes will not interfere with the work of other trades and that conduit stubs for

motors and equipment will be placed in proper locations.

- L. There shall be separate raceway systems for all voltages and system types. All wiring shall be in raceway systems.
- M. Holes through existing concrete walls, for conduit installation, shall be made with a core drill.
- N. All raceways penetrating walls shall be sealed on both sides with approved sealant material.
- O. Hanger rods for supporting raceway shall be all-thread galvanized rod. Minimum size rod shall be 1/4 inch, use larger rods where required for supporting loads heavier than recommended for 1/4-inch rods.
- P. Raceways shall be fastened with malleable iron beam clamps or stamped steel or malleable iron one-hole straps, or "minerallac" type conduit hangers. Spring steel fasteners as manufactured by Cady or approved equal, may be used in stud walls and above ceilings.
- Q. Perforated strap hangers are not permitted.
- R. Raceways fastened directly to concrete, brick or block walls or concrete ceiling shall be rigidly secured by means of proper size machine screws, or bolts, and lead expansion type shields. Plastic or fiber expansion shields are not permitted. Toggle bolts may be used with hollow concrete blocks.
- S. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box.
- T. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- U. Install pull wires in empty raceways. Use no. 14 AWG wire or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- V. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits enter or leave hazardous locations.
 - 2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - 3. Where required by the NEC.
- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install removable flush plugs flush with floor.
- X. Flexible Connections: Use short length (maximum of 6 ft.) of flexible conduit for recessed and semi recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Install separate ground conductor across flexible connections.
- Y. Surface Metal Raceway: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals.
- Z. Select each surface metal raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to

provide a seat for the fixture canopy.

- AA. Where a surface metal raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy, with or without extension ring, the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
- BB. Provide surface metal raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem suspension.
- CC. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, provide a backplate slightly smaller than the fixture canopy, and no additional surface mounted outlet box need be installed.

3.03 ADJUSTING AND CLEANING

- A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION 26 05 33

SECTION 26 0519

WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements"
 - 2. "Cabinets, Boxes and Enclosures"

1.02 SUMMARY

- A. This Section includes wires, cables, and connectors for power, lighting, and related systems rated 600 volts and less.

1.03 SUBMITTALS

- A. Product Data for electrical wires, cables and connectors.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following code:
 - 1. NFPA 70 "National Electrical Code."
- B. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
- C. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
 - 1. UL Std. 83 Thermoplastic-Insulated Wires and Cables.
- D. NEMA/ICEA Compliance: Provide components which comply with the following standards:
 - 1. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - 2. WC-7 Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
 - 3. WC-8 Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- E. IEEE Compliance: Provide components which comply with the following standard.
 - 1. Std. 82 Test procedures for Impulse Voltage Tests on Insulated Conductors.
- F. All wire and cable shall conform to the requirements of the National Electrical Code and shall meet all A.S.T.M. Specifications. Wire and cable shall be new, manufactured within one year of date of installation, shall have size, grade of insulation, voltage rating and manufacturer's name permanently marked on the outer covering at intervals not exceeding 24 inches, and shall be delivered in complete coils or reels with identifying size and insulation tag.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wire and Cable:

- a. American Insulated Wire Corp.
- b. Carol Cable Co. Inc.
- c. Essex Group, Inc.
- d. Rome Cable
- e. Senator Wire and Cable Co.
- f. Southwire Company.
- g. Triangle Wire

2. Connectors for Wires and Cable Conductors:

- a. AMP
- b. 3M Company
- c. O-Z/Gedney Co.
- d. Square D Co.

2.02 WIRES AND CABLES

- A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.
- B. Conductors: Provide solid conductors for power and lighting circuits no. 10 AWG and smaller. Provide stranded conductors for sizes no. 8 AWG and larger. Minimum size no. 12 AWG for power.
- C. Conductor Material: copper conductors with conductivity of not less than 95% at 20 deg. C (68 deg. F).
- D. Insulation: Provide THHN/THWN insulation for all conductors size no. 8 AWG and smaller. For all other sizes provide THHN/THWN or XHHW insulation as appropriate for the locations where installed.
- E. Color Coding for phase identification in accordance with Table 1 in Part 3 below.
- F. Jackets: Factory-applied nylon or PVC external jacketed wires and cables for pulls in raceways over 100-feet in length, for pulls in raceways with more than three equivalent 90 deg. bends, for pulls in conduits underground or under slabs on grade, and where indicated.

2.03 CONNECTORS FOR CONDUCTORS

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 EXECUTION

3.01 WIRING METHOD

A. Use the following wiring methods as indicated:

- 1. Wire: install all wire in raceway.
- 2. Metal Clad Cable, Type MC: for wiring in gypsum board partitions and for connections from raceway

outlet boxes to lighting fixtures.

- B. All 120V and 277V single-phase branch circuits shall have a dedicated full-sized neutral conductor. The sharing of the neutral conductor for single-phase loads on a three-phase system is not allowed.

3.02 INSTALLATION OF WIRES AND CABLES

- A. General: Install electrical cables, wires, and connectors in compliance with NEC.
- B. Coordinate cable installation with other Work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- E. Conceal all cable in finished spaces.
- F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.
- G. Keep conductor splices to minimum.
- H. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- I. Use splice and tap connectors which are compatible with conductor material.
- J. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- K. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.
- L. All single-phase branch circuits shall be wired with dedicated full sized neutral conductor. The use of shared neutrals is not allowed.

3.03 FIELD QUALITY CONTROL

- A. The Electrical Contractor shall furnish all test equipment and labor necessary to perform insulation tests as specified herein.
- B. Test all wiring set under this Section using an approved type constant "megger". Leave name free from any grounds, crosses, shorts, etc., and leave all materials and apparatus in first class working condition. All wires that are shorted or unintentionally grounded shall be replaced at no additional costs.
- C. The Contractor shall megger and record all 600 volt insulated conductors size #2 AWG and larger using Contractor furnished 500 volt megger for one minute. Disconnect motors and transformers during tests. Make tests on circuits isolated from source and load. Submit three (3) sets of cable test results to Engineer for review.
- D. Make any additional tests required by the Owner, Engineer or any authorities having jurisdiction.
- E. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

F. TABLE 1: Color Coding for Phase Identification:

1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208Y/120 Volts	Phase	480Y/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	White
Green	Ground	Green

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other sections of these Specifications.
- B. Requirements of the following Division 26 sections apply to this section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Materials and Methods"
 - 3. "Wires and Cables"
 - 4. "Raceways"

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
 - 1. Product data for ground rods, connectors and connection materials, and grounding fittings.

1.04 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- B. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).
- D. Comply with UL Standards:
 - 1. UL 467, "Grounding and Bonding Equipment."
 - 2. UL 869, "Electrical Service Equipment."
 - 3. UL 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. A.B. Chance Co.
2. Erico Products, Inc.
3. Galvan Industries, Inc.
4. GB Electrical, Inc.
5. Ideal Industries, Inc.
6. Kearney.
7. Lyncole XIT Grounding.
8. McGill Electrical Products Group.
9. O-Z/Gedney.
10. Racor, Inc.
11. Thomas & Betts Corp.
12. W.H. Salisbury & Co.
13. Utilco Co.

2.02 GROUNDING AND BONDING PRODUCTS

- A. Products: Product types indicated, sizes and ratings shall comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern. All products shall comply with NEC, UL, and IEEE requirements.
- B. Conductor Materials: Copper.

2.03 WIRE AND CABLE CONDUCTORS

- A. General: Comply with Division 26 Section "Wires and Cables." Conform to NEC Chapter 9 Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Green insulated.
- C. Bare Copper Conductors: Conform to the following:
 1. Solid Conductors: ASTM B-3.
 2. Assembly of Stranded Conductors: ASTM B-8.
 3. Tinned Conductors: ASTM B-33.

2.04 MISCELLANEOUS CONDUCTORS

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 gauge bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.05 CONNECTOR PRODUCTS

- A. General: Listed and labeled as grounding connectors for the materials used.
- B. Pressure Connectors: High-conductivity-plated units.
- C. Bolted Clamps: Heavy-duty units listed for the application.
- D. Electrical Grounding Connection Accessories: Electrical insulating tape, heat-shrinkable insulating tubing, welding materials.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
- B. Install separate insulated equipment grounding conductors with circuit conductors in all raceway systems.
- C. Signal and Communications: For telephone, alarm, and communication systems, provide a #4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location.
- D. Separately derived systems required by NEC to be grounded shall be grounded in accordance with NEC paragraph 250-30.

3.02 INSTALLATION

- A. General: Ground electrical systems and equipment in accordance with NEC requirements except where the Drawings or Specifications exceed NEC requirements.
- B. Telecommunication Room Ground Bus: Size, location, and arrangement as indicated. Space 1 inch from wall and support from wall 6 inches above finished floor, except as otherwise indicated.
- C. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
- D. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- E. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.

3.03 CONNECTIONS

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
- B. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
- C. Make connections with clean bare metal at points of contact.
- D. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.
- E. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
- F. Coat and seal connections involving dissimilar metals with anti-oxidation compound to prevent future penetration of moisture to contact surfaces.
- G. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical

connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

- H. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

3.04 FIELD QUALITY CONTROL

- A. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."
- B. Ground/resistance maximum values shall be as follows:
 - 1. Equipment rated 500 kVA and less: 10 Ohms
 - 2. Equipment rated 500 kVA to 1000 kVA: 5 Ohms
 - 3. Equipment rated over 1000 kVA: 3 Ohms
- C. Deficiencies: Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated the provisions of the Contract, covering changes will apply.
- D. Report: Prepare test reports, certified by the testing organization, of the ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

END OF SECTION 26 05 26

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SECTION 26 0529
SUPPORTING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"
 - 3. Refer to other Division 26 sections for additional specific support requirements that may be applicable to specific items.

1.02 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

1.03 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Slotted Metal Angle and U-Channel Systems:
 - a. Allied Tube & Conduit
 - b. B-Line Systems, Inc.
 - c. Cinch Clamp Co., Inc.
 - d. GS Metals Corp.
 - e. Haydon Corp.
 - f. Unistrut Corp.
 - 2. Conduit Sealing Bushings:
 - a. Bridgeport Fittings, Inc.
 - b. Cooper Industries, Inc.
 - c. GS Metals Corp.
 - d. Killark Electric Mfg. Co.
 - e. Madison Equipment Co.
 - f. L.E. Mason/Red Dot Div.
 - g. O-Z/Gedney

- h. Producto Electric Corp.
- i. Raco, Inc.
- j. Red Seal Electric Corp.
- k. Spring City Electrical Mfg. Co.
- l. Thomas & Betts Corp.

2.02 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.03 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features as follows:
 - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts: All steel springhead type.
 - 3. Powder-Driven Threaded Studs: Heat-treated steel, designed specifically for the intended service.
- C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- D. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.04 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:
 - a. 3-inch and smaller: 20-gage
 - b. 4-inch to 6-inch: 16-gage
 - c. over 6-inch: 14-gage
 - 2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC

requirements.

- B. Coordinate with the building structural system and with other electrical installation.
- C. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.
 - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
 - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 - 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 - 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 - 6. Space supports for raceways in accordance with the NEC.
 - 7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
- D. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- E. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
- F. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:
 - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
 - 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
 - 3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

END OF SECTION 26 05 29

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"

1.02 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
 - 1. Identification labeling for cables and conductors.
 - 2. Operational instruction signs.
 - 3. Warning and caution signs.
 - 4. Equipment labels and signs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section "Wires and Cables" for requirements for color coding of conductors for phase identification.
- C. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product Data for each type of product specified.
- C. Schedule of identification nomenclature to be used for identification signs and labels.
- D. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.04 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the Identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. American Labelmark Co.
 2. Ideal Industries, Inc.
 3. LEM Products, Inc.
 4. Markal Corp.
 5. Panduit Corp.
 6. Seton Name Plate Co.
 7. Standard Signs, Inc.
 8. W.H.Brady, Co.

2.02 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- B. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with Eyelet for fastener.
- C. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick and 3 inches in length; 1/8-inch thick for larger sizes. Engraved legend in white letters on black face and punched for mechanical fasteners.
- D. Baked-Enamel Warning and Caution Signs for Interior Use:
1. Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.
- E. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, nonfading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide 1/4-inch grommets in corners for mounting.
- F. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.
- G. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color coding.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.
- B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- D. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

- E. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
1. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
 2. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.
- F. Tag or label conductors as follows:
1. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
 2. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure (except for three- circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- G. Install equipment/system circuit/device identification as follows:
1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment provided. Provide singleline of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
 - a. Electrical cabinets, and enclosures.
 - b. Motor starters.
 - c. Disconnect Switches
 - d. Pushbutton stations.
 - e. Contactors.
 - f. Remote-controlled switches.
 - g. Control devices.
 2. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above.
 3. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION 26 05 53

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SECTION 26 27 16

CABINETS, BOXES, AND ENCLOSURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"
 - 3. "Raceways"

1.02 SUMMARY

- A. This section includes cabinets, boxes, and enclosures for electrical installations. Types of products specified in this Section include:
 - 1. Outlet and device boxes.
 - 2. Pull and junction boxes.
 - 3. Floor boxes.
 - 4. Cabinets.
 - 5. Hinged door enclosures.

1.03 DEFINITIONS

- A. Cabinet: An enclosure designed either for surface or for flush mounting and having a frame, or trim in which a door or doors may be mounted.
- B. Device Box: An outlet box designed to house a receptacle device or a wiring box designed to house a switch.
- C. Enclosure: A box, case, cabinet, or housing for electrical wiring or components.
- D. Hinged Door Enclosure: An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box.
- E. Outlet Box: A wiring enclosure where current is taken from a wiring system to supply utilization equipment.
- F. Wiring Box: An enclosure designed to provide access to wiring systems or for the mounting of indicating devices or of switches for controlling electrical circuits.

1.04 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
- B. Product data for floor boxes and for cabinets and enclosures with classification higher than NEMA 1.
- C. Shop drawings for boxes, enclosures and cabinets that are to be shop fabricated, (nonstock items). For shop fabricated junction and pull boxes, show accurately scaled views and spatial relationships to adjacent equipment. Show box types, dimensions, and finishes.

1.05 QUALITY ASSURANCE

- A. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.
- B. National Electrical Code Compliance: Components and installation shall comply with NFPA 70 "National Electrical Code."
- C. NEMA Compliance: Comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

- 1. Floor Boxes:

- a. Appleton Electric Co.
- b. Cooper Industries, Inc.
- c. General Electric
- d. Hubbell
- e. Racor, Inc.
- f. Steel City
- g. Thomas & Betts Corp.
- h. The Wiremold Company

- 2. Cabinets:

- a. Electric Panelboard, Inc.
- b. Erickson Electrical Equipment Co.
- c. Hoffman Engineering Co.
- d. Parker Electrical Mfg. Co.
- e. Square D Co.

2.02 CABINETS, BOXES, AND FITTINGS, GENERAL

- A. Electrical Cabinets, Boxes, and Fittings: Of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

2.03 MATERIALS AND FINISHES

- A. Sheet Steel: Flat-rolled, code-gage, galvanized steel.
- B. Fasteners for General Use: Corrosion resistant screws and hardware including cadmium and zinc plated items.
- C. Fasteners for Damp or Wet Locations: Stainless steel screws and hardware.
- D. Cast Metal for Boxes, Enclosures, and Covers; Copper-free aluminum except as otherwise specified.
- E. Exterior Finish: Gray baked enamel for items exposed in finished locations except as otherwise indicated.
- F. Painted Interior Finish: Where indicated, white baked enamel.
- G. Fittings for Boxes, Cabinets, and Enclosures: Conform to UL 514B. Malleable iron or zinc plated steel for conduit hubs, bushings and box connectors.

2.04 METAL OUTLET, DEVICE, AND SMALL WIRING BOXES

- A. General: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size, and depth to suit each location and application.
- B. Steel Boxes: Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.
- C. Cast-Aluminum Boxes: Copper free aluminum threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices and closure plugs.
- D. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- E. Cast-Iron Floor Boxes: Fully adjustable, watertight, cast iron construction with (4) independent wiring compartments allowing for (2) duplex receptacles and (2) tel/data service outlets.
- F. Steel Floor Boxes: Fully adjustable, concrete-tight, stamped steel construction with (4) independent wiring compartments allowing for (2) duplex receptacles and (2) tel/data service outlets.
- G. Service Fittings for Floor Outlet Boxes: Flush mounted, fully recessed activation fittings. Type as specified on drawings with carpet trim, plate with wire management blocks or flush plate with trim ring.

2.05 FLOOR BOXES

- A. Furnish and install floor boxes where indicated on the drawings, complete with wiring device, carpet flange and covers. Steel floor boxes shall be used for above grade applications and cast iron for on grade or below grade applications.
- B. The below floor boxes and accessories shall be as manufactured by The Wiremold Company or approved equal.
- C. Floor boxes shall be as follows:
 - 1. Steel: Walkerbox cat. no. RFB4 or RFB4-SS.
 - 2. Cast Iron: Walkerbox cat. no. RFB4-CI-1.

2.06 PULL AND JUNCTION BOXES

- A. General: Comply with UL 50, "Electrical Cabinets and Boxes", for boxes over 100 cubic inches volume. Boxes shall have screwed or bolted on covers of material same as box and shall be of size and shape to suit application.
- B. Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing.
- C. Hot-Dipped Galvanized Steel Boxes: Sheet steel with welded seams. Where necessary to provide a rigid assembly, construct with internal structural steel bracing. Hot-dip galvanized after fabrication. Cover shall be gasketed.
- D. Stainless-Steel Boxes: Fabricate of stainless-steel conforming to Type 302 of ASTM A 167, "Specification for Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip." Where necessary to provide a rigid assembly, construct with internal structural stainless-steel bracing. Cover shall be gasketed.
- E. Cast-Aluminum Boxes: Molded of copper free aluminum, with gasketed cover and integral threaded conduit entrances.
- F. Cast-Iron Boxes: Molded of cast iron alloy with gasketed cover and integral threaded conduit entrances.

- G. Boxes Approved for Classified Locations: Cast metal or cast nonmetallic boxes conforming to UL 886, "Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations," listed and labeled for use in the specific location classification, and with the specific hazardous material encountered. Conduit entrances shall be integral threaded type.

2.07 CABINETS

- A. Comply with UL 50, "Electrical Cabinets and Boxes."
- B. Construction: Sheet steel, NEMA 1 class except as otherwise indicated. Cabinet shall consist of a box and a front consisting of a one piece frame and a hinged door. Arrange door to close against a rabbet placed all around the inside edge of the frame, with a uniformly close fit between door and frame. Provide concealed fasteners, not over 24-inches apart, to hold fronts to cabinet boxes and provide for adjustment. Provide flush or concealed door hinges not over 24-inches apart and not over 6-inches from top and bottom of door. For flush cabinets, make the front approximately 3/4 inch larger than the box all around. For surface mounted cabinets make front same height and width as box.
- C. Doors: Double doors for cabinets wider than 24-inches. Telephone cabinets wider than 48-inches may have sliding or removable doors.
- D. Locks: Combination spring catch and key lock, with all locks for cabinets of the same system keyed alike. Locks may be omitted on signal, power, and lighting cabinets located within wire closets and mechanical-electrical rooms. Locks shall be of a type to permit doors to latch closed without locking.

2.08 STEEL ENCLOSURES WITH HINGED DOORS

- A. Comply with UL 50, "Cabinets and Enclosures" and NEMA ICS 6, "Enclosures for Industrial Controls and Systems."
- B. Construction: Sheet steel, 16 gage, minimum, with continuous welded seams.
- C. Doors: Hinged directly to cabinet and removable, with approximately 3/4-inch flange around all edges, shaped to cover edge of box. Provide handle operated, key locking latch. Individual door width shall be no greater than 24-inches. Provide multiple doors where required.
- D. Mounting Panel: Provide painted removable internal mounting panel for component installation.
- E. Enclosure: NEMA 12 surface mounted, except as indicated. Where door gasketing is required, provide neoprene gasket attached with oil-resistant adhesive, and held in place with steel retaining strips. For all enclosures of class higher than NEMA 1, use hubbed raceway entrances.

2.09 CAST METAL ENCLOSURES WITH HINGED DOORS

- A. Copper free aluminum with bolted, hinged doors. Where used at hazardous (classified) locations, enclosures shall conform to UL and shall be listed and labeled for the classification of hazard involved.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. Locations: Install items where indicated and where required to suit code requirements and installation conditions.
- B. Cap unused knockout holes where blanks have been removed and plug unused conduit hubs.
- C. Support and fasten items securely in accordance with Division 26 Section "Supporting Devices."

- D. Sizes shall be adequate to meet NEC volume requirements, but in no case smaller than sizes indicated.
- E. Remove sharp edges where they may come in contact with wiring or personnel.
- F. Where two, or more, switches or other similar wiring devices are indicated at a single location they shall be installed in a ganged common box.
- G. Boxes to be set in concrete shall be type suitable for the purpose.

3.02 APPLICATIONS

- A. Cabinets: Flush mounted, NEMA enclosure type 1 except as otherwise indicated.
- B. Hinged Door Enclosures: NEMA type 12 enclosure except as indicated.
- C. Hinged Door Enclosures Outdoors: Install drip hood, factory tailored to individual units.
- D. Outlet Boxes and Fittings: Install outlet and device boxes and associated covers and fittings of materials and NEMA types suitable for each location and in conformance with the following requirements:
- E. Interior Dry Locations: Sheet steel, NEMA type 1.
- F. Locations Exposed to Weather or Dampness: Cast metal, NEMA type 3R.
- G. Wet Locations: NEMA type 4 enclosures.
- H. Corrosive Locations: NEMA type 4X enclosures.
- I. Pull and Junction Boxes: Install pull and junction boxes of materials and NEMA types suitable for each location except as otherwise indicated.

3.03 INSTALLATION OF OUTLET BOXES

- A. Outlets at Windows and Doors: Locate close to window trim. For outlets indicated above doors use 6'-9" mounting height above finished floor and center outlets above the door opening except as otherwise indicated.
- B. Column and Pilaster Locations: Locate outlet boxes for switches and receptacles on columns or pilasters so the centers of the columns are clear for future installation of partitions.
- C. Locations in Special Finish Materials: For outlet boxes for receptacles and switches mounted in desks or furniture cabinets or in glazed tile, concrete block, marble, brick, stone or wood walls, use rectangular shaped boxes with square corners and straight sides. Install such boxes without plaster rings. Saw cut all recesses for outlet boxes in exposed masonry walls.
- D. Gasketed Boxes: At the following locations use cast metal, threaded hub type boxes with gasketed weatherproof covers:
- E. Exterior locations. Where surface mounted on unfinished walls, columns or pilasters. (Cover gaskets may be omitted in dry locations). Where exposed to moisture laden atmosphere. At food preparation equipment within four ft. of steam connections. Where indicated.
- F. Cast-Iron Boxes: Iron alloy, waterproof, with threaded raceway entries and features and accessories suitable for each location, including mounting ears, threaded screw holes for devices and closure plugs.
- G. Mounting: Mount outlet boxes for switches with the long axis vertical or as indicated. Mount boxes for receptacles either vertically or horizontally but consistently either way. Three or more gang boxes shall be mounted with the long axis horizontal. Locate box covers or device plates so they will not span different types

of building finishes either vertically or horizontally. Locate boxes for switches near doors on the side opposite the hinges and close to door trim, even though electrical floor plans may show them on hinge side.

- H. Ceiling Outlets: For fixtures, where wiring is concealed, use outlet boxes 4-inches square by 2-1/8-inches deep, minimum.
- I. Cover Plates for Surface Boxes: Use plates sized to box front without overlap.
- J. Protect outlet boxes to prevent entrance of plaster, and debris. Thoroughly clean foreign material from boxes before conductors are installed.
- K. Concrete Boxes: Use extra deep boxes to permit side conduit entrance without interfering with reinforcing, but do not use such boxes with over 6-inch depth.
- L. Floor Boxes: Install in concrete floor slabs so they are completely enveloped in concrete except for the top. Where normal slab thickness will not envelop box as specified above, provide increased thickness of the slab. Provide each compartment of each floor box with grounding terminal consisting of a washer-in-head machine screw, not smaller than no. 10-32, screwed into a tapped hole in the box. Adjust covers of floor boxes flush with finished floor.
- M. Existing Outlet Boxes: Where extension rings are required to be installed, drill new mounting holes in the rings to align with the mounting holes on the existing boxes where existing holes are not aligned.

3.04 INSTALLATION OF PULL AND JUNCTION BOXES

- A. Box Selection: For boxes in main feeder conduit runs, use sizes not smaller than 8-inches square by 4-inches deep. Do not exceed 6 entering and 6 leaving raceways in a single box:
- B. Cable Supports: Install clamps, grids, or devices to which cables may be secured. Arrange cables so they may be readily identified. Support cable at least every 30-inches inside boxes.
- C. Mount pull boxes in inaccessible ceilings with the covers flush with the finished ceiling.
- D. Install pull and junction boxes in locations that allow for access to covers and contents.
- E. Size: Provide pull and junction boxes for telephone, signal, and other systems at least 50 percent larger than would be required by Article 370 of NEC, or as indicated. Locate boxes strategically and provide shapes to permit easy pulling of future wires or cables of type's normal for such systems.

3.05 INSTALLATION OF CABINETS AND HINGED DOOR ENCLOSURES

- A. Mount with fronts straight and plumb.
- B. Install with tops no more than 78-inches above floor.
- C. Set cabinets in finished spaces flush with walls.

3.06 GROUNDING

- A. Electrically ground metallic cabinets, boxes, and enclosures. Where wiring to item includes a grounding conductor, provide a grounding terminal in the interior of the cabinet, box or enclosure.
- B. Provide grounding bushings on metallic conduits that enter non-metallic cabinets, boxes and enclosures to ensure bondings of raceway system.

3.07 CLEANING AND FINISH REPAIR

- A. Upon completion of installation, inspect components. Remove burrs, dirt, and construction debris and repair

damaged finish including chips, scratches, abrasions and weld marks.

- B. Galvanized Finish: Repair damage using a zinc-rich paint recommended by the tray manufacturer.
- C. Painted Finish: Repair damage using matching corrosion inhibiting touch-up coating.

END OF SECTION 26 27 16

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. "Basic Electrical Requirements".

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles
 - 2. Ground Fault Circuit Interrupter Receptacles
 - 3. Plugs
 - 4. Plug Connectors
 - 5. Snap Switches
 - 6. Dimmer-Switches
 - 7. Wall Plates
 - 8. Poke-Through Assemblies
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 26 Section "Circuit and Motor Disconnects" for devices other than snap switches and plug/receptacle sets used as disconnects for motors.
 - 2. Division 26 Section "Electrical Identification" for requirements for legends to be engraved on wall plates.

1.03 SUBMITTALS

- A. Product data for each type of product specified.
- B. Coordinate color of device and device cover plates with architect prior to purchase.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following codes:
 - 1. NFPA 70 "National Electrical Code".
 - 2. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

1.05 SEQUENCE AND SCHEDULING

- A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arrow-Hart Co.
2. Crouse-Hinds Co.
3. General Electric Co.
4. Hubbell Inc.
5. Leviton Co.
6. Pass and Seymour Inc.
7. Square D Co.
8. Russellstoll

2.02 WIRING DEVICES

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Coordinate with Architect for device and wall plate colors except as otherwise indicated. Devices have been specified around Leviton.

B. Toggle Switches:

1. Switches shall be specification grade, back and side wired with white handles. Switches shall be rated for 20 Ampere, 120/277 volts and shall be grounding type.
2. Toggle switches shall be equal to the following:
 - a. Single Pole - Cat. No. 1221-X
 - b. Single Pole With Pilot Light (120 Volt) - Cat No. 1221 X PLR
 - c. Single Pole With Pilot Light (277 Volt) - Cat No. 1221 X PLR
 - d. Double Pole - Cat. No. 1222-X
 - e. 3-way - Cat. No. 1223-X
 - f. 4-way - Cat. No. 1224-X
 - g. Single Pole, Lock Type - Cat. No. 1221-L-X

C. Receptacles:

1. Receptacles shall be duplex, specification grade, 3-wire, grounding type, back and side wired with white nylon body. Receptacles shall be rated for 20 Ampere at 125 volts and shall be NEMA 5-20R configuration.
2. 20 Ampere duplex receptacles shall have ground terminal lugs and automatic grounding clips attached to one mounting ear.
3. 20 Ampere duplex receptacles shall be Cat. No. 5362-X.

D. Ground Fault Interrupter Type Receptacles:

1. Ground fault interrupter type receptacles shall be duplex, specification grade, 3-wire, and grounding type. Receptacles shall have self test diagnostic feature that prevents receptacle from being reset if an internal malfunction occurs. Receptacles shall be rated for 20 Ampere at 125 Volts and shall be NEMA 5-20R configuration, white body.

- 2. Ground fault interrupting type receptacles shall be Cat. No. 8899-X.
- E. Dimmer Switches: solid state dimmer switches conforming to NEMA WD 1, mounted in outlet boxes as indicated. Dimmer switches shall be compatible with light fixture drivers and ballasts, and shall be compatible with the other room lighting controls:

2.03 WIRING DEVICE ACCESSORIES

- A. Wall plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section "Electrical Identification." Provide plates possessing the following additional construction features:
 - 1. Material and Finish: Plastic, smooth.
- C. Interior unfinished locations:
 - 1. Material and Finish: Steel plate, galvanized.
- D. Interior and exterior locations:
 - 1. Damp locations: In areas classified as damp location per the NEC the device cover shall be Die-cast metal with self-closing lid, Cat. No. 4976.
 - 2. Wet locations: In areas classified as wet location per the NEC the device cover shall be thermoplastic with self-closing lid, which for receptacles would allow a cord to be plugged in and the lid closed, Cat. No. 5977.
- E. Floor Service Outlets: Modular, above-floor floor service outlets and fittings of types and ratings indicated. Construct of die cast aluminum, satin finish. Use design compatible with floor outlet wiring methods indicated. Provide 20-amperes, 125-volts, and gray duplex receptacles. NEMA configuration 5-20R where indicated. Provide with 3/4 inch or 1 inch NPT, 1 inch long, locking nipple for installation where compatible with wiring method.
- F. Poke-Through Assembly Devices: Factory-fabricated poke-through assembly devices with modular, above-floor service outlets, multi-channeled thru-floor raceway/fire stop assembly and below-floor junction box assembly. Construct above floor service fitting of die cast, satin finished aluminum with 20-ampere, 125-volts, gray duplex NEMA 5-20R receptacle and modular communication/data service outlet with separation barrier between power and low-tension section. Provide integral assembly UL listed as a total unit, with fire rating consistent with that of floor penetrated.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES AND ACCESSORIES

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.
- D. Install wiring devices after wiring work is completed.
- E. Where two light switches are controlling two separate 277 volt circuits and are ganged together, Contractor shall furnish and install barriers between switches.
- F. Where two or more switches or other similar wiring devices are indicated at a single location, they shall be installed under one multiple gang device plate and in an order appropriate to the location of the fixtures or devices being controlled.
- G. Duplex receptacles shall be mounted in a vertical position, unless noted otherwise on the Drawings.
- H. Wiring devices mounted over counters shall be installed above the countertop backsplashes and so as not to interfere with any cabinet work.
- I. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

3.02 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.03 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

3.04 MOUNTING HEIGHTS

- A. All wiring devices shall be mounted at the following heights above finished floor to the center of the device, unless noted otherwise on the Drawings:
 - 1. Switches - 48 inches
 - 2. Duplex receptacles - 18 inches
 - 3. Weatherproof receptacles - 24 inches

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this Section:
 - 1. "Basic Electrical Requirements."
 - 2. "Basic Electrical Materials and Methods."

1.02 SUMMARY

- A. This Section includes fuses rated 600 V and below and accessory items. Types of products in this Section include the following:
 - 1. Plug Fuses.
 - 2. Cartridge Fuses.
 - 3. Spare Fuse Cabinet.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:
- B. Product Data for fuses. Include descriptive data and time-current curves for all fuses and let-through current curves for those with current limiting characteristics.
- C. Coordination Study: Where fuses of a manufacturer other than the one designated in the Schedule of Fusible Devices are selected, submit a full coordination study showing graphically that the substitute fuses coordinate selectively with both upstream and downstream components. Prepare the study under the supervision of a registered professional engineer in accordance with ANSI/IEEE Standard 242-1986, "Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems." Include single line diagram, coordinated time/current characteristics, fuse performance curves, and fault current calculations adequate to demonstrate satisfactory component protection and selective coordination of protective devices.
- D. Shop drawing of spare fuse cabinet showing dimensions and features including storage provision for fuse cartons.

1.04 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. UL Listing and Labeling: Items provided under this Section shall be listed and labeled by UL.
- C. Nationally Recognized Testing Laboratory Listing and Labeling (NRTL): Items provided under this Section shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver spare fuses stored in locked spare fuse cabinet after cabinet has been installed.

1.06 EXTRA MATERIALS

- A. Maintenance Stock, Fuses: For types and ratings required, furnish spare fuses, amounting to one unit for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Bussmann Div., Cooper Industries, Inc.
 - 2. General Electric Co.
 - 3. Gould, Inc.
 - 4. Littelfuse, Inc.

2.02 FUSES, GENERAL

- A. General: Provide fuses of types, classes, and current ratings as indicated. Voltage ratings shall be consistent with the circuits on which used.
- B. Fuses for Direct Current Circuits: Marked for such use by the manufacturer on the fuse label.

2.03 PLUG FUSES

- A. Standard: Comply with UL 198F "Plug Fuses."
- B. Type: Type S, dual-element, time delay.

2.04 CARTRIDGE FUSES

- A. General: Comply with ANSI/IEEE Standard FU1, "Low Voltage Cartridge Fuses." Provide nonrenewable-cartridge-type fuses except as indicated.
- B. Class J Fuses: Comply with UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- C. Class L Fuses: Comply with UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- D. Class RK1 and RK5 Dual Element Time Delay Fuses: Comply with UL 198E, "Class R Fuses."
- E. Class RK1 Fast Acting Fuses: Comply with UL 198E, "Class R Fuses."

PART 3 - EXECUTION

3.01 APPLICATION OF FUSES

- A. General: Apply fuses as indicated and as follows:
 - 1. New General Purpose Fusible Switches: Apply the following class and types:
 - a. 30-600 Amperes: Class RK1, time delay.
 - 2. Combination Starters: Class RK1, time delay.
- B. Existing General-Purpose Switches: Apply the following classes and types:

1. 30-600 Amperes: Class RK1, time delay.

3.02 INSTALLATION

- A. Install fuses in fusible devices as indicated.
- B. Install spare fuse cabinet wall mounted where indicated.
- C. Coordination Study: Where coordination study recommends changes in types, classes, features, or ratings of fuses or fusible devices from those indicated, and those changes are approved, make them with no change to the contract price or time of completion.

END OF SECTION 26 28 13

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SECTION 26 28 16

CIRCUIT AND MOTOR DISCONNECTS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this section:
 - 1. “Basic Electrical Requirements”
 - 2. “Fuses”
 - 3. “Wiring Devices”

1.02 SUBMITTALS

- A. Product data for each type of product specified.

1.03 QUALITY ASSURANCE

- A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen Bradley/Rockwell Automation
 - 2. ABB
 - 3. Crouse-Hinds/Cooper Industries
 - 4. Cutler-Hammer/Eaton Corp.
 - 5. General Electric Co.
 - 6. Siemens Energy & Automation Inc.
 - 7. Square D Company

2.02 CIRCUIT AND MOTOR DISCONNECT SWITCHES

- A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features ratings, and enclosures as indicated. Provide NEMA 1 enclosure except for outdoor switches, and other indicated locations provide NEMA 3R enclosures with raintight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
- B. Switches shall have quick-make, quick-break operating mechanism and handle which shall be an integral part of the box and not the cover. Covers shall have dual interlocks to prevent unauthorized opening of the cover with the switch in the "ON" position or closing of the switching mechanism with the cover open.
- C. Switches shall have switch blades visible in the "OFF" position when the cover is open. Disconnect switches shall have permanently attached arc suppressors hinged or otherwise attached to permit easy access to the line side lugs without removal of the arc suppressors.
- D. Switches shall have provisions for padlocking in the "OFF" position only, with three padlock.

- E. Switch cable lugs shall be U.L. approved for copper and aluminum cables. All current carrying parts shall be plated by electrolytic process.
- F. Switch enclosures shall be code gauge steel with rust inhibiting phosphate primer and baked enamel finish.
- G. Fusible Switches: heavy duty switches, with fuses of classes and current ratings indicated. See Section "FUSES" for specification. Where current limiting fuses are indicated, provide switches with non-interchangeable feature suitable only for current limiting type fuses.
- H. Non-fusible Disconnects: heavy duty switches of classes and current ratings as indicated.
- I. Double-Throw Switches: heavy duty switches of classes and current ratings as indicated.

PART 3 – EXECUTION

3.01 INSTALLATION OF CIRCUIT AND MOTOR DISCONNECTS

- A. General: Provide circuit and motor disconnect switches as indicated and where required by the above Code. Comply with switch manufacturers' printed installation instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

3.03 APPLICATIONS

- A. Provide enclosure material specific for location in which installed according to NEMA standards.

END OF SECTION 26 28 16

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Requirements of the following Division 26 sections apply to this section.
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"
 - 3. "Wiring Devices"

1.02 SUMMARY

- A. Extent, location, and details of lighting fixture work are indicated on drawings and in schedules.
- B. Types of lighting fixtures in this section include the following:
 - 1. Incandescent.
 - 2. Fluorescent.
 - 3. LED.
 - 4. Battery backup emergency and exit lighting.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's product data on each type of lighting fixture and indicate or highlight the following items:
 - 1. Clearly indicate light fixture designation, model number and options on product data sheet. Product data sheet for each light fixture type is to be furnished in alphabetical or numerical order.
 - 2. Design Lights Consortium and Energy Star compliance is to be displayed on the product specification sheets when applicable.
 - 3. Data sheet shall indicate efficiency, voltage, lamping, wattage, correlated color temperature (CCT) in Kelvin (K), color rendering index (CRI), and accessories indicated on each sheet, plus the following:
 - a. For LED Fixtures:
 - 1) LED driver type.
 - 2) Number LED's.
 - 3) Delivered Lumens.
 - 4) Efficacy (delivered maintained lumens per watt).
 - 5) Input Current
 - 4. Submit details indicating compatibility with ceiling grid system.
 - 5. If light fixtures are dimmable, submit control type and wiring diagrams. Verify compatibility between fixture and dimmer control.
- B. Submit design of hangers, method of fastening, other than indicated or specified herein.
- C. The lighting system indicated on the Contract Documents form the quality and performance for the installation. Products of the alternate manufactures listed on the contract documents will be considered. Substitute lighting

not indicated on the contract documents must be reviewed by the Architect/Engineer prior to bid. Substituted lighting is to have light fixture specifications sheets, lighting point by point and power density calculations for Architect/Engineer's consideration.

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 700 as applicable to installation, and construction of building lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds. Pub/No.'s LE 1 and LE 2 pertaining to lighting equipment.
3. UL Compliance: Provide lighting fixtures and components which are UL-listed and labeled. Comply with the following UL standards pertaining to lighting fixtures:
 - a. UL 1598: Luminaires.
 - b. UL 924: Emergency Lighting and Power Equipment
 - c. UL 2108: Low Voltage Lighting Systems.
 - d. UL 8750: Light Emitting Diode, LED, Equipment for use in Lighting Products.
4. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.
5. American National Standards Institute (ANSI).
6. ANSI/IES RP-16-10 - Nomenclature and definitions for illuminating engineering.
7. ANSI E1.20 - Remote Device Management over DMX512 Networks.
8. ANSI C62.41 - Recommended practice in low power circuits.
9. Illuminating Engineering Society of North America (IESNA):
 - a. IES LM-79-08
 - b. IES LM-80-08
 - c. IES LM-82-12
 - d. IES LM-84
 - e. IES LM-85
 - f. IES TM-26
 - g. IES TM-28
 - h. IES G-2
10. Federal Communications Commission (FCC):
 - a. FCC 47 CFR Part 15 Class A and Class B
 - b. FCC 47 CFR Part 18, Subpart C
11. International Electro technical Commission (IEC):
 - a. IEC 60929
 - b. IEC 62386
12. Manufacturer's Qualification: Firms regularly engaged in manufacture of lighting fixtures of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver lighting fixtures and lighting controls in factory fabricated containers or wrappings, which properly protect fixtures from damage.
- B. Store lighting fixtures and lighting controls in original packaging. Store inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting fixtures with other work.
- B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction

1.07 EXTRA MATERIALS

- A. Furnish stock of replacement lamps amounting to 10 percent and replacement ballasts amounting to 5 percent (but not less than one lamp or ballast in each case) of each type and size of lamp and ballast used in each type unit. Deliver replacement stock as directed to Owner's storage space.

PART 2 - PRODUCTS

2.01 LIGHTING FIXTURES

- A. Refer to Light Fixture Schedule on drawings for types required including manufacture, model number, voltage, luminaire construction type (e.g. NEMA 4X or IP-66), mounting, reflectors, wattage, mean lumen output. Various lighting fixture types are required. Fixtures must comply with minimum requirements as stated herein and on the lighting fixture schedule. Review architectural drawings and specifications to verify ceiling types, modules, and suspension systems are appropriate to installation
- B. Various fixture types are required. Fixtures must comply with minimum requirements as specified herein and on the schedule. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation.
- C. Provide lighting fixtures, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lamp holders, reflectors, energy efficient ballasts, starters, drivers and wiring. Fixtures shall have concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise.
- D. Ship fixtures factory-assembled, with those components required for a complete installation.
- E. Individual lighting systems (containing ballast or driver, lamps or LED's and luminaire) shall be provided with a quick disconnect. Disconnect shall open circuit to each individual lighting fixtures for maintenance and to replace parts as required. Lighting systems on emergency power shall not require a quick disconnect.
- F. Lighting fixtures shall be provided with an integral fuse or internal overload protection.
- G. Lighting fixtures installed outside the building shall be Dark-Sky compliant and shall be controlled by a time clock, photocell, integral or remote, unless otherwise noted.
- H. Lighting fixture shall be constructed to be suitable for the environment in which the lighting fixture is being installed.

I. Wiring: Provide electrical wiring within fixture suitable for connecting to branch circuit wiring as follows:

1. NEC Type AF for 120 volt, minimum No. 18 AWG.

2.02 FLUORESCENT ELECTRONIC BALLASTS

- A. Electronic ballasts shall be full light output, high frequency (minimum 20K Hz) electronic type, operate without detectable flicker, have a minimum sound rating A and be specifically designed to operate the quantity and type of lamps specified. Ballasts shall be UL listed as class P for indoor use and Type 1 for outdoor applications. Ballasts shall comply with the limits of FCC Part 18, Subpart C limits for EMI and RFI. Ballasts shall be thermally protected and surge protected in accordance with IEEE 587 Category A. Ballasts shall have minimum 90% power factor, 90% ballast factor and input current THD less than 15%. Lamp current crest factor shall be 1.6 or less. Ballasts shall operate as a parallel circuit allowing remaining lamp(s) to maintain full light output if one or more lamps fail or are removed (except T12 HO). Fixtures installed in an outdoor environment shall have low temperature starting ballast of 0 deg. minimum starting temperature unless otherwise noted.
- B. Ballasts shall carry a minimum 3 year warranty against defects which will include replacement costs. Voltage shall be as indicated in the Fixture Schedule. Ballasts shall be as manufactured by Magnetek/Triad, Motorola, ELBA or approved equal as designated on the local utility "approved ballast list".

2.03 MAGNETIC/HYBRID FLUORESCENT BALLASTS

- A. Shall be full light output, reduced input wattage, UL listed and incorporate a solid state device that cuts off power to the lamp electrodes once the lamp has started. Ballasts shall have class P, 90% minimum power factor, 92% ballast factor and sound rated A and operate the lamps at a frequency of 60 Hz. Ballasts shall be specifically designed to operate the quantity and type of lamps specified. Ballasts shall be UL listed as class P for indoor use and Type 1 for outdoor applications. Ballasts shall comply with the limits of FCC Part 18, Subpart C limits for EMI and RFI. Ballasts shall be thermally protected in accordance with IEEE 587 Category A.
- B. Ballasts shall carry a minimum 3 year warranty against defects which will include replacement costs. Voltage shall be as indicated in the Fixture Schedule. Ballasts shall be as manufactured by Advance, General Electric, Magnetek/Universal or approved equal.

2.04 DIMMING BALLASTS

- A. Dimming ballasts may be electronic or magnetic type as specified. Ballast and lamp combinations shall be tested and recommended by the specific by the Dimming System manufacturer. Ballasts specification shall be the same as stated above for electronic and magnetic ballasts.

2.05 LED (LIGHT EMITTING DIODE) LIGHTING FIXTURE

A. NON-DIMMED LED DRIVER/CONTROLLERS FOR INTERIOR LED'S:

1. Driver shall comply with the following standards and classifications:
 - a. Driver shall be UL listed as class 2 for indoor use in a dry or damp location.
 - b. Driver shall comply with the limits of FCC Title 47 CFR Part 15 for digital devices.
 - c. Driver must meet or exceed NEMA 410 standards for driver inrush limiting.
 - d. Minimum IP classification rating shall be IP-20.
2. Driver shall have a minimum lifetime of 50,000 hours at maximum allowable case temperature. Driver shall be fully functional and operate in ambient temperatures between 0 degrees and 60 degrees Celsius.
3. Driver shall be able to withstand a surge of up to 2.0 kV and shall be protected from overload, short circuit and overheating. Upon returning to normal conditions the driver's protection devices shall automatically

reset to its normal operations.

4. Power factor shall be a minimum of 0.90 at 115VAC, 0.85 at 277VAC.
5. Total Harmonic Distortion (THD) maximum shall be less than 20%.
6. Driver shall be specifically designed to operate the quantity and type of LED arrays or modules specified.

B. DIMMABLE LED DRIVER/CONTROLLER:

1. LED dimmable driver specification shall be the same as stated above for non-dimmable LED drivers.
2. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10, smooth and continuous change in level (unless step dimming is specified), and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.
 - a. Driver control input shall meet or exceed the following standards:
 - 1) 4-Wire (0-10V DC Voltage Controlled) Dimming:
 - a) Must meet IEC 60929 Annex E for General White Lighting LED drivers.
 - b) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 mA per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
 - 2) Digital (DALI Low Voltage Controlled) Dimming:
 - a) Must meet IEC 62386.
 - 3) Digital Multiplex (DMX Low Voltage Controlled) Dimming:
 - a) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address).
 - b) Capable of signal interpolation and smoothing of color and intensity transitions.
3. Drive shall "dim" LED's with pulse width modulation (PWM) or constant current reduction (CCR) technology.

C. Output voltage for LED drivers shall match LED voltage. Output current shall not exceed the LED module or array's current requirement. Refer to manufacture's specification for voltage and current range and tolerances.

D. LED ARRAY OR MODULE:

1. LED array or module shall be suitable for its environment. Interior arrays shall be a minimum of IP-20. The exterior arrays shall be a minimum of IP-66.
2. LEDs shall be rated for minimum 50,000 hours of operation at or above L70 lumen maintenance.
 - a. Color corrective temperature (CCT) shall be provided per contract drawings. LED array shall have a minimum Color Rendering Index (CRI) of 80 for indoor use and 65 for outdoor use unless otherwise specified

2.06 LAMP SOCKETS

A. Lamp sockets in straight tube and u-bent rapid start lamp fixtures with electronic ballasts shall match bi-pin type

and single pin with instant start lamps. Compact fluorescent lamps shall be four pin types and model to match the specific lamp.

- B. Lamp sockets in straight tube and u-bent rapid start lamp fixtures with magnetic or hybrid ballasts shall match bi-pin type and single pin with instant start lamps. Compact fluorescent lamps shall be two pin types and model to match the specific lamp.
- C. Lamp sockets for HO and VHO lamps shall match single pin RDC base.
- D. Lamp sockets for HID fixtures shall match the specified lamp.

2.07 LAMPS

A. Fluorescent:

1. Provide T-8 fluorescent lamps, Triphosphor 3500 K color temperature, minimum output 90 lumens per watt and CRI of 85.
2. Provide compact fluorescent lamps of type and color indicated. Provide two pin construction for lamps installed in fixtures with magnetic ballasts and four pin construction for lamps installed in fixtures with electronic ballasts. Match pin arrangement to specific fixture socket and ballast requirements, types as indicated.
3. Provide clear/phosphor coated metal halide lamps in wattages indicated, minimum output 82 lumens per watt, CRI of 70, color temperature of 3700 K, types as indicated.
4. Provide high-pressure sodium lamps in wattages indicated, minimum output 95 lumens per watt, CRI of 22, color temperature of 2100 K, types as indicated.

B. Exit LED:

1. Provide red LED's shielded with acrylic panel designed for even illumination of "EXIT" panel.

2.08 BATTERY BACKUP EMERGENCY AND EXIT LIGHTING

A. Emergency Self-Contained Battery Units:

1. Self-contained emergency lighting units with style, shape, and trim as indicated.
2. Self-diagnostic or Continuous Verification types shall conduct periodic tests to verify proper operation; at a minimum, 90 minute, monthly and semi-annual intervals. Malfunction during any self-test shall be through external visual status indicator.
3. Battery: Sealed, maintenance-free, lead calcium type with 5 year nominal life.
4. Charger: Minimum two-rate, fully automatic, solid-state type, with sealed transfer relay.
5. Operation: Relay turns lamp on automatically when supply circuit voltage drops to 80 percent of nominal or below. Lamp operates for duration of outage, up to 1.5 hours. Lamp automatically disconnected from battery of voltage approaches deep-discharge level. When normal voltage is restored, battery is automatically recharged within 16 hours and then floated on trickle charge.
6. Control panel contains low-voltage disconnect switch, LED indicator light, test switch, and concealed terminals for remote lamp head connection.
7. Emergency two head fixtures shall have integral lamp heads mounted on housing with 90-deg for wall mount and, 180-deg for ceiling mount, 2-way locking swivel joints for aiming. Lamp types and lenses as

indicated.

B. Emergency Fluorescent Power Supply

1. Internal and /or External Types: For designated fluorescent fixtures, provide internal self-contained, modular, battery-inverter unit, factory or field installed and mounted within the fixture body.
2. Arrange unit with test switch and LED indicator light, visible and accessible without opening fixture or entering ceiling space.
3. Battery: Sealed, maintenance-free, nickel-cadmium type, with normal 10-year life, minimum.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Operation: Relay turns one or two lamps, as noted, on automatically when supply circuit voltage drops to 80 percent of nominal or below. Lamps operate for duration of outage, up to 1.5 hours with an initial light output of 600 lumens. When normal voltage is restored, battery is automatically recharged

C. Emergency Battery Inverter Unit

1. Emergency lighting inverter units with ratings as indicated.
2. UL 924 Self testing and diagnostic.
 - a. Malfunction during any self-test shall be indicated through external visual status indicator.
3. Battery provided shall be valve-regulated sealed lead-calcium unless specified elsewhere in the contract documents. Battery shall be sized to illuminate the emergency battery unit's lamps for a minimum of 90 minutes. Batteries shall automatically disconnect on low charge and automatically restart upon utility return.
4. Charger: Minimum three stage, fully automatic, solid state type, with sealed transfer relay.
5. Output: PWM/MOSFET pure sine wave inverter technology with the following characteristics:
 - a. 120 or 277ac volts, 1 phase, 60 Hz.
 - b. <3% THD for linear load.
 - c. Circuit breaker protected.
 - d. Frequency during emergency mode: 60 Hz +/- 0.5Hz.
 - e. Load Power Factor: 0.5 lag to 0.5 lead.
 - f. Inverter overload: 250% for 16 cycles, 110% continuous.
 - g. Output can be Normally-On, Normally-Off or Switched.
 - h. 3.5 Crest Factor.

D. Emergency Exit Sign Fixture

1. Exit signs shall be constructed to be suitable for the environment in which the exit sign is being installed.
2. Letter and housing color is per contract documents.
3. Exit signs requiring a battery shall be provided with Nickel-cadmium type battery unless otherwise specified. Battery shall be size to illuminate the exit sign for a minimum of 90 minutes. Ni-Cd battery shall have a minimum life of 15 years.
4. Exit signs provided with battery shall be provided with self-diagnostic testing option. Option shall automatically conduct periodic self-tests to verify battery operation once every 30 days for 90 minutes. Provide LED indicator light for a failure status.
5. Charger shall be a minimum two rate, fully automatic, solid state type, with sealed transfer relay.

PART 3 - EXECUTION

3.01 INSTALLATION OF LIGHTING FIXTURES

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight.
- C. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.
- D. Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- E. Support:
 - 1. Recessed and semi-recessed fixtures, where fixture size matches the ceiling grid, may be supported from suspended ceiling support system if the ceiling system support rods or wires are installed at a minimum of four rods or wires per fixture and located not more than 6 inches from fixture corners. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.
 - a. For fixtures smaller than the ceiling grid, install a minimum of four rods or wires per fixture and locate at corner of the ceiling grid in which the fixture is located. If the ceiling support does not match the above ceiling criteria then the fixture shall be independently supported from the structure. Do not support fixtures by ceiling acoustical panels.
 - b. Where fixtures smaller than the ceiling grid are indicated to be centered in the acoustical panel, support fixtures independently with at least two ¾- inch metal channels spanning and secured to the ceiling tees.
 - c. Surface mounted fixtures greater than 2 feet in length shall have an additional point of support in addition to the outlet box fixtures stud.
 - d. Fasten fixtures securely to indicated structural supports; and ensure that pendant fixtures are plumb and level. Provide individually mounted pendant fixtures longer than 2 feet with twin stem hangers. Provide stem hanger with ball aligners and provisions for minimum one inch vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than number of fixtures in the row.
 - e. All square and round fluorescent fixtures in a room or area shall have their LED light bars in the same orientation in the space.
 - f. Lighting fixtures installed in the corrosive areas shall be sealed, gasketed and constructed with non-corrosive material. Minimum construction shall be NEMA 4X. Fixture shall be supported by non-corrosive hardware. Hardware with corrosive resistant coating shall not be acceptable. All penetrations shall be properly sealed, and fittings shall be suitable for corrosive areas.
 - g. External drivers and remote ballasts for lighting fixtures shall be installed in an accessible location and shall be provided with an air gap around the unit for ventilation. Locate driver within the manufacture's recommended distance between driver and lighting fixture. Install heavier gauge wiring as required by manufacture if standard distances are exceeded.
 - h. Lighting fixtures (non-pole mounted) located outside and/or on building exterior shall be of weatherproof construction, gasketed with non-ferrous metal screws and cold weather ballast or driver. Minimum construction shall be NEMA 3R and/or IP-65. Finishing screws to match fixture. If required, remote ballasts and emergency ballasts shall be installed in nearest accessible

conditioned space adjacent to lighting fixture. Locate ballast within the manufacture's recommended distance between ballast and lighting fixture.

- i. Exterior pole mounted lighting fixtures shall be mounted in the orientation to furnish the proper lighting distribution. Properly bond and ground entire lighting fixture with pole.
- F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A, and the National Electrical Code.
- G. Lighting fixtures installed in the explosion proof areas shall be sealed, gasketed and constructed without exposing the electrical components of the lighting fixture. Lighting fixture shall be provided with hub connections. Minimum construction shall meet Class 1 Div 1 classification and IP66. Fixture shall be supported by non-corrosive hardware. Hardware with corrosive resistant coating shall not be acceptable. All penetrations into the lighting fixture shall be sealed air tight.

3.02 FIELD QUALITY CONTROL

- A. Replace all incandescent, fluorescent and HID lamps in lighting fixtures where used for temporary lighting prior to Date of Substantial Completion.
- B. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- C. At Date of Substantial Completion, replace lamps and ballasts in lighting fixtures which are observed to be defective after Contractor's use and testing.
- D. Tests: After emergency lighting units have been installed and building circuits have been energized with normal power source, apply and interrupt electrical energy to demonstrate proper operation. Remove and replace malfunctioning units with new units and proceed with retesting. Give the Architect advance notice of dates and times for all field tests. Provide instruments as required to make positive observation of test results. Include the following in tests:
 1. Duration of supply.
 2. Normal transfer to battery source and retransfer to normal.
 3. Light level intensity.

3.03 ADJUSTING AND CLEANING

- A. Protect installed fixtures from damage, paint, plaster, and dust during remainder of construction period.
- B. Clean lighting fixtures of dirt and construction debris upon completion of construction. Clean fingerprints and smudges from lenses.

3.04 GROUNDING

- A. Provide equipment grounding connections for lighting fixtures as indicated. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

3.05 DEMONSTRATION

- A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

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SECTION 28 31 00

FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this Section:
 - 1. "Basic Electrical Requirements"
 - 2. "Basic Electrical Materials and Methods"

1.02 SUMMARY

- A. This Section includes modifications to the existing fire alarm system. It includes requirements for system components including the following:
 - 1. Speakers.
 - 2. Visual alarm signals.

1.03 DEFINITIONS

- A. Alarm Initiating Device: A manual station, smoke detector, heat detector, flame detector, or sprinkler water flow switch.
- B. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of a manual station and the operation of a sprinkler system flow switch.
- C. Class A Wiring: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the FACP and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs.
- D. Hard-Wired System: Alarm, supervisory, and initiating devices directly connected, through individual dedicated conductors, to a central control panel without the use of multiplexing circuits or devices.
- E. Supervisory Signal: Indicates need for action regarding fire suppression or other protective system.
- F. Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.
- G. Zone: Initiating device or combination of devices connected to a single alarm initiating device circuit.

1.04 SYSTEM DESCRIPTION

- A. General: Zoned, noncoded, addressable, microprocessor-based type system with manual and automatic alarm initiation.
- B. Signal Transmission: Hard-wired, using separate individual circuits for each zone of alarm initiation and alarm device operation.
- C. Audible Alarm Indication: Notification speakers.
- D. System connections for alarm initiation and alarm indicating circuits: Class A wiring.

- E. Functional Description: Provide a complete fire alarm and detection system with the following functions and operating features:
1. Priority of Signals: Automatic response functions shall be accomplished by the first zone initiated. Alarm functions resulting from initiation by the first zone shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. Supervisory or trouble signals shall have second- and third-level priority. Signals of a higher-level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
 2. Noninterfering: Provide zoned, powered, wired, and supervised system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones shall be manually resettable from the FACP after the initiating device or devices have been restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.
 3. Signal Initiation: The manual or automatic operation of an alarm initiating or supervisory operating device shall cause the FACP to transmit an appropriate signal including:
 - a. General alarm.
 - b. Smoke detector alarm.
 - c. Door release.
 - d. System trouble.
 - e. Fan shutdown.
- F. Transmission to Remote Central Station: Existing to remain.
- G. Silencing at FACP: Existing to remain.
- H. Annunciation: Existing to remain.
- I. General Alarm: Existing sequence to remain.
- J. Indicating the general alarm condition at the FACP and the system annunciator: Existing to remain.
- K. Manual station alarm operation initiates a general alarm.
- L. Water flow alarm switch operation:
1. Initiates a general alarm.
- M. Smoke detection initiates a general alarm.
- N. Sprinkler valve tamper switch operation:
1. Causes a supervisory audible and visible "valve tamper" signal indication at FACP and annunciator.
 2. Causes location indicating light to flash for the device that has operated.
 3. Initiates transmission of supervisory signal to remote central station.

1.05 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials and NRTL listing data.
- C. Wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Include drawings indicating components for both field and factory panel wiring.
- D. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project. Manufacturer's standard descriptions for generic systems are not acceptable.
- E. Calculations for battery capacity for both alarm and supervisory modes for modified NAC panels.
- F. Operation and maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 26 Section "Basic Electrical Requirements." Operation and maintenance data shall cover each type of product, including all features and operating sequences, both automatic and manual. Provide spare parts data. Provide the name, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.
- G. Operating and instruction manuals shall be submitted prior to testing of the system, five (5) complete sets of operating and instruction manuals, four (4) shall be delivered to the Owner upon completion, and one (1) to the fire department prior to final acceptance.
- H. Complete, simple, comprehensive, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a complete trouble-shooting manual explaining what might be wrong if a certain malfunction occurs and explaining how to test the primary internal parts of each piece of equipment, shall be delivered to the Owner upon completion of the system.
- I. Maintenance instructions shall be complete, easy to read, understandable, and shall provide the following information:
 - 1. Instructions on replacing any components of the system, including internal parts.
 - 2. Instructions on periodic cleaning and adjustment of equipment with a schedule of these functions.
 - 3. A complete list of all equipment and components with information as to the address and phone number of both the manufacturer and local supplier of each item.
 - 4. User operating instructions shall be provided, prominently displayed on the cabinet front or on a separate sheet located next to the control unit in accordance with U.L. #864.
- J. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with the referenced standards.
- K. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make a simultaneous identical submission to the authority having jurisdiction. Include copies of annotated Contract Drawings as required to depict component locations to facilitate review. Upon receipt of comments from the authority, submit a copy of the marked-up submittal for review. Make resubmissions to the authority if required to make clarifications or revisions to obtain approval.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who is a factory-authorized service representative to perform the Work of this Section.
- B. Compliance With Local Requirements: Comply with the applicable building code, local ordinances, and regulations and the requirements of the authority having jurisdiction.
- C. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- D. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the following publications:
 - 1. NFPA 72A, "Installation, Maintenance, and Use of Local Protective Signaling Systems for Guard's Tour, Fire Alarm, and Supervisory Service."
 - 2. NFPA 72G, "Guide for the Installation, Maintenance and Use of Notification Appliances for Protective Signaling Systems."
- E. UL Listing and Labeling: Provide system and components specified in this Section that are listed and labeled by UL.
- F. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility for system components furnished.

1.07 EXTRA MATERIALS

- A. General: Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.
- B. Lamps for Remote Indicating Lamp Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.
- C. Lamps for Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements and compatibility with the existing fire alarm system, provide products as manufactured by JCI (Simplex Time Recorder Co.).

2.02 ALARM INDICATING DEVICES

- A. General: Equip alarm indicating devices for mounting as indicated. Provide terminal blocks for system connections.
- B. Addressable Interface Units: Unit designed to monitor system component not equipped for multiplex communication with FACP and transmit identification and status to that terminal. Provide units with a communication transmitter and receiver complete having a unique identification and status-reporting capability to the FACP.

- C. Visual Alarm Signals: Dual-voltage (120-V a.c. or 24-V d.c.) strobe lights utilizing high-intensity, clear, optic lens and xenon flash tube. Provide luminaires having their lenses mounted on an aluminum face plate. Provide the word "FIRE" engraved in minimum 1-inch-high letters displayed on the unit. Provide with lamps having a minimum peak intensity of 8,000 candlepower. Strobe leads shall be factory-connected to screw terminals.
- D. Combination Signals: Provide factory-combined audible and visible alarm units of type indicated in a single mounting unit where indicated.
 - 1. High-Range Speaker Units: Rated 2-15 watts.
 - 2. Low-Range Speaker Units: Rated 1-2 watts.
 - 3. Speaker Mounting: Flush, semi-recessed, surface, or surface-mounted bi-directions as indicated.

2.03 WIRE

- A. Line-Voltage and Low-Voltage Circuits: Solid copper conductors with 600-V rated insulation.
 - 1. Provide Class 1 initiating and alarm circuits with electrical supervision for shorts and open conditions.
 - 2. Install diodes or resistors in fire alarm control cabinet (Class A).
 - 3. Install diodes or resistors at "end-of-line" device (Class B).
 - 4. Fire alarm system wiring shall be a power limited fire protection signaling circuit multi-conductor cable, 105 degree Celsius, Type FAPL, 300 volt rated, red jacket.
 - 5. Signal circuit wiring shall be minimum No. 14 AWG copper, solid.
 - 6. Initiation circuit wiring shall be minimum No. 16 AWG copper, solid.

2.04 TAGS

- A. Tags for Identifying Tested Components: Comply with NFPA 72H.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Install system in accordance with NFPA Standards referenced in Parts 1 and 2 of this Section.

3.02 EQUIPMENT INSTALLATION

- A. Existing Fire Alarm Equipment: Maintain fully operational until the new equipment has been tested and accepted. As new equipment is installed, labeled it "NOT IN SERVICE" until the new equipment is accepted. Remove tags from new equipment when put into service and tag existing fire alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of the new fire alarm system, remove existing, disconnected fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed deliver to the Owner. Removed from the site and legally disposed of the remainder of the existing material.

- C. Audible Alarm Indicating Devices: Install not less than 90 inches above the finished floor nor less than 6 inches below the ceiling. 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.
- D. Visual Alarm Indicating Devices: Install adjacent to each alarm bell or alarm horn. Install not less than 80 inches above the finished floor and at least 6 inches below the ceiling.
- E. Device Location Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

3.03 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway in accordance with Division 16 Section "Raceways." Conceal raceway except in unfinished spaces and as indicated.
- B. Install wires and cables without splices. Make connections at terminal strips in cabinets or at equipment terminals. Make soldered splices in electronic circuits in control cabinets.
- C. System shall be free from grounds, shorts and open circuits.
- D. All wire terminations at control panel and annunciator panel shall be properly tagged showing zone and/or circuit identification.
- E. Power shall not be applied to the system until the system has been completely checked for grounds, shorts and open circuits, by an authorized representative of the manufacturer.
- F. Raceways containing conductors identified as "Fire Protective Alarm System" conductors shall not contain any other conductors, and A.C. current carrying conductors will not be allowed in the same raceway with the D.C. fire alarm detection and signaling conductors.
- G. The Installer shall coordinate the installation of the fire alarm equipment with the manufacturer or his authorized distributor. All conductor and wiring shall be installed per the manufacturer's recommendations. It shall be the Installer's responsibility to coordinate with the supplier the correct wiring procedures prior to installing any conduits or conductors.
- H. Pigtail connections between circuit wires and detector terminals are not acceptable. Devices shall be connected directly to the circuit line wires.
- I. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- J. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where any circuit tap is made.
- K. Alarm Wiring: For the low-voltage portion of the fire alarm system, install No. 16 AWG conductors and 75-deg C insulation in wet, damp, or dry locations. Provide wiring operating at line voltage as minimum No. 12 AWG size having similar insulation.
- L. Color Coding: Color code all fire alarm conductors differently from the normal building power wiring. Provide one color code for alarm circuits wiring and a different color code for supervisory circuits. Provide a color code for audible alarm indicating circuits different from alarm initiating circuits. Use different colors for visual alarm indicating devices. Paint fire alarm system junction boxes and covers red.

3.04 FIELD QUALITY CONTROL

- A. **Manufacturer's Field Services:** Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. **Pretesting:** Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. **Report of Pretesting:** After pretesting is complete, provide a letter certifying the installation is complete and fully operable. The letter shall include the names and titles of the witnesses to the preliminary tests.
- D. **Final Test Notice:** Provide 10 days' minimum notice in writing when the system is ready for final acceptance testing.
- E. **Minimum System Tests:** Test the system in accordance with the procedures outlined in NFPA 72H, Chapters 2 and 4 and NFPA 72E, Chapter 8. Minimum required tests are as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground. Report readings less than 1-megohm for evaluation.
 - 3. Test all conductors for short circuits utilizing an insulation testing device.
 - 4. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
 - 5. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 6. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Proper signal transmission in accordance with class of wiring used shall be observed.
 - 7. Test the system for all specified functions in accordance with the manufacturer's operating and maintenance manual. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.
 - 8. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.
- F. **Retesting:** Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- G. **Report of Tests and Inspections:** Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
- H. **Tag all equipment and stations and other components at which tests have been satisfactorily completed.** Place tags upon completion of tests.

3.05 COMMISSIONING

- A. Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance

personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
 2. Schedule training with the Owner at least seven days in advance.
 3. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls to suit actual occupied conditions. Provide up to three visits to the site for this purpose.
- B. Provide complete maintenance and inspection service for the fire alarm system, by a factory-trained authorized representative of the manufacturer, for a period of one year after final inspection and tests.
- C. Prior to final acceptance of system, manufacturer of system shall, in presence of Contractor, Owner's Representative and Architect's/Engineer's representative, test each sensing or detection and alarm device.
- D. Submit copy of test results in duplicate after signed by Owner's Representative to Architect/Engineer, Owner, Owner's Insurance Company and local Fire Protection Authority. Mount copy of inspection record in Lexan enclosed frame assembly on control panel.

END OF SECTION 28 31 00