DIVISION 2 – SITE WORK

02 41 00- DEMOLITION

- Furnish all labor, materials and equipment as required to complete the demolition and removal of all items located in the construction areas. Upon completion of all demolition work, all areas shall be left broom clean.

- Demolition of telephones, electrical voice/data and panels are to be removed back originating source. Demolition of cores and related cabling to be removed from tenant spaces below.

- During the removal of any environmentally hazardous materials protection protocols should be strictly followed per code and/or local governing authority.

- All existing construction items that interfere with the construction negotiated by the pricing plan / space plan with work letter shall be removed, relocated or kept flush in ceiling, wall or floor as required.

- All damaged, altered or reworked areas shall be patched as required and finished to match existing adjacent areas or as specified to provide a "like-new finish".

- Contractor shall provide plastic sheeting or other appropriate barrier to control, dust and debris such that it does not affect areas outside the area of work.
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall perform all planning, notifications, administration and execution necessary to safely remove, dispose and/or handle the regulated and hazardous materials listed within this Section and shall be in accordance with local, state and federal regulations.

1.2 RELATED WORK

A. Drawings, General Conditions, Modifications to the General Conditions, and Supplemental Conditions to the General Conditions, and other Divisions apply to this Section.

1.3 WORK INCLUDED

A. The Contractor shall supply all labor, equipment, notifications, services, insurance, special permits and equipment necessary for the following regulated materials:

   1. Asbestos:

      a. Asbestos abatement is included in this Project. Refer to other sections for Infection Controls or Covid-19 mitigation for safe work practices and procedures.

      b. Contractor shall refer to the Good Faith Hazardous Materials Survey Report (Attached in Appendix C and prepared by PBS). This document lists suspect asbestos-containing materials (ACM) sampled and analyzed for asbestos content, or presumed to exist, at the areas of the building included in the Work. The Contractor shall ensure that copies of this information are made available to and retained at the project site by all subcontractors.

      c. Advisory Notice - ACM Caution (Hidden Materials). The possibility exist that suspect ACM may be present at concealed locations in wall and ceiling cavities, within HVAC equipment and potentially in other select concealed areas. These may include, but are not limited to waterproofing membrane, vapor barriers, internal gasketing, mastics, caulking, and sealants on HVAC equipment, construction adhesives, electrical insulators, below grade pipe covering and insulation.

      d. Contractor shall be aware that suspect-ACMs may exist in inaccessible locations of the spaces included in the Work and in areas not included in the Work. Should suspect materials are found or uncovered during construction, they shall be assumed to contain asbestos until testing proves otherwise (by certified AHERA building inspector).

      e. Contractor is advised that, should additional ACMs not included in the Hazardous Materials Survey Report be encountered, the Owner may elect to include the abatement of such materials in the work at a mutually agreed upon price. Work impacting such materials is not to occur prior to the Contractor receiving explicit written authorization from the Owner, and any Work performed without such approval is performed at the Contractor’s own risk and expense.
f. The disturbance or impact of ACMs may cause asbestos fibers to be released into the building’s atmosphere, thereby creating a potential health hazard to building and tunnel occupants. Contractor is to apprise all workers, supervisory personnel, subcontractors and consultants who will be at the jobsite of the seriousness of this potential hazard and of proper Work procedures that must be followed, should it occur.

g. Where in the performance of the Work, workers, supervisory personnel, subcontractors, or consultants encounter, disturb, or otherwise function in the immediate vicinity of any identified ACMs, Contractor shall take appropriate continuous measures, as necessary, to protect its employees, sub-contractors, building occupants from the potential hazard of exposure to airborne asbestos. Such measures shall include the procedures and methods described herein, and compliance with applicable local, state and federal regulations.

h. Remove and dispose of the following asbestos-containing materials (ACM) according to Section 02 82 00 and review all project related construction documents and demolition drawings.

i. Less than 1% of Asbestos. For all trades – wallboard/joint compound and mud as a “composite” was found to contain asbestos in trace concentrations throughout. Impact of referenced materials that were identified to contain less than 1% of asbestos shall be undertaken according to WISHA Regional Directive (WRD) 23.30. Refer to project plans for location of wall penetration and wall demolition, and other associated impacts. Requirements include, but are not limited to, the following:

   i. Worker training must include asbestos awareness and hands-on training per WAC 296-62-07722(5).

   ii. Work must be supervised by a Competent Person per WAC 29-62-07728.

   iii. Provide worker/personnel exposure assessment.

   iv. Worker respiratory protection is to be based on overall dust levels and comply with WAC 296-62 including the provision of personnel exposure assessment and monitoring during work.

   v. Use of wet, non-aggressive techniques and prompt cleanup with HEPA-equipped vacuums.

   vi. All dust remaining in the work areas must be cleaned-up following impact of wall system using vacuums with HEPA filters and wet-wiping. Protect finishes, equipment and items remaining in work areas as necessary.

   vii. Owner reserves the right to collect asbestos air samples from the work areas related to wall assembly impacts.

   viii. Provide to Owner for review the above work plan requirements and all training certificates.
2. Metals/Lead:
   a. Lead/metals-containing materials and associated health and safety compliance and controls in accordance with regulatory requirements.

   b. The Owner has conducted a survey of representative areas in the Building to be impacted by the Work for the presence of lead-containing components. Findings and related analytical data are included in the attached Appendix C Hazardous Materials Survey Report – lead-containing paint was identified at the project.

   c. Contractor shall comply with all applicable Metals regulations, laws and ordinances concerning the impact, removal, handling, storage, disposal, monitoring and protection against exposure or environmental pollution related to building components containing lead coatings or lead products. Impacts to lead that may be required by the Work include, but are not limited to; product installation, manual demolition, mechanical demolition, cutting, sawing, drilling, sanding, scraping, welding or torch-cutting. Confirm required impacts with other applicable specification sections and drawing sheets. In addition, provide all infection controls and engineering controls per contract requirements.

   d. Work impacting lead/metals-containing painted coatings and lead/metals-containing items and products within this contract is the responsibility of the Contractor, and all affected Sub-Contractors, and shall be performed in accordance with all applicable local, state and federal regulations. Refer to Section 02 83 00.

3. Polychlorinated Biphenyls (PCBs)
   a. PCB-containing light ballast or leaking ballasts were not identified at the project site.

   e. Representative light ballasts inspected were found to be labeled “No PCBs” or the electronic types without suspect potting compound. However, all magnetic ballasts not marked (unlabeled) or labeled with “No PCBs” must be segregated and recycled through the Owner as they may contain PCBs in low concentrations. As part of the scope of the project, contractor is to inspect light fixtures and individual ballast (magnetic devices for suspect potting compound regardless of labeling) during demolition activities for proper handling and disposal/recycling.

   f. Contractor is responsible for handling, removal, and proper storage of magnetic ballasts for Owner disposal in accordance with applicable local, state and federal regulations and these Specifications. Remove all magnetic ballasts (labeled or unlabeled with “No PCB”) as part of the scope for proper disposal by Owner.

   g. Provide U.S. Department of Transportation approved 55-gallon drums (with approved lid) and deposit all removed ballast into containers.

   h. Drummed ballast will be disposed-off or recycled by Owner through the UW Environmental Program Office (EPO) as a state regulated waste.
i. Prevent damage to any unlabeled ballasts and immediately report any leaking ballasts to the Owner’s Representative.

j. Submit for review a work plan to address handling and removal of PCB-containing light ballast (labeled and non-labeled) including all appropriate worker protection, environmental controls, and cleanup procedures.

4. Mercury

a. Fluorescent Lighting Tubes/Bulbs and Thermostats.

i. Work includes handling and removing of light tubes, compact bulbs, high-intensity discharge lamps and thermostats for Owner to properly dispose. Fluorescent lighting tubes/bulbs and thermostats may not be disposed of as construction debris because they contain mercury. Thermostats and whole/intact fluorescent shall remain intact during handling, removal, storage, and transportation.

ii. Thermostats, whole fluorescent light tubes/bulbs and light ballast from the project on the Seattle campus are recycled through UW Recycling Program. Coordinate with the Owner’s representative for the recycling program. To initiate this process, the Owner will contact UW Recycling by calling the Recycle Information Line at 206.685.2811 or sending an email to recycle@u.washington.edu at a minimum one week prior to the scheduled removal of lamps.

iii. The Owner’s fluorescent tube recycling vendor will drop off and subsequently pick up the appropriate number of fiber drums at the project location on specified dates – coordinate with Owner for logistics. The project will be billed directly for tube recycling. Fluorescent tubes must be managed under the state Universal Waste rules. This means that all fluorescent tube drums must be labeled as Universal Waste (usually the recycling contractor does this, but it is the ultimate responsibility of the Owner to label them). The drums must also be under the generator’s control at all times and must be stored at a covered or indoor site.

iv. Damaged and broken tubes/bulbs are disposed of as hazardous waste through the UW Environmental Program Office (EPO) as well. Contractor to provide to Owner for review their work plan to address handling and removal of light tubes and light ballast including all appropriate worker protection and environmental controls.

v. P-Traps (not in the scope): Owner will remove P-traps associated with the dental wing due to potential mercury-containing waste.

5. Refrigerants – Not Used

a. Coordinate with the Owner prior to refrigerant-containing equipment altering work, demolition, installation and any refrigeration discharge activities.

b. All University air conditioning, chiller or refrigeration equipment (including removal of equipment) or installing new equipment, contractor shall notify the Facilities
c. Submit to Owner a work plan for the demolition, decommissioning and dismantling of equipment that may contain refrigerants (chiller unit). All ozone-depleting refrigerants (CFC) including HCFCs and HFCs must be recovered from equipment and appliances prior to demolition or disposal. It is the responsibility of the Contractor to ensure recovery machines, gauges and other recovery equipment shall meet the required standards for evacuation levels, hydrostatic testing dates, DOT guidelines, color coding, cylinder identification and pressure ranges per Section 608 of the Federal Clean Air Act.

d. Information about the contractor, company, agents and type of equipment to be removed or installed including who perform the work and their EPA certifications must be on file at the UW Refrigeration Shop before work begins. Notification forms are at https://www.washington.edu/facilities/fsstech/node/609.

e. Spent refrigerants that cannot be reclaimed or recycled: these refrigerants are subject to all the applicable requirements of 173-303 WAC (Dangerous Waste Regulations) and must be treated as hazardous waste. UW EH & S Environmental Programs will handle such disposal.


8. Contaminated Ductwork - Not Used – Not in the Scope


   a. The purpose of the site specific safety plan (SSSP) is to inform workers of the unique characteristics of SARS-CoV-2 including common reference to the virus Covid-19 and to provide general guidelines for protecting the workers, UW staff, site visitors and the job site. As part of the scope the Contractor shall incorporate the best management work practice to prevent the spread of Covid 19 virus for this project.

   b. The mitigation plan and work practice submitted should incorporate by reference and not limited (including all amendments) of the University of Washington’s Project Delivery Group Covid-19 prevention guidance document, UW PDG Covid-19 construction project site guidance, April 9, 2020 and the Department of Labor and Industries, Division of Occupational Safety and Health (DOSH), General Coronavirus Prevention Under Stay Home - Stay Healthy Order Updated. And subsequent amendments, extensions, and clarifications, including the Implementation of Phase 1 Construction Restart – Proclamation 20-25 Addendum (4/24/2020) and associated guidance (e.g. DOSH F414-164 and F414-162).

   c. Submit SSSP Covid-19 mitigation plan for Owner review: Such plans should have the minimum guidelines such as a Covid 19 site supervisor, Covid 19 symptoms, worker Covid 19 safety training, infection prevention measure, social distancing, worker screening, engineering controls to prevent spread of virus, PPE, mask wearing at all times, sanitation and cleaning, employee health symptoms, reporting system for confirmed cases and corrective action such as contact tracing and decontamination and enhanced sanitizing of work areas, job hazard analysis if work task is within the 6 feet distancing and project documentation.
10. Silica and Fugitive Dust

a. Presumed silica-containing building materials such as in structural and finish assemblies of masonry walls and mortar, concrete slab (exterior walls, interior walls, floor, columns and ceiling assemblies), and wallboard assemblies are present in the areas of work in all buildings. Silica controls and risk assessment shall apply during concrete floor grinding or preparation of new floor finish and new wall assembly’s installation.

b. Contractor is responsible for proper handling, removal, storage, and proper recycling of silica-containing materials according to all applicable regulation, employee and environment protection. Refer other section for engineering requirements for dust and particulate controls during all work including demolition activities.

c. Construction activities including but not limited to floor preparation, grinding, chipping, drilling, sawing, cutting and jack hammering and other general construction or demolition require control of potentially airborne silica dust from contaminating the environment within the facility. Impact of these building materials with detectable concentrations of silica shall be performed according to Washington Labor and Industries regulations for Silica in Construction (WAC 296-840 and -841 Airborne Contaminants) including all applicable employee exposure assessment.

d. All employers of personnel performing work related to the above are to address the following information related to all tasks to be performed by their personnel. Provide for Owner review Work Safety Plan or Job Hazard Plan to address Silica in building materials to be impacted, including: worker training, personal protective equipment and engineering controls (to limit and control dust) to be implemented during the work, decontamination procedures, access restriction procedures and controlled/restricted areas, enclosures, debris clean-up procedures, worker exposure assessments and any related air monitoring.

11. Contaminated Soil Remediation – Not Used – Not in the Scope


PART 2 - PRODUCTS

2.1 MATERIALS
A. Not Used

2.2 EQUIPMENT
A. Not Used
PART 3 - EXECUTION

3.01 WORK PERFORMED BY ENVIRONMENTAL CONSULTANT

A. In addition to contractor’s ambient and personnel monitoring other necessary sampling such as post-remediation clearance, determination of hazardous and regulated materials or dangerous waste profiling for disposal may be performed by the Owner’s Environmental Consultant.

END OF SECTION
PART 1 - GENERAL

1.01 SCOPE

A. This section covers the removal and disposal, or other impact, of asbestos-containing materials (ACM) at the areas included in the Work as defined by these Contract Documents. See Sections 01 11 01 (Summary of Work - Regulated Materials) and 02 80 00 (Facility Remediation).

B. Advisory Notice – Asbestos Caution (Hidden Materials): The possibility exist that suspect ACM may be present at concealed locations in wall and ceiling cavities, within HVAC equipment and potentially in other concealed areas and the space below and above the work areas. These may include, but are not limited to wall mastics, caulking, sealants on HVAC equipment, construction adhesives, wiring and electrical insulators, pipe covering and insulation, firestop and penetration materials and vapor barriers. Stop work immediately and promptly inform the UW if suspect materials are noted - the material shall be assumed to contain asbestos until laboratory analysis is completed by certified AHERA building inspector.

C. Provide all labor, materials, equipment, services, permits and insurance required to complete asbestos-related procedures as indicated in the Contract Documents. Handling, removal, shipping and disposal of ACMs shall be in compliance per federal, state and local regulations.

D. Provide all required Infection Controls or Covid-19 safe work practices and mitigating procedures (per other Section and Washington State Governor’s proclamation and all amendments).

E. The Contractor shall refer to the Hazardous Materials Survey Report that lists suspect materials sampled in areas included in the Work and analysis for asbestos content. Contractor shall ensure that a copy of this information is made available to and retained at the project site by all subcontractors.

F. The Contractor shall be responsible for all air sampling including worker/personnel and area monitoring (pre-abatement and contractor’s post abatement clearance sampling).

G. Abatement/Removal: Provide all labor, coordination, materials, equipment, insurance, notification, and permits required to undertake selective ACM removal, and disposal as indicated in the Contract Document, demolition scope and the following listed abatement:

In all abatement areas provide negative pressure machines to utilize as air scrubbers in regulated and restricted work areas.

1. Remove ACM floor tile and mastic to “facilitate the project” associated with the demolition of walls, pony walls, equipment and cabinets. ACM flooring is present throughout the space and under cabinets, equipment and under walls. Contractor shall refer to demolition plans for coordination of abatement activities (assumed approximately combined 900 SF for ACM flooring and mastic to be removed in spot areas in F218, 218A and 216).

2. Remove assumed potential ACM mudded pipe fitting insulation and pipe penetrations (to floor below) associated mechanical demolition (including the 1st floor ceiling). Assume total 50 mudded pipes, pipe insulation and pipe penetrations). Abatement of plumbing and heating lines to facilitates mechanical demolition. Radiator pipes at ceiling level with ACM insulation will remain and not be disturbed. Account for
incidental damage and associated repairs of ACM pipe insulation and cleanup (10 LF using bridging encapsulation and plaster wrap covers).

3. Remove ACM cement board drying rack in F 218A (8 SF).

4. Remove Lab sinks with ACM undercoating (total 4 sinks).

5. Remove fire doors with assumed ACM lining (total 2 doors).

6. Remove assumed ACM mastic/glue in shelving units and cabinets to be demolished (20 SF) including wall mastic uncovered during construction (25 SF).

7. Contractor shall refer to mechanical demolition for coordination of abatement activities.

H. Owner will conduct confirmation bulk sampling to determine asbestos content in any assumed asbestos-containing material or suspect material found and uncovered during construction.

I. Less than 1% of Asbestos. For all trades – wallboard/joint compound and mud as a "composite" was found to contain asbestos in trace concentrations throughout. Impact of referenced materials that were identified to contain less than 1% of asbestos shall be undertaken according to WISHA Regional Directive (WRD) 23.30. Refer to project plans for location of wall penetration and wall demolition, and other associated impacts. Requirements include, but are not limited to, the following:

1. Worker training must include asbestos awareness and hands-on training per WAC 296-62-07722(5).

2. Work must be supervised by a Competent Person per WAC 29-62-07728.


4. Worker respiratory protection is to be based on overall dust levels and comply with WAC 296-62 including the provision of personnel exposure assessment and monitoring during work.

5. Use of wet, non-aggressive techniques and prompt cleanup with HEPA-equipped vacuums.

6. All dust remaining in the work areas must be cleaned-up following impact of wall system using vacuums with HEPA filters and wet-wiping. Protect finishes, equipment and items remaining in work areas as necessary.

7. Owner reserves the right to collect asbestos air samples from the work areas related to wall assembly impacts.

8. Provide to Owner for review the above work plan requirements and all training certificates.

1.02 RELATED SECTIONS

A. Drawings, General Conditions, Modifications to the General Conditions, and Supplemental Conditions to the General Conditions, and other Divisions apply to this Section.

1.03 DEFINITIONS
A. Wherever the terms below occur in this contract document, they will have the meanings which follow:

1. Abatement: Procedures to control fiber release from asbestos-containing building materials. Includes encapsulation, enclosure, removal, repair and related activities.
2. Adequately wet: sufficiently mixed, saturated, or coated with water or an aqueous solution to prevent emissions.
4. Amended Water: Water containing a surfactant additive.
5. Asbestos: Asbestiform varieties of actinolite, amosite, (Cummingtonite - grunerite, tremolite, chrysotile, crocidolite and anthophylite.)
6. Asbestos-containing Material (ACM): Any material containing more than one percent (1%) asbestos as defined under NESHAPS CFR 40 Part 61, and OSHA 29 CFR Part 1926.1101, or at least one percent (1%) asbestos as defined under Regulation III of the Puget Sound Clean Air Agency
7. Asbestos-containing Waste Material: Asbestos-containing materials, materials used to control the work area during the asbestos project, debris, containers, bags, protective clothing and HEPA filters.
8. Authorized Visitor: The Owner or designated representative, or a representative of any regulatory or other agency having jurisdiction over the project, and having required training, medical, fit test, etc.
10. Certified Asbestos Supervisor: person certified by WAC Chapter 296-65-012, whose duties include at least: establishing negative pressure, mini-enclosure, glove bag or other engineering controls, ensure integrity of those controls, supervise employee monitoring, protective equipment, training, hygiene and decontamination procedures.
11. Certified Industrial Hygienist (CIH): An industrial hygienist certified in Comprehensive Practice by the American Board of Industrial Hygiene.
12. Class I Asbestos Work: Activities involving the removal of TSI, surfacing ACM and presumed asbestos-containing materials as defined by OSHA. Materials include those otherwise regulated by WISHA including, but not limited to, pipe insulation.
13. Class II Asbestos Work: Activities involving the removal of ACM which is not thermal system insulation or surfacing material as defined by OSHA. This also includes, but is not limited to, the removal of asbestos-containing floor tile, cement asbestos board, roofing and siding.
14. Critical Barrier: Barrier constructed of two layers of six-mil plastic sheeting and sealed at the edges with duct tape and, as appropriate, spray adhesive. Critical barriers constructed in exterior areas shall utilize reinforced plastic sheeting.
15. Decontamination Area: Enclosed area adjacent and connected to regulated area and consisting of equipment room, shower area, and clean room, which is used to decontaminate workers, materials, and equipment.
16. Disposal: Procedures necessary to transport and deposit the asbestos-contaminated material in an approved waste disposal site in compliance with EPA and other applicable regulations.
17. Disposal Site: EPA and UW approved landfill for asbestos-containing waste.
18. EPA: U. S. Environmental Protection Agency.
19. Encapsulant (Sealant): A liquid material which can be applied to asbestos-containing material and which controls the possible release of asbestos fibers from the material either by creating a membrane over the surface (bridging encapsulant), or by penetrating into the material and binding its components together (penetrating encapsulant).
20. Environmental Consultant: Environmental consultant specializing in asbestos abatement and retained by the Owner.
21. Fiber: A particulate form five micrometers or longer, with a length to diameter ratio of at least 3:1.
22. Fibers/cc: Fibers per cubic centimeter of air.
23. Fixed Object: Fixtures which are attached to the building or are too heavy or bulky to remove from the work area.

24. Glove bag: A manufactured device consisting of a transparent plastic bag with inward projecting sleeves, an internal tool pouch, provisions for fastening and sealing at the top and sides, and a receptacle in the bottom to hold asbestos waste. The glove bag is installed so as to surround the material to be removed and contain all fibers released during the process. Glove bags are used to remove insulation from small sections of pipe and fittings.

25. HEPA Filter: A High Efficiency Particulate Air (absolute) filter capable of trapping and retaining 99.97% of asbestos fibers greater than 0.3 microns in length.

26. HEPA Vacuum Equipment: High Efficiency Particulate Air (absolute) filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters of 99.97% efficiency for retaining fibers of 0.3 microns in length or larger shall be installed for filtering discharge air.


28. Independent Testing Laboratory: A laboratory financially independent from and hired by the Owner or Contractor which is either AIHA-accredited for asbestos with demonstrated proficiency via the AIHA PAT program, or has analysts proficient in the AIHA AAR program for air sample analysis.

29. Industrial Hygienist: An employee of the Independent Testing Laboratory who is experienced and trained in asbestos sampling and analysis as specified.


31. Mini-enclosure: An enclosure fabricated to effectively contain a small work area conforming to EPA, AHERA, 40 CFR 763 Subpart E, Appendix B.

32. Movable Object: Furnishings which are not attached to the building structure and can be removed from the work area.

33. Non-Isolated, Regulated Area: Work area where Class II asbestos abatement work is performed as defined by OSHA 29 CFR 1910.

34. NVLAP: National Voluntary Laboratory Assurance Program.

35. PACM: Presumed asbestos-containing materials.

36. PAT: Proficiency Analytical Testing program performed for NIOSH method 7400.

37. PCM: Phase Contrast Microscopy analytic method applied to air samples to determine airborne fiber concentrations, NIOSH method 7400.

38. PLM: Phase Light Microscopy analytic method applied to bulk material samples to determine asbestos content, EPA method 40 CFR 763, Subpart F, Appendix A.

39. Public Area: Any area outside the isolated work area. When work area isolation measures are removed, the work area becomes a public area.

40. Regulated Area: Area which only certified asbestos workers and other persons authorized by Regulation I of the Washington Industrial Health Act have access, where asbestos materials to be removed exist, or where airborne fiber concentrations are expected to exceed 0.01 f/cc.

41. Removal: All operations where ACM and/or PACM are taken out or stripped from structures or substrates, and include demolition activities.

42. Surfactant: A chemical wetting agent added to water to improve penetration, thus reducing the quantity of water required for a given operation or area.

43. Thermal System Insulation (TSI): ACM applied to pipes, fittings, boilers, Breaching, tanks, ducts or other structural components to prevent heat loss or gain.

44. Transport: Hauling of asbestos-containing waste from a work site to a disposal site and deposit of the waste by a firm in compliance with the EPA, Washington State and PSCAA.

45. Waste Load-out Area: A two chamber system adjacent to the negative pressure enclosure used for the final preparation and external decontamination of waste containers, and short term storage waste containers prior to transport from the jobsite.
46. Waste Shipment Records: Form similar to that shown in EPA NESHAP 40 CFR 61.150(d)(1), or an EPA approved state or local form.
47. Worksite Entry Logbook: A logbook kept in the clean room which must be signed by everyone entering or leaving the work area.

1.04 DOCUMENTS INCORPORATED BY REFERENCE

A. The current issue of each document shall govern. Where conflict among requirements or with these Specifications exists, the most stringent requirements shall apply.


3. U.S. Department of Labor Occupational Safety and Health Administration (OSHA):


6. Title 29 Code of Federal Regulations Section 1910 et al.--Occupational Exposure to Asbestos; Final Rule.


8. Title 29 Code of Federal Regulations Section 1910.2--Access to Employee Exposure and Medical Records.


13. CERCLA, Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601 et.seq.)


17. Washington Industrial Safeties and Health Act (WISHA) and DOSH (Dept. of Health and Safety – WA. State Labor and Industries).


19. Electrical work shall be performed in accordance with the National Electrical Code.

20. All local ordinances, regulations, or rules pertaining to asbestos, including its storage, transportation, and disposal.

1.05 SUBMITTALS AND NOTICES

A. Contractor shall provide electronic documents of the "Pre-Job Submittals" as indicated below for review by the Environmental Consultant and Owner. No asbestos-related work will be permitted prior to submittals being approved by the Environmental Consultant. Allow ten (10) days for review.

B. Additional requirements for submittals are also described in other sections of these specifications. The requirements in this section pertain to asbestos-containing materials removal.

C. Submit the "Contractor Acknowledgment of Asbestos Hazard Training, Respirator Training and Agreement to Undertake All Required Precautions", Form 028200-1. (attached to this Section) completed and signed by the Abatement Contractor in conjunction with pre-job submittals.

D. Contractor shall submit to the Environmental Consultant the following information prior to beginning work on the project:

1. Work Plan: Include a detailed plan of the procedures proposed for use in complying with the requirements, including the following:

   a. A description of all special equipment, techniques, and methods to be used on the Project, including description of work area layout(s) citing entries/exits, HEPA exhausts through open windows, decon units, waste load-outs, emergency spill controls SOP, etc.

   b. A detailed project schedule, including proposed clearance monitoring schedule and progression of abatement through the work areas.

   c. Specific information relating to handling, transport and disposal of asbestos-containing waste. Identify any disposal site (must be Owner approved site) at which any waste material generated during the project will be disposed and furnish evidence of all necessary government approvals to dispose of the waste.

2. Laboratory Qualification Information: Submit information pertaining to the proposed Air Monitoring Program for this project. Air monitoring shall include employee exposure monitoring, area air sampling and post abatement air sampling. This information shall include the name(s) of the on-site Industrial Hygiene Technician working under the foreman's supervision, types of equipment, sampling schedule, sampling procedures, calibration record keeping, name and address of proposed Independent Testing
Laboratory, and evidence of analyst’s NIOSH 582 course completion and AIHA PAT program participation.

3. Notifications and Permits: Submit copy of all required notifications and permits obtained by the contractor (Washington State Department of Labor and Industries, and PSCAA) and copies of all types of specified bonds and insurance. Submit upon receipt any approved amendments to notifications or re-notifications for multi-phase activities. See Permits and Notifications for additional requirements.

4. Asbestos Supervisor: Submit the name, Asbestos Supervisor Certification, Certificate of Worker Acknowledgment and resume of experience of the assigned on-site foreman. At a minimum, the foreman shall have successfully completed a supervisor training course in compliance with WAC Chapter 296-65-007. References and work on similar projects will also be reviewed. The Owner reserves the right to reject the foreman from the work at any time during the project. The Contractor shall then submit another on-site foreman for approval as described above.

5. Emergency Cleanup and Control Plan: Contractor shall submit for review a comprehensive plan detailing procedures to be implemented in the event of an asbestos spill. Information shall include the name of the Contractor’s supervisory personnel responsible for identifying spills, detailed procedures of cleanup of spills, communication procedures, and methods to expedite response time.

E. Periodic Job Submittals:

1. Personal/worker Air Monitoring: Submit copies of all personal air monitoring data sheets, chain-of-custody and analytical results to the Owner and Environmental Consultant on a daily basis prior to the start of the next work shift following sample collection.

2. Daily Logs: Submit daily logs to the Owner and Environmental Consultant daily prior to the start of the next work shift. Daily logs shall indicate the ACM quantity removed, date, time, identity, company or agency represented, and reason for entry of all persons entering the work area, and the type, amount and location(s) of all ACMs removed.

3. Provide documentation of training (and current certification identification numbers), medical monitoring and fit test records of employees as required by applicable regulations. Such documentation will be maintained on the project site as required by applicable regulations.

F. Post-Job Submittals shall be delivered to the Owner within 15-days of completion of work and shall include the following:

1. Certification: Provide the completed Certification of Clearance that Contractor has fully inspected the work area and completed work in strict accordance with the Specifications.

2. Air Monitoring: Submit documentation of all employee personal air monitoring results relative to OSHA and WISHA respiratory protection level compliance. Include copies of all air monitoring data sheets, chain-of-custody documentation and analysis reports for sampling conducted at the site.

3. Project Record Documents: Provide project records including documentation of all contract changes, and copies of worksite entry log books, safety logs, sign-in sheets, and supervisor’s daily field reports.
4. Disposal Manifests: Submit copies of all asbestos waste disposal transportation and disposal manifests including signed receipts from the landfill (shall be Owner approved landfill), and chain-of-custody.

1.06 PERSONNEL PROTECTION

A. Training: All personnel accomplishing removal of asbestos-containing materials shall have received the minimum training as required by the Washington State Department of Labor and Industries for the work to be performed. At a minimum, the supervisor shall be the bearer of a current "Certified Asbestos Supervisor Certificate" issued by the Washington State Department of Labor and Industries. Prior to commencement of work, Contractor shall ensure all workers have been trained as specified in WAC Chapter 296-65.

1. The Contractor shall provide and post decontamination, respirator, and work procedures for abatement crew.

2. The Contractor shall ensure that all employees have been trained as to emergency evacuation procedures specific to each work area.

B. Personnel Protective Equipment for Asbestos Removal: Provide protective clothing and equipment per WAC 296-62 and Protective Clothing and Equipment.

1.07 AIR MONITORING BY CONTRACTOR (PERSONNEL EXPOSURE AND CLEARANCE)

A. Laboratory Analysis: An Independent Testing Laboratory shall be retained by the Contractor for PCM sample analysis. All analysis shall be performed by an analyst experienced and trained in asbestos sampling and analysis. At a minimum, documentation of prior asbestos sampling and analysis experience, plus satisfactory completion of the NIOSH 582 course or equivalent will be required. Air sample collection may be performed by an Industrial Hygienist or the Contractor's foreman at the Contractor's option. The Contractor shall perform sampling and analysis of air samples for asbestos in compliance with WAC Chapter 296-62-07735, Appendix A-WISHA reference method.

B. Sample Documentation: Documentation shall be kept for each filter sample procured as to worker sampled, activity, work area location, date and time taken, volume of air drawn through filter, pump identification number and calibration. Documentation shall indicate in what areas tests were taken and clearly indicate the specified maximum allowable fiber levels for each area tested. Report all data on copies of the Asbestos Air Sample Data Sheet bound in these Specifications or similar approved form within 48 hours. Fill in all information on every form. Submit chain-of-custody records along with all samples.

C. Analysis Procedures: The samples shall be collected on 25 mm filters and analyzed within 12 hours using the membrane filter method at 400-500x magnification with phase contrast illumination--NIOSH Analytical Method No. 7400--for laboratory and field analysis. The analyst shall sign and submit permanent records of all samples analyzed directly to the Environmental Consultant. The Independent Testing Laboratory shall seal the unused portion of all filters in airtight containers so that individual samples can be re-analyzed at a later date if necessary. The containers shall be clearly labeled with Project Name and Sample Number and shall become property of the Owner at work completion at the Owner's request.

D. Controls: The Contractor's testing laboratory shall submit sample analysis results, chain-of-custody and equipment calibration records to the Owner prior to the start of the next work shift following collection.
E. Contractor's Sampling During Abatement.

1. Sample Collection: Air monitoring shall be performed to determine worker exposure during the period of asbestos abatement in each work area. Begin sampling when asbestos removal commences. Contractor shall determine which worker(s) in each work area is probably experiencing the most severe exposure. This is the "Most Contaminated Worker(s)". 8-hour TWA and 30-minute excursion samples shall be collected on this worker(s). This worker shall wear a personal sampling pump and the sample shall be drawn from the breathing zone of this worker.

2. The number of air samples collected shall be in accordance with the Contractor's approved work plan, however, a minimum of one sample per work area must be collected daily.

F. Quality Assurance: See Quality Assurance for additional requirements related to air monitoring.

1.08 AIR MONITORING BY OWNER

A. Industrial Hygienist: The Environmental Consultant may collect and analyze asbestos air samples prior to abatement, inside the work area, outside the work area, at HEPA exhaust, and work area clearance/post abatement, and conduct visual inspection at the Owner's discretion and expense. See Section 1.14, Quality Assurance, for additional requirements related to air monitoring.

B. Sampling and analysis of asbestos samples shall be performed in compliance with WAC Chapter 296-62-07735, Appendix A—WISHA and DOSH reference method.

C. The Owner reserves the right to monitor Contractor's performance via air samples on abatement workers in addition to the Contractor's air monitoring responsibility.

1.09 OWNER OCCUPANCY

A. The area of abatement shall be occupied only by properly trained and protected personnel during abatement activities. Construct the abatement control areas and perform the work so as not to interfere with the Owner's site and facility operations. Owner will temporary vacate the Work Areas during abatement. All existing furnishing, equipment, medical devices, computers etc. remaining at the work areas shall be protected and covered with 6-mil plastic sheeting during asbestos abatement.

1.10 WORKING HOURS

A. No asbestos abatement shall occur when University staff or building users have access to the work area(s). Refer to other Section for work hours and all restriction.

1.11 PERMITS AND NOTIFICATIONS

A. The Contractor is responsible for obtaining and maintaining all permits and notifications as required for the completion of the work by the Washington State Department of Labor and Industries, the U.S. E.P.A., the Puget Sound Clean Air Agency and any other permitting agency involved with the completion of the work included herein.

B. Puget Sound Clean Air Agency (PSCAA)
1. At least 15 days before undertaking an Asbestos Project, the Contractor shall submit to the Owner a copy of the Notice of Intent to Remove Asbestos that the Contractor has filed with PSCAA. Prior to the start of any abatement work, the Contractor shall post the Notice of Intent to Remove Asbestos with PSCAA's case number and signature of reviewing officer to prove that the Notification has been processed by PSCAA.

2. The Contractor shall participate in PSCAA's Contractor Job Scheduling program whereby a daily fax is sent to PSCAA informing them of the Contractor's work schedule. A copy of this document shall be faxed to the Owner at the same time it is faxed or emailed to PSCAA. This PSCAA notification shall remain open until the entire general contract work has been completed, in case additional asbestos should be encountered.

1.12 LIABILITY

A. The Contractor is an independent contractor and not an employee of the Owner, Architect or Environmental Consultant. The Owner, Architect and the Environmental Consultant shall have no liability to the Contractor or any third persons for Contractor's failure to faithfully perform and follow the provisions of these Specifications and the requirements of the governing agencies. Notwithstanding the failure of the Owner, Architect or the Environmental Consultant to discover a violation by the Contractor of any of the provisions of these Specifications, or to require the Contractor to fully perform and follow any of them, such failure shall not constitute a waiver of any of the requirements of these Specifications which shall remain fully binding upon the Contractor.

1.13 SUBCONTRACTORS

A. Contractor performing work of this section shall be bound to all the work and safety standards specified and contractor's personnel shall meet requirements as specified.

1.14 QUALITY ASSURANCE

A. Qualifications for Performance of Work

1. Contractor performing the work of this section shall have a record of successful experience in asbestos removal and related Work similar in scope and magnitude to this Project. Contractor shall have valid licenses and certifications as a Contractor and an Asbestos Abatement Contractor in the State of Washington.

2. Maintain on site a full-time Certified Asbestos Supervisor approved by the Owner per pre-job submittals.

3. Provide one experienced Foreman for every ten asbestos workers, or portion thereof, utilized on the Project.

B. On-Site Observation

1. Pre-Removal: Contractor and Environmental Consultant shall perform observations regarding: demarcation of regulated area, installation of critical barriers, integrity of negative pressure enclosures, waste load-out facilities, and other conditions affecting abatement work. Contractor shall request pre-removal observations a minimum of two hours prior to desired removal commencing. No abatement work shall be performed prior to pre-removal observation by the Environmental Consultant.

2. Observation: Contractor and Environmental Consultant shall perform observations regarding: integrity of isolation barriers, decontamination facilities, worker protection,
Contractor’s air monitoring program, performance of abatement operations, and conformance to the Specification, EPA, OSHA, WISHA and PSCAA regulations.

3. Post Removal: Contractor and Environmental Consultant shall perform visual inspections after the removal of asbestos-containing materials and cleaning of work area(s) is complete.

a. Following abatement and cleaning of work area(s), the abatement superintendent shall inspect the work area(s), and notify the Environmental Consultant that the scheduled post-abatement inspection may commence.

b. Visual Inspections will be considered acceptable when no dust, debris or other refuse of any kind exists within the work area(s).

c. Upon completion of the post-abatement inspection, the Environmental Consultant shall indicate acceptance of the work area for compliance, as appropriate.

d. Should additional cleaning of the work area be required to meet the standards set forth in paragraph b of this section, the Environmental Consultant shall indicate deficiencies on the “Daily Log” report and notify the Contractor of such deficiencies.

e. The Contractor shall not proceed with post-abatement sampling until post-removal visual inspection by the Environmental Consultant has determined work area(s) acceptable and completes the “Certificate of Clearance Form” found in the end of this Section. Both contractor and Environmental Consultant shall sign this form for submittal to the Owner.

4. Daily Work Area Inspection/Cleaning: Inspect all work areas prior to the end of each work shift. Personnel performing such inspections shall have proper training per (minimum of Class III asbestos training). Daily work area inspections shall identify any dust, debris or other refuse existing in areas to be occupied by building staff or users subsequent to the Contractor’s work shift.

a. Any suspect asbestos debris (<1 SF) is to be cleaned using HEPA vacuums, wet-wiping and appropriately trained personnel.

b. Any other debris identified is to be cleaned using wet-wiping and/or HEPA vacuuming.

c. Document location(s) and type(s) of debris identified, cleaning procedures, and the time of completion of cleanup in each area.

d. Any identified suspect asbestos spills in excess of 1 localized SF are to be reported immediately to the Owner and Environmental Consultant, and the affected area is to be restricted pending cleanup in compliance with the Contractor’s emergency cleanup and control plan required under Item  below.

5. Stop Work: Owner shall notify the Contractor in writing to stop abatement work if the Owner determines that work practices are in violation of regulations, these Specifications or that work is endangering workers or occupants of the building. The Contractor shall continue work when conditions and actions are corrected and when written authorization is received from the Owner.
6. Schedule of Inspections: The Contractor shall schedule pre-removal and post-removal visual inspections with the Environmental Consultant a minimum of forty-eight (48) hours in advance of the desired inspection occurring.

   a. Any delay in the completion of the Work caused by a lack of proper scheduling of inspections shall not be sufficient cause for any extension of time or extension of the project completion date.

C. Air Monitoring

1. Notification: If, at any time during the work, analysis of an air sample taken by the Contractor, Owner, or Environmental Consultant, indicates a fiber concentration in excess of the applicable Maximum Allowable Fiber Concentration, the laboratory that analyzed the air sample shall immediately notify the Contractor, Owner and Environmental Consultant.

2. Maximum Allowable Fiber Concentrations:
   a. Outside all Regulated Work Areas: 0.01 f/cc (fibers per cubic centimeter by PCM) or below pre-abatement.
   b. Inside Non-Isolated Regulated Work Area: 0.01 f/cc or below pre-abatement levels.
   c. Post-Abatement/Clearance: 0.01 f/cc or below pre-abatement levels.

3. Procedures: Immediately upon being notified of fiber concentration in excess of the Maximum Allowable Fiber Concentration, the Contractor shall perform the following steps in the order presented, at no additional cost to the Owner:
   a. Stop abatement work and identify source of high fiber counts.
   b. Corrective Actions: Immediately correct containment breaches, pressure differential changes and potential cause of high fiber counts. The Environmental Consultant will determine the affected area considered to be contaminated and the proper cleaning to be performed by the Contractor at no additional cost to the Owner.
   c. Clean the affected area. Cleaning will include wet methods and HEPA vacuuming.
   d. Re-sample air until fiber counts are determined to be below the specified maximum levels.
   e. Secure and repair containment barriers, repair or add equipment, modify work procedures, and make other changes to reduce fiber counts.
   f. Resume work and air monitoring.

4. Post-Abatement Sampling: The Contractor is responsible for all post abatement and/or clearance sampling using PCM sample collection and analysis. Provide to Owner and Environmental Consultant all air clearance sampling data. Analysis of PCM air clearance samples shall be posted by the contractor within four hours upon completion of clearance sampling. Upon review and found to be acceptable (and as compared to Environmental Consultant’s QA/QC clearance sampling data), the work area can be considered “cleared for re-occupancy”. If there are conflicts with PCM sampling results, the best air quality results shall be used and applied in the field.

D. Performance: Work shall be performed in a skillful manner representing industry standards. Environmental Consultant shall require Contractor to remove from the work site employees
and subcontractors the Environmental Consultant deems incompetent, careless or objectionable.

E. Additional Costs: The Contractor shall be responsible for costs of any testing, cleanup, repair, down time loss, etc. that is a result of the Contractor's negligence, poor maintenance of isolated areas, improper procedures or airborne fiber concentrations above the Maximum Allowable Fiber Concentrations.

PART 2 - PRODUCTS

2.01 PROTECTIVE CLOTHING AND EQUIPMENT

A. Provide approved clothing per WAC 296-62 for all workers and all official representatives of the Owner, State or other governmental entity, and the Environmental Consultant who may inspect or visit the project. Work clothes shall consist of disposable full-body coveralls and head and foot covers ("Tyvek" or approved equal), boots, or sneakers. Eye, hearing, fall protection, gloves and hard hats shall be available, as required by job site conditions.

B. Respirators: At a minimum, respiratory protection shall be approved by NIOSH/MSHA (National Institute for Occupational Safety and Health/Mine Safety and Health Administration), United States Department of Labor, and U.S. Department of Health, Education and Welfare, Centers for Disease Control, in accordance with WAC Chapter 296-62-071 and WAC 298-841/842. Respiratory protection shall provide workers with a maximum calculated fiber level inside the mask of 0.01 f/cc.

1. Selection: As part of the Contractor's Respiratory Protection Program, all workers shall be provided with a selection of brands and sizes of respirators to choose from. At a minimum, all workers shall be quantitatively or qualitatively fit-tested at the time of respirator selection per WAC Chapter 296-62-07715 and WAC 298-841/842.

2. Contractor shall supply replacement filter cartridges as required. Cartridges which have become wet or clogged shall be replaced immediately.

3. Contractor shall provide personal protective equipment and supplies to the Environmental Consultant and authorized visitors for use on the site.

C. Air-purifying Equipment: Air-purifying equipment shall consist of High-efficiency Particulate Air (HEPA) filtration systems. No air movement system or air equipment shall discharge asbestos fibers outside the work area. Each unit shall be capable of variable volume from a minimum of 500 CFM to at least 1700 CFM under load and shall have at least 2 stages of prefiltration ahead of the HEPA final filter. Each unit shall be equipped with an elapsed time indicator (hour meter), static pressure gauge with low flow alarm, and be overload protected. At the Contractor's option, each unit shall be equipped with heat and smoke sensors which will visually and audibly warn workers and shut unit fan down within 30 seconds. The units shall be: Micro-Trap Portable Air Filtration System manufactured by Asbestos Control Technology, Inc. or Owner approved equal.

D. Water-purifying Equipment: Capable of removing all fibers longer than 5 microns or as required by local regulations from water used in abatement work and decontamination showers. Control Resource Systems, Inc. "AQUA-HOG" or Owner approved equal.

E. Vacuum Equipment: all vacuum equipment utilized in the work area shall be High-efficiency Particulate Air (HEPA) equipment, and suitable for wet/dry usage.
F. Transportation Equipment: Transportation equipment, as required, shall be suitable for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property. Equipment shall have a hard bottom and sides. If equipment is rented, notify rental agency in advance, in writing, of intended use of equipment.

G. Electrical: Electrical tools, equipment and lighting shall meet all applicable codes and regulations, including WAC Chapter 296-155-426 to 462. Ground fault protection as required by OSHA, shall be in effect at all times. Contractor shall take all additional precautions and measures necessary to ensure a safe working environment during wet removal.

H. Remote Filter Housing: Stainless steel housing with pre-filters and HEPA filter sealed to cabinet flanges by Century Equipment “Advance Guard II” or approved equal.

I. Other Tools and Equipment: Provide other suitable tools for the removal, glovebags, enclosure, encapsulation, patching, and disposal activities including but not limited to: hand-held scrapers, wire brushes, sponges, and rounded-edge shovels.

J. Lighting: Provide adequate lighting for safe execution of work and for Environmental Consultant to perform visual inspections of work areas.

K. Pre-manufactured Remote Decontamination Facility: Remote decontamination facilities shall be in compliance with all applicable state, federal and local codes and regulations and function in accordance with these specifications.

2.02 MATERIALS

A. Plastic Sheet: Plastic sheet shall be flame-retardant polyethylene material, minimum thickness of 6-mil, sized in lengths and widths to minimize the frequency of joints. Exterior applications require reinforced plastic sheeting.

B. Plastic Bags: Plastic bags shall be 6-mil polyethylene printed with warning labels with waterproof print and permanent adhesive in accordance with WAC Chapter 296-62-07721, OSHA, DOT and EPA regulations. Permanently mark the label with the date the material was collected for disposal, the name of the waste generator, the name and affiliation of the certified asbestos supervisor, and the location at which the waste was generated.

C. Tape: Tape shall be capable of sealing joints of adjacent sheets of plastic and for attachment of plastic sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under dry and wet conditions, including use of amended water. Minimum of 2” wide tape must be used. Do not use polyethylene tape.

D. Disposal Containers: Disposal containers shall be suitable to receive and retain any asbestos-containing or contaminated materials until disposal at an approved site. The containers shall be labeled with waterproof print and permanent adhesive in accordance with WAC Chapter 296-62-07721, OSHA, DOT and EPA regulations. Permanently mark the label with the date the material was collected for disposal, the name of the waste generator, the name and affiliation of the certified asbestos supervisor, and the location at which the waste was generated. Containers must be both airtight and watertight, and have hard top, bottom and sides.

E. Warning Labels: Warning labels on plastic bags and disposal containers shall include the following information:

DANGER
CONTAINS ASBESTOS FIBERS
F. Warning Signs: Warning signs shall be provided and displayed at each regulated area in accordance with WAC Chapter 296-62-07721. Warning signs shall include the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING AIRBORNE ASBESTOS FIBERS

G. Amended Water: Clean potable water containing a surfactant additive. The surfactant additive shall be 50% poloxylene ether and 50% polyethylene ester, or equivalent, and shall be mixed with water at a concentration of one ounce surfactant to 5 gallons of water, or as recommended by the manufacturer in the case of an equivalent.

H. Encapsulants (Sealants): Encapsulants shall be of the bridging or penetrating variety and shall be listed as "satisfactory" by the EPA. Penetrating Encapsulant: No. 207 Special Sealer #33775-27A as manufactured by Makus-Cincinnati, Inc.; "Asbestop 30B-2" as manufactured by Asbestos Corp.; "Cable Coating 22-P" as manufactured by American Coatings Corp., or approved. Bridging Encapsulant: Decadex Firecheck, manufacturer's standard color "Magnolia", as manufactured by Pentagon Plastics, Inc.; "Cable Coating 2-B", manufacturer's standard color gray, as manufactured by American Coatings Corp.; or Owner approved equal.

I. Other Materials: Provide materials such as lumber, nails and hardware, which may be required to construct and dismantle the decontamination area and barriers isolating the work area.

J. Spray Glue: Spray glue shall be a heavy duty adhesive in aerosol can, "CDC Spray Glue" as manufactured by AMREP, Inc., or Owner approved equal.

PART 3 - EXECUTION

3.01 WORK AREA PREPARATION

A. Worker Decontamination Facilities

1. Modified Worker Decontamination Enclosure System
   a. At entrances to non-isolated work areas the Contractor shall construct a personnel decontamination enclosure system or area consisting of plastic sheeting barriers with a HEPA vacuum and a water source. The system shall include a decontamination area where workers can remove contaminated protective clothing, decontaminate themselves and change into street clothing.

   b. Contractor shall not begin asbestos abatement work unless this system is functional, in good repair, and has been found acceptable for specification compliance by the Environmental Consultant.
B. Access to Work Area by Others

1. Except for emergency personnel, the Contractor shall limit access to the work area to authorized visitors.

2. The Contractor shall provide protective clothing, respirators and equipment for all authorized visitors, as specified.

3. All authorized visitors shall be subject to the personnel protection provisions specified above, and shall sign in and out on the Worksite Entry Logbook.

C. Personnel Protection During Work in Non-Isolated Work Areas

1. Work clothes per 2.01-A and respiratory protection per 2.01-B.

2. Clothing: Workers shall wear two layers of coveralls after removal of street clothes. Worker decontamination will consist of personal decontamination in a regulated area over drop plastic sheeting with HEPA vacuum and wet methods. The first layer of coveralls must be removed when exiting the work area.

3. Workers shall not eat, drink or chew gum at the worksite except in the established clean room. Smoking or using other tobacco products is prohibited.

4. Workers shall be fully protected with respirators and protective clothing immediately prior to the first disturbance of asbestos-containing or contaminated material and until final cleanup is completed.

D. Emergency Precautions

1. Emergency Exits: The Contractor shall establish emergency and fire exits from the work area. Contractor shall ensure these exits are well marked and remain unobstructed.

2. First Aid: The Contractor shall be prepared to administer first aid to injured personnel after decontamination. Seriously injured personnel shall be treated immediately or evacuated without delay for decontamination.

3. Fire Department: Contractor shall notify the local fire department of the asbestos abatement project prior to beginning work area preparation.

4. Contractor shall provide fire extinguishers at all abatement work areas.

5. Emergency Clean-up: Contractor to submit to the Environmental Consultant for review an emergency control and cleanup plan to be followed in the event of asbestos contamination during work in non-isolated work areas. Contractor shall ensure all workers are thoroughly familiar with approved plan.

E. Building Security and Protection

1. The Contractor shall post adequate warning signs at all potential entrances to work areas.

2. Building Protection: Contractor shall protect all existing fixed equipment, existing building finishes that are to remain, and existing systems and functions from damage during the abatement process. Extra precautions are to be taken in protecting existing electrical panels, light fixtures, etc. Any damage to existing building, services, and/or equipment shall be remedied by the Contractor at his expense.
3. Power Failure: Contractor shall notify Environmental Consultant and Owner immediately when a power failure occurs. Asbestos abatement work will stop and the work area will be misted with water. If power failure exceeds 15 minutes, workers shall use appropriate personnel decontamination procedures and shall seal the work area. Precautions to prevent visible emissions will be performed under the direction of the Environmental Consultant.

4. Contractor shall maintain access and use of existing fire lanes and maintain security measures to prevent unauthorized access, theft or vandalism.

3.02 NON-ISOLATED WORK AREA PREPARATION

A. Performance: Contractor shall perform the following procedures in the order in which they are presented for work in non-isolated work areas according to the approved work plan. Any alternative control measures considered for Class II asbestos abatement work involving the removal of ACM that is not TSI, surfacing or sheet flooring materials shall be reviewed by the Environmental Consultant and performed in accordance with 29 CFR 1926.1101.

1. Coordinate to ensure shut down and isolation of any HVAC equipment near work areas. Allow for fourteen (14) day notification period required for shut-downs. Coordinate regarding all electrical, safety and other service connections, requirements and equipment. Contractor is responsible to detect operation of systems intended to be shut down during abatement.

2. Completely pre-clean visible accumulation of any debris in work area using HEPA vacuum equipment and use wet cleaning methods.

3. Set up a modified worker decontamination enclosure system as described above. Once this system is installed and abatement commences, it shall be utilized in the specified manner for decontamination of only personnel. All personnel shall sign the Worksite Entry Logbook each time they enter or exit the work area. Work performed outdoors in excavated areas shall be performed wearing two disposable suits.

4. Have emergency cleanup equipment and supplies, including HEPA vacuum, amended water, disposal bags, buckets, towels and sponges, on hand prior to start of abatement work.

B. Compliance: No asbestos abatement work shall occur unless the work area has been found acceptable for Specification compliance by the Environmental Consultant. Notifications to perform asbestos abatement and the Hazardous Materials Inspection Summary shall be posted at the work site.

3.03 ISOLATED WORK AREA PREPARATION

A. Coordinate to ensure shut down and isolation of any HVAC equipment near work areas. Allow for fourteen (14) day notification period required for shut-downs. Coordinate all electrical, safety and other service connections, requirements and equipment. Contractor is responsible to detect operation of systems intended to be shut down during abatement.

B. Remove all uncontaminated removable equipment, fixtures, and supplies from the Work Area before commencing Work. If equipment and furnishing remain completely pre-clean and cover all unmovable furnishings or equipment with two layers of polyethylene sheeting, securely taped in place with duct tape. Such fixtures and equipment shall be considered outside the Work Area unless covering plastic or seal is breached. Contractor is responsible for any damage that these items incur while working in these areas.
C. Install critical barriers as follows:

1. Individually clean and seal all ventilation openings (supply and exhaust), doorways, lighting fixtures, floor drains and all other openings into the Work Area with two layers of reinforced polyethylene sheeting, taped securely in place with duct tape. Maintain seal until all Work is completed. Provide scaffolding and rigid post as necessary for proper structure integrity when negative pressure is applied.

2. Clean and seal all lighting fixtures and HVAC diffusers with duct tape, and plastic sheeting to provide an airtight and watertight seal. Take care to avoid wrapping plastic sheeting on light fixtures, which may generate heat. Ensure that all electrical conduit connections and other electrical devices inside the Work Area that are exposed to moisture are sealed.

3. Use duct tape to seal all seams of HVAC ductwork or other system components that extend through Work Area.

4. Completely pre-clean visible accumulation of any debris in work area using HEPA vacuum equipment or wet cleaning methods.

5. Seal all openings through the floor at columns and piping risers with a fire-stop sealant to provide an airtight and watertight separation between the Work Area and the floor below.

6. Seal all doorways and openings into work areas with hard rigid barriers and cover with a layer of reinforced plastic sheeting for dust controls.

D. Construct separate Decontamination Units in compliance with EPA, OSHA, and WISHA guidelines concerning number, size and placement of airlocks, etc. Shower in worker Decontamination Unit shall open into airlock on both contaminated and uncontaminated sides. Construct Decontamination Units of appropriate materials (including black plastic sheeting). Shower in personnel Decontamination Unit shall contain both hot and cold running water. Supply sufficient shower units to comply with OSHA regulations. Post OSHA decontamination procedures in Change Room and Equipment Room for duration of Project. Water for the showers shall be plumbed from an Owner-designated source.

E. Trap shower waste water using filters having a maximum pore size of 5.0 microns, and drain into a sanitary sewer. Replace contaminated filters when they become clogged but not less than every third day. Dispose of filters as contaminated waste.

F. Submit the proposed route of exhaust of negative air pressure to Environmental Consultant prior to initiating its use. Coordinate with Owner for location to exhaust (to outside the building) all negative pressure air from work areas. Place Work Area under negative air pressure utilizing negative air equipment. Allow no air movement system or air filtering equipment to discharge unfiltered air outside the Work Area. Maintain a negative pressure in the Work Area continuously (24 hours per day) from the start of removal of asbestos-containing material until the area is decontaminated and certified as such by the required air testing. Ensure that the air within the Work Area is changed at least once every 15 minutes, and maintain a pressure differential of at least - 0.02 inches of water between the air within the Work Area and the air outside the Work Area. Provide manometer devise with paper read-out for all full enclosure/isolation Work Areas.

G. Notify Environmental Consultant for observation and acceptance of all critical barriers, HEPA filtration systems, and Decontamination Units before proceeding with installation of Primary Barrier.

H. Install Primary Barrier as follows:
1. Clean all surfaces in Work Area using a HEPA filtered vacuum and by wet wiping prior to the installation of the Primary Barrier.

2. Cover floor of Work Area with one layer of reinforced polyethylene sheeting, turned up walls at least 12 inches. Form a sharp right angle bend at junction of floor and wall so that there is no radius that could be stepped on causing the wall attachment to be pulled loose. Use spray cement and duct tape to seal all seams in floor covering.

3. Cover all walls in Work Area with one layer of polyethylene sheeting, mechanically supported and sealed with duct tape and spray cement. Seal all joints, including the joining with the floor, with duct tape.


I. Install Secondary Barrier as follows:

1. Cover floor of Work Area with a second layer of polyethylene sheeting, turned up walls at least 12 inches. Form a sharp right angle bend at junction of floor and wall so there is no radius of sheeting that could be stepped on causing the wall attachment to be pulled loose. Locate seams at least six feet from, or at right angles to, seams in Primary Barrier layer. Use spray cement and duct tape to seal entire length of all seams in floor covering.

2. Cover all walls in Work Area with a second layer of polyethylene sheeting. Support polyethylene sheeting on wall with duct tape; seal top of Secondary Barrier to Primary Barrier with duct tape so debris cannot get behind it.

3. Install sheeting so Secondary Barrier can be removed independently of the Primary Barrier.

4. Notify Environmental Consultant for visual review and acceptance of Secondary Barrier before proceeding with any abatement activities.

J. Maintain emergency and fire exits from the Work Areas, or establish alternative exits satisfactory to fire officials.

K. Ensure that all barriers remain effectively sealed and taped for the duration of abatement activities and subsequent cleaning. Repair damaged barriers and remedy defects immediately upon discovery. Visually inspect enclosure at the beginning of each Work period. Repair damaged barriers and remedy defects immediately upon discovery.

3.04 CEILING PLENUM CLEANING (NOT USED)

3.05 REMOVAL OF ASBESTOS-CONTAINING MATERIALS IN ISOLATED WORK AREAS

A. Contractor shall remove all asbestos-containing materials intact and non-aggressive measures as defined in these Contract Documents. Contractor shall apply spray coat of amended water to asbestos materials to be removed. Keep material damp during entire removal process. Immediately place asbestos-containing materials in properly labeled asbestos waste bags following removal.

B. Contractor shall maintain a safe and uncluttered work site including staging area, work area, worker decontamination system, and waste load-out area.

D. Contractor shall promptly remove waste bags to the waste load-out area.
E. All dust and debris remaining in the work areas must be cleaned-up following asbestos-related work using HEPA vacuuming and wet-wiping. Protect finishes and items remaining in work areas as necessary.

J. Ensure proper cleaning of boots and equipment is performed prior to exiting such work areas.

K. Contractor shall clean external surfaces of contaminated containers and equipment thoroughly by wet sponging and HEPA vacuum.

L. Encapsulate the work area upon visual observation by Consultant and prior to final air clearance sampling.

M. See requirements under 1.14-B-3 for procedures regarding post-abatement inspection.

3.06 REMOVAL/IMPACT OF ASBESTOS-CONTAINING MATERIALS IN NON-ISOLATED AREAS

A. Contractor shall remove all asbestos-containing materials as defined in these Contract Documents. Contractor shall apply spray coat of amended water to asbestos materials to be removed. Keep material damp during entire removal process. Immediately place asbestos-containing materials in properly labeled asbestos waste bags following removal.

B. Contractor shall maintain a safe and uncluttered work site including staging area, work area, worker decontamination system, and waste load-out area.

D. Contractor shall promptly remove waste bags to the waste load-out area.

E. All dust and debris remaining in the work areas must be cleaned-up following asbestos-related work using HEPA vacuuming and wet-wiping. Protect finishes and items remaining in work areas as necessary.

F. Ensure proper cleaning of boots and equipment is performed prior to exiting such work areas.

G. Contractor shall clean external surfaces of contaminated containers and equipment thoroughly by wet sponging and HEPA vacuum. Encapsulate the work area upon visual observation by Consultant and prior to final air clearance sampling.

H. See requirements under 1.14-B-3 for procedures regarding post-abatement inspection.

I. Not In Scope - Chemicals and solvents shall not be used to remove ACM floor mastic. ACM floor mastic shall be removed with mechanical means until the floor substrate (concrete slab) is smooth minus mastic.

J. Glovebag Abatement: Glovebag work shall be completed within mini-enclosures in all areas. All removal using the glovebag method shall be performed strictly according to regulations, manufacturer's printed instructions, and as demonstrated by the manufacturer's representative or as further specified in this section. A minimum of two workers are required during glovebag operations. Workers are not to smoke or wear hand or wrist jewelry while using glove bags.

   1. Contractor shall coordinate with the Owner to ensure the shutoff of all sources of heat to objects to be worked on. Do no work on objects above 150 °F.

   2. Contractor shall install port for hose of HEPA vacuum to create reduced pressure inside glove bag. Installing of fresh air intake and/or bridging to prevent collapse of
bag are acceptable. Contractor shall use the smoke test method to check for leaks in each glovebag.

3. During the removal phase, Contractor shall utilize amended water to reduce potential for airborne fibers.

4. After completion of insulation removal and cleaning, but prior to removal of glove bag, Contractor shall apply a single "tack" coat of penetrating encapsulant to surface of pipe and any remaining non-asbestos insulation, within the glove bag. In addition, properly seal and cap all abated openings per regulatory requirements.

5. After the pipe has been encapsulated, but prior to removal of glove bag, Contractor shall thoroughly wash the upper chamber of the glove bag and seal the contents of the bag in the lower chamber.

6. Contractor shall remove all contaminated air in the glovebag using a HEPA vacuum.

7. Contractor shall promptly double-bag the glove bag after removal is complete, place into a sealed container and remove to the bag holding enclosure.

8. Contractor shall not reuse glovebag, slide glove bag or join multiple glovebags to perform additional removal.

9. Asbestos-containing material remaining in wall and floor penetrations shall be wetted and placed in asbestos waste bag. Area shall be HEPA vacuumed cleaned.

3.07 DISPOSAL

A. Regulations: The Contractor shall determine current waste handling, transportation, and disposal regulations for the work site and for each waste disposal landfill. The Contractor must comply with these regulations and U.S. Department of Transportation, PSCAA Regulation III, Article 4 and EPA requirements.

B. Waste Load-Out:

1. Contractor shall coordinate activities to ensure that all asbestos-containing waste is properly containerized and removed from all work areas prior to the end of each work shift. Contractor shall prevent the accumulation of waste containers within work areas and shall ensure that all waste containers are stored in lockable, properly sealed storage container(s) at the end of each work shift.

2. Contractor shall perform waste load-out activities during pre-approved time periods via pre-approved routes through the building per Work Plan approved by Owner and Environmental Consultant.

C. Transport: Contractor shall remove all properly labeled asbestos waste from the site at the end of each work shift for disposal at Owner approved waste disposal site operated in accordance with the provisions of 40 CFR 61.156. Notify disposal site in advance of delivery to ensure immediate disposal. Maintain chain-of-custody until accepted by the landfill.

1. The University of Washington currently approves disposal of asbestos-containing waste at the following sites:

   a. Rabanco Regional Disposal Facility in Roosevelt, Washington
   b. Eastmont Transfer Station in Seattle, Washington
   c. Cedar Hills Landfill in Maple Valley, Washington
   d. Waste Management Columbia Ridge Landfill in Arlington, Oregon
   e. WCI Finley Butte Landfill, in Boardman, Oregon
f. Waste Management, Greater Wenatchee Landfill, East Wenatchee, Washington

D. Submit disposal receipts and chain-of custody for waste as specified. Contractor shall make available all disposal manifests and receipts upon request from the Environmental Consultant or Owner.
CONTRACTOR ACKNOWLEDGMENT OF ASBESTOS HAZARD TRAINING, RESPIRATOR TRAINING AND AGREEMENT TO UNDERTAKE ALL REQUIRED PRECAUTIONS

Date: ______________

To: UNIVERSITY OF WASHINGTON
Re: HSC F Wing – CEDI & Academic Affairs

CONTRACTOR’S FIRM NAME: ____________________________

I am an asbestos contractor and hereby warrant that I have complied with the following requirements:

1. All workers employed in the above project understand that this project includes removal and disposal of asbestos. All workers are advised and they understand the dangers inherent in handling asbestos. All workers have been informed that breathing asbestos fibers can cause Asbestosis, Mesothelioma, lung cancer and other cancers.

2. All workers and I are familiar with all Local, State and Federal requirements relating to asbestos and agree faithfully to take all required precautions and comply with these regulations.

3. All asbestos workers have had a medical examination within the past twelve months, which was paid for by the employer. This examination included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray. The results of the physician’s medical examination and any limitations workers may have regarding the wearing of respiratory protection, exposure to heat stress, or any other health risks discovered during this exam are being followed. All protective equipment required by regulations and as a result of the Worker’s medical examination has been supplied.

4. All workers requiring Personal Protective Equipment have been trained in the use of each type of respiratory protective equipment and all other equipment required on this project. This training included an explanation of dangers related to misuse of this equipment and instruction on fitting, testing, inspection, donning, wearing, cleaning and maintaining this respiratory equipment.

I certify that I am a principal of the above firm and, under penalty of perjury under the laws of the State of Washington that the “Asbestos Contractor Information Form” and the foregoing is true and correct.

Name: ____________________________

Print

Title: ____________________________

Print

____________________________
Signature

This form shall be completed and submitted with the Pre-Job Submittals.
CERTIFICATE OF CLEARANCE FORM

CONTRACTOR’S CERTIFICATION OF VISUAL INSPECTION
In accordance with Section 02 82 00, the Contractor’s Supervisor hereby certifies that he/she has visually inspected all surfaces within the work area and has found no dust, debris or residue.

Work Area: ________________________________________________________________

ACM Removed: ______________________________________________________________

ACM Remaining: _____________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________ __________________________

Signature of Supervisor: __________________________ _____________Date: _______________

Print Name: ____________________Certificate #:  ____________ Expiration Date: ___________

Company Name__________________________________________________________________

THE OWNER’S REPRESENTATIVE CERTIFICATION OF VISUAL INSPECTION
In accordance with Section 02 82 00, the Owner’s Representative hereby certifies that he/she has visually inspected all surfaces within the work area and has found no dust, debris or residue. The Owner’s Representative certifies that final clearance air sampling has met the criteria established in the specifications. All clearance air sample data and supporting paperwork is to be submitted to Owner.

Signature: _____________________________ Date: ____________Pass / Fail (see punch list)

Print Name: _____________________________Certificate # & Expiration Date: ________________________________

Company: ________________________________

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. General work items include, but are not limited to:

1. Metals Compliance Health and Safety Program: Activities and performance requiring compliance with this Section include the impact of painted coatings or building components containing lead and other regulated heavy metals as defined in these Specifications. Impacts may include, but are not limited to: manual demolition, mechanical demolition, new work installation, grinding, tuck-pointing, cutting, sawing, scraping, surface preparation, surface cleaning, drilling, sanding, welding or torch-cutting. Refer to Section 01 11 01 and 02 80 00, for information regarding lead/metals-containing items in areas of the Work.

2. Managing and Handling: Conduct activities involving lead-containing paint (or metals-containing building materials) under Work of this Contract in accordance with this Section and current applicable state and federal regulations including: "Lead"; WAC 296-155-176: "Occupational Health and Environmental Control"; and 29 CFR 1926.62: "Lead Exposure in Construction - Interim Final Rule" and WAC 296-841 "Airborne Contaminants" rule.

3. Lead-containing paint or coating was identified on the following building components.

   - Interior white and off-white coating/paint on concrete ceiling and walls (0.02% Lead-containing). Assumed white paint to contain lead associated with all ceiling painted surfaces covering mechanical, plumbing/piping, HVAC ductwork and electrical conduits.
   - Masonry mortar (0.018% Lead-containing) associated with CMU and concrete walls and ceilings.
   - Yellow paint on metal window frames and window sills.

4. Waste Disposal: Disposal of waste as "dangerous" according WAC 173-303 is required for debris or items failing characterization (waste profiling requirements related to lead). Dangerous waste will be separated and segregated from the general construction/demolition debris, properly packaged and disposed through UW EH&S Environmental Program Office (EPO).

5. Initial waste stream characterization of the site indicates demolition debris will not require special handling related to lead/metals and may be disposed-off as solid waste (construction demolition and land clearing debris) using Owner approved facilities and landfill.

6. Upon waste profiling, metals-containing items and lead painted building materials must be segregated and handled as regulated waste without regard to waste stream characterization and must be disposed of as general construction debris (for landfill) and cannot be recycled. *Exception, paint on metals can be recycled as scrap metal.*

7. Monitoring: Monitoring of airborne concentrations of lead in accordance with WAC 296-155-176 and this Section (contractor's responsibility). The intent of this Section is to reduce and maintain employee exposure to lead and surrounding environmental airborne concentrations at or below the permissible exposure limit.

1.2 RELATED WORK

A. Drawings, General Conditions, Modifications to the General Conditions, Supplemental Conditions to the General Conditions, and other Divisions apply to this Section.
1.3 SUBMITTALS

A. Submit electronic documentation of the following "Pre-Work Submittals" prior to start of work. The Work may not proceed until complete Pre-Work Submittal package has been reviewed and approved by the Environmental Consultant. Allow ten days for Owner review.

1. Metals Compliance Program: Submit a site-specific lead/metals compliance program in accordance with WAC Chapter 296-155 and this section. The plan shall be developed and implemented to provide engineering, work practice and administrative controls to reduce and maintain employee exposure to lead/metals at or below the permissible exposure limit. The plan will include at a minimum task-specific descriptions of activities; engineering (such as and not limited to negative pressure enclosure) and dust controls; personnel; procedures; method of compliance; technology used to meet compliance; air monitoring plan; detailed schedule; work practice program; administrative controls and other relevant information. Implementation of work practices not described in the Metals Compliance Plan will not be permitted until an amendment to the submittal is reviewed by the Environmental Consultant and Owner.

2. Medical Program: Submit written proof medical exam program complies with OSHA Lead Regulations 29 CFR 1910.2 and 1926.62, and WAC Chapter 296-155. Initial medical surveillance consisting of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels shall be submitted for each employee occupationally exposed to lead at or above the action level.

3. Worker Training Program: Submit written proof indicating that all employees impacting lead-containing materials have received training per 29 CFR 1926.62 and WAC Chapter 296-155. Proof shall include a signature from the Contractor's Principal indicating that all employees performing lead related activities have completed such a program.


5. Waste Stream Calculations: Submit a detailed breakdown of waste stream constituents and associated volumetric calculations for review by the Environmental Consultant to determine the need for additional waste stream calculation or further waste characterization.

B. Final Submittals:

1. Project Record Documents: Provide record of metals control activities including disposition of each type of metals-containing item and products removed from the site.

2. Air Monitoring: Submit copies of all air monitoring data (including sample data sheets), chain-of-custody documentation and calibration records related to the initial exposure assessment for workers impacting metals-containing materials.

1.4 AIR MONITORING

A. Testing Laboratory: An Independent Testing Laboratory shall be retained by the Contractor for all metals air analysis. All personnel exposure monitoring analysis shall be performed in accordance with 29 CFR Part 1926.62 and WAC Chapter 296-155. The laboratory must participate in the ELPAT Program and be a member of AIHA. Air sample collection may be performed by an Industrial Hygienist or the Contractor's trained supervisor at the Contractor's option.

B. Sample Documentation: Documentation shall be kept for each filter sample procured as to worker sampled, social security number, activity, work area location, date and time taken, volume of air
drawn through filter, pump identification number and calibration. Documentation shall indicate in what areas tests were taken and shall clearly indicate the specified maximum allowable levels for each area tested. Report all data. Complete laboratory chain-of-custody records.

C. Analysis Procedures: The samples shall be collected on 37 mm filters and analyzed within 24 hours using NIOSH Analytical Method No. 7105 or 7082. The containers shall be clearly labeled with project name and Sample Number and shall become property of the Owner at work completion at the Owner's request.

D. Contractor’s Sampling During Metals Related Activities:

1. Initial exposure: Personnel exposure monitoring shall be performed by the Contractor during impact of representative metals-painted building components per WAC 296-155.

2. Most Contaminated Worker: The Contractor shall determine which worker(s) in each work area is probably experiencing the most severe exposure. This is the “Most Contaminated Worker(s)”. An 8-hour TWA samples shall be collected on this worker(s). Worker shall wear a personal sampling pump and the sample shall be drawn from the breathing zone of this worker.

3. Number of samples: The number of air samples collected shall be as defined in the approved Metals Compliance Program. Historical measurements per WAC 296-155 may be used to satisfy continuing exposure assessment requirements.

E. Work Area Monitoring

1. Monitoring: The Owner reserves the right to monitor Contractor's performance via air, dust wipe and TCLP samples during metals related activities, in addition to the Contractor's exposure monitoring and testing. Sampling by the Owner will not be available for use as the Contractor’s Initial Exposure Assessment.

2. Quality Control

   a. Maximum allowable airborne concentrations: Contractor shall ensure that at all times airborne concentrations of metals outside lead or metals related work areas are maintained at or below the OSHA Action Level of 25 µg/m³ (for Lead), 0.5 mg/m³ (for Barium/Chromium) and 0.05 mg/m³ (for Mercury).

   b. Immediately upon being notified of concentrations exceeding the specified maximum allowable levels, the Contractor shall perform the following steps in the order presented, at no additional cost to the Owner: Stop lead/metals related activities work, identify source of high metals concentrations, develop plan with Environmental Consultant and Owner to complete metals related activities in a manner to prevent visible emissions and elevated metals levels.

1.5 SUBCONTRACTORS

A. Subcontractors employed by the Contractor shall be bound to all the work and safety standards specified. Subcontractor's personnel shall meet requirements as specified, and shall be supervised by the Contractor during performance of this work.

1.6 LIABILITY

A. The Contractor is an independent contractor and not an employee of the Owner, Architect or Environmental Consultant. The Owner and the Environmental Consultant shall have no liability to the Contractor or any third persons for Contractor's failure to faithfully perform and follow the
provisions of these Specifications and the requirements of the governing agencies. Notwithstanding the failure of the Owner or the Environmental Consultant to discover a violation by the Contractor of any of the provisions of these Specifications, or to require the Contractor to fully perform and follow any of them, such failure shall not constitute a waiver of any of the requirements of these Specifications which shall remain fully binding upon the Contractor.

PART 2 - PRODUCTS

2.1 PROTECTIVE CLOTHING AND_EQUIPMENT

A. Personnel Protective Equipment and materials (not limited to negative air equipment equipped with HEPA filters, flex-ductwork for exhaust, 6-mil plastic sheeting, duct tape, rigid barriers, wood studs, etc.) for Lead/metals-related activities shall be provided per WAC 296-155.

PART 3 - EXECUTION

3.1 WORK PRACTICES

A. Restrictions:

1. Use of mechanical methods including, but not limited to power sanding, grinding, sand-blasting, etc. shall be performed within a negative pressure enclosure (NPE) pending approval of negative exposure assessment by the Owner.

B. Negative Exposure Assessment: The Contractor may waive the requirement of a negative pressure enclosure when using mechanical methods upon approval by the Environmental Consultant of data indicating a negative exposure assessment has been completed per WAC 296-155 and paragraph 1.6, Air Monitoring. The Contractor shall allow 48-hours for review of such data.

C. Housekeeping: Maintain all surfaces as free as practicable of accumulations of metals and perform clean-up and wet wipe down of work areas as necessary according to WAC 296-155-17617.

D. Work Practices:

1. Set-up Activities: Prior to impact of metals-containing painted components, Contractor shall cover the ground below the work area with 6-mil plastic sheeting or equivalent. The drop-sheeting shall extend outward a minimum of 6 feet from the location of item(s) being removed. Any tears that occur in the drop-sheeting shall be immediately repaired with duct tape or other acceptable seal. Debris shall be collected with a wet/dry vacuum to avoid escape from the drop-sheeting. Wash water shall be retained on the drop-sheeting and removed by mops or wet/dry vacuums. The residue/debris and water shall be placed in storage drums for testing prior to disposal. See paragraph 3.1-E for testing requirements.

2. Perform work impacting metals-containing items and painted components in accordance with approved metals work plan. Use procedures and equipment required to limit occupational and environmental exposure to metals when lead-containing paint is impacted. The procedures employed by the Contractor shall not create the potential for contaminating surrounding areas or materials with lead-containing dust. Dust generation shall be minimized at all times.

3. At completion of the above operations, HEPA vacuum drop-sheeting to remove any paint particles or debris and wet-wipe or mop-up plastic sheeting to remove all dust.

E. Debris Testing

1. It is recommended that the water collected with wet/dry vacuums be filtered to remove paint
and debris chips and then stored in drums for testing prior to disposal. The paint and debris chips shall be placed in a separate drum for disposal at the Contractor's expense. If appropriate, no rinse water shall be discharged without testing by the Environmental Consultant.

2. Debris Testing: Representative sample of debris shall be collected for TCLP testing by the Environmental Consultant. The method/location of general debris disposal will be established by test results - less than 5 parts per million (ppm) for Lead/Chromium. See paragraph 3.1-F for disposal requirements.

F. Disposal Procedures:

1. Waste characterization of the anticipated general waste stream will be performed by the Owner as necessary. Results of such characterization will be provided to the Contractor as appropriate. The Owner anticipates that disposal of demolition debris can be performed as general construction waste and subject to Owner approved Subtitle D landfill.

2. Metals or Lead-Containing Building Materials Disposal: Any waste failing TCLP and categorized as hazardous and regulated waste will be separated and segregated from the general construction/demolition debris, packaged and disposed through UW’s Environmental Programs Office.

3. Construction debris containing-lead and regulated metals (barium): Refer to Section 01 11 01 for exceptions (recycling of metals is allowed such as steel radiators and steel door casing). Construction and demolition debris generated from the project site will be treated as construction/demolition and land clearing debris (CDL) for landfill even if TCLP test analysis for metals are below acceptable levels. CDL solid waste will be disposed of at an Owner approved Subtitle D landfill listed below:
   a. Rabanco Regional Disposal Facility in Roosevelt, Washington
   b. Eastmont Transfer Station in Seattle, Washington
   c. Cedar Hills Landfill in Maple Valley, Washington
   d. Waste Management Columbia Ridge, Landfill in Arlington, Oregon
   e. WCI Finley Butte Landfill, in Boardman, Oregon
   f. Waste Management, Greater Wenatchee Landfill, East Wenatchee, Washington

END OF SECTION
DIVISION 6 - ARCHITECTURAL CARPENTRY AND CASEWORK

06 10 00 - ROUGH CARPENTRY

- Rough carpentry to include any wood studs, furring, blocking, rough framing, wood curbs, bucks, nailers, backing, fixture framing, equipment supports, etc. as detailed. Not all rough framing may be shown or detailed.

06 20 00 - FINISH CARPENTRY

- Finish carpentry to include installation of all fixtures and associated trims, hardware and nosings.
- Provide interior door and sidelight frames as scheduled.

06 40 00 - ARCHITECTURAL WOODWORK AND CASEWORK

- Cabinet construction: comply with the A.W.I. architectural woodwork quality standards for custom grade work. cabinets shall be flush construction, UON.
- Provide particle board, med. density, weighing <40 lb./cu. ft., at least 3/4" thick.
- Cabinet hardware: full extension drawer glides, stainless steel cabinet pulls, us32d finish, and concealed door hinges, shelf hardware and other required items, UON in elevations / details, or per building standard.
- Plastic laminate: high-pressure decorative laminate selected from Wilsonart, Nevamar, and Formica, UON. laminate to be general-purpose grade .050" horizontal and 0.030" vertical.
  - Specs:
    - Vertical Surfaces: Wilsonart, 7995-38 Sterling Ash, Fine Velvet Finish
    - Countertops: Wilsonart, D403-60 White Sand, Matte Finish
- Interior cabinet surfaces and shelves to be prefinished with white melamine, UON.
- Shelf edging to be p-lam, UON.
- Submit shop drawing submittals for architect's review.

DIVISION 8 - DOORS AND WINDOWS

08 14 00 - WOOD DOORS

- Lynden (or equal) flush doors, Maple veneer, SCL core, 3/4" solid maple stiles (to match veneer)
- Provide and install interior suite doors as indicated on drawings.
- Door schedule specifics finish (both sides of door) and frame, UON.
- Doors shall be pre-machined for hardware per hardware schedule.
- Vision Panel Glass: 1/4" tempered clear, full lite, solid Maple wood stops with lip over door face
• Frames: Ceco (or equal) Hollow metal, welded, heavy duty 16-Gauge cold rolled steel.

08 71 00 - FINISH HARDWARE

• UW Hardware Specifications:
  o Keypad Type: Trilogy DL3500, mortise prep w/ interchangeable core, Finish: US26D (satin chrome)
  o Locks: Medeco lock cylinder cores (cores / keying by UW Lockshop)
  o Hinges: Bommer (or equal – Hager, Stanley) 4.5” x 4.5”, five knuckle, flat bottom tips, square corner, ball-bearing, Finish US26D (satin chrome)

• Match UW specifications and finishes.

• Finish and specialty hardware includes all accessories, tools and fasteners required for hardware installation and maintenance. Items not specifically mentioned, but necessary to complete the work, shall be furnished matching in quality and finish of specified in similar locations.

• Provide all hardware as specified per the hardware schedule.

• All lock sets shall conform to the building's grand master keying systems. Provide two (2) keys for each lock and two (2) master keys for the suite. All keys to be tagged with room numbers. Confirm quantity with building management.

• Submit hardware schedule with catalogue cut sheets for architect's review.

• All doors shall have, at a minimum, 1-1/2 pair of butt hinges, one latch set or lock set and one door stop to meet accessibility requirements.

• All hardware shall be commercial grade and rated at required assemblies.

• Provide door closers per hardware schedule and at all rated assemblies.

• All hardware shall match building standard in style and finish.

• Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

• Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

• Provide proper smoke gaskets at rated assemblies.

• The following UL listings are required on the following hardware:
  o Panic hardware - UL #305
  o Fire exit hardware - UL #106 & #305
  o Electromagnetic lock hardware - UL # wax-s-a-6635

• The crash bar must be at least 1/2 of the door width and open force no more than 15 lbs. Verify with building standard & management and inform architect if building standard doesn't comply.

08 81 00 - GLASS

• All glass at sidelights and doors shall be 1/4" tempered safety glazing, UON.
• Film on glass to be 3M, Dusted Crystal

• Contractor shall verify glass thickness is appropriate for dimensions and spans.

• This project contains glazing that will be subject to federal glazing standards. Glazing subcontractor shall be responsible for adherence to the requirements. If glazing subcontractor finds anything in the documents not in compliance with the standard, they shall bring discrepancies to the attention of the architect before proceeding with the work.

DIVISION 9 - FINISHES

09 20 00 GYPSUM DRYWALL AND METAL STUDS

• Include necessary materials, labor, and accessories for the installation of all partitions as shown in the plans.

• "Wall surfaces" mean all vertical surfaces including columns where exposed, convector or radiator enclosures, fascias, returns, plywood backboards, etc.

• All partition heads shall match building standard, UON.

• Walls shown aligned with base building structure shall be flush and smooth with base building structure, UON.

• Seismic bracing: provide seismic bracing as required per the latest building codes to the partition heads and ceiling grid.

• Framing studs: galvanized steel studs per construction plans. Provide with sheet metal backing within all walls receiving casework (cabinets, bookshelves, etc.). Verify stud size matches door frames in stocks if applicable.

• Contractor shall provide and locate access panels as required after installation of mechanical ducts, plumbing, and electrical work. Fire rate as required.

• All drywall to be 5/8" type "x" unless otherwise noted. Provide "m/r" type drywall where required by code and at all toilet rooms and wet or damp areas. Provide cement backer board behind tile conditions, UON.

• Install corner beads at all external corners. Install metal edge trim wherever edge if gypsum board would otherwise be exposed or semi-exposed.

• Prior to receiving finish, all surfaces shall be properly prepared as required to receive final finishing as specified.

• Extend all soffit framing to structure above. Provide structural diagonal bracing as necessary.

• Provide framing for suspended ceiling with seismic bracing in accordance with requirements of applicable codes and as shown on drawings.

• Use acoustical sealant around all pipes, ducts, conduit outlets, switches, etc. On both sides of crossing/penetration walls with acoustical insulation. Penetrations of fire-rated walls shall be protected by applicable fire-rated assemblies and materials.

• Fire and smoke separation assemblies shall be marked as required in section 703.6.
09 51 00 - CEILING SUSPENSION SYSTEMS

- **UW Specification:**
  - Tile: Armstrong, Dune Second look II, 15/16” Angled Tegular, 24 x 48 x 3/4”
  - Suspension System: 15/16” Prelude (standard T-bar)

- Provide new ceiling tile, ceiling grid and all accessories as required to install suspended acoustical ceiling as indicated on drawings.

- Provide seismic bracing as required by code at new ceiling work only. Verify with building management if existing conditions are seismically braced or provide per code.

- Coordinate work with other trades having work in the ceiling and telephone and data cable companies wherever their respective work is contiguous.

- Provide cutouts and other special provisions in acoustical work as required for lighting fixtures, registers, diffusers, sprinklers, and other inserted items.

- All cutouts shall be centered within acoustic ceiling tile, UON.

- All materials shall have class 1 flame spread rating and be installed in accordance with manufacturer's specifications and codes.

- All joints in the tile field shall be square, level, and perfectly aligned with each other.

- Installed suspended ceilings to be level within a tolerance of 1/8” in 12-0”. Anchor as required.

- In areas of alterations contractor shall match conditions and make every effort to align, level, and match new ceiling to old. Contractor shall review all ceilings upon commencement of the project and inform the building management of any discontinuities in the ceiling within 10 days.

- Adjust partition head detail to match existing conditions if necessary.

09 53 00 - ACOUSTICAL TREATMENT

- Provide acoustical insulation between framing studs and extending two feet on each side of partition head above ceilings for all walls noted per plans.

- New demising wall construction to have sound batt insulation between framing studs and two feet of insulation on either side of the partition head above ceiling grid, UON.

09 65 00 - RESILIENT FLOORING

- Provide VCT, sheet linoleum, sheet vinyl and rubber base as indicated in drawings. Color and manufacturer per finish schedule.

- Provide rubber-reducing strips in color to match specified base. Reducing strips to occur at all areas of floor material transition.

- Base to be installed in longest available length with no pieces less than 12”. No joints at outside corners or within 6” of corners.

- Patch level and prepare sub flooring with cementitious underlay per MFR's written instructions in areas to receive new flooring. Max. Allowable tolerance = 1/4” over 10'.
• General contractor shall apply floor wax to new flooring areas per manufacturers specifications, UON.

• Unless specified all rubber base shall be coved base.

• Specification:
  o Roppe: 4” coved base, Color: 123 Charcoal

09 68 00 - CARPET
• Specification:
  o Mohawk Commercial: Learn and Live Collection, Side Stripe Tile GT419, Color: Eastside 961
• Provide and install commercial grade carpet as indicated in drawings.

• Prepare sub floor with cementitious underlay where required to provide approved substrate. Max allowable tolerance = 1/4” over 10’.

• Provide seaming diagrams for architect’s review.

09 90 00 - PAINTING AND STAIN
• Specification:
  o General Paint: Sherwin Williams, SW 7008 Alabaster
  o Accent Paint: Sherwin Williams, SW 6557 Wood Violet
  o Accent Paint: Sherwin Williams, SW 9161 Dustblu

• Unless otherwise noted, prime all GWB wall surfaces and paint with minimum of two (2) finish coats of Benjamin Moore eggshell finish latex paint or approved equal, UON. Provide for numbers of paint colors as indicated in drawings.

• Finish doors, door frames, and sidelight frames as indicated in drawings.
  o Painted woodwork to be finished with one (1) coat primer and two (2) finish coats.
  o Sealed woodwork to be stained per finish schedule and sealed with a commercial grade clear stain varnish.

• Paint for the light surfaces to conform to the requirements of the "architectural specifications manual" (AWS) for paint systems. Latex paint: AWS system 3-b "custom" (1) coat primer and two (2) finish coats. Grade light color paint finish on gypsum board surfaces.

• Paint for the dark surfaces to conform to the requirements of the "architectural specifications manual" (AWS) for paint systems. Latex paint: AWS system 3-b "custom" (1) coat primer and two (2) finish coats. Grade dark color paint finish on gypsum board surfaces.

• Upon completion of work, remove excess paint, stain, varnish, adhesive, caulk, etc. From all other surfaces that were not specified to receive same.

• Touch-up and patch surfaces as required after the completion of work by other trades.

• Where columns occur in areas scheduled to be finished, they shall receive the same finish as the room, UON.

• All painted surfaces shall be prepared in strict accordance with manufacturer’s specifications (especially in regards to the priming of existing surfaces).
• Putty all nail holes, countersunk screws, bolts, cracks, etc. Before applying finish.

• Sand all wood surfaces smooth and even before applying finish.

• Sand enameled finishes applied to woods or metal between coats with fine sandpaper to produce smooth finish.

• Make finish work uniform and smooth, free of duns, sags, defective brushing and clogging. Make edges of paint adjoining other materials or colors sharp and clean without overlapping.

DIVISION 10 – SPECIALITIES

10 26 13 – Corner Guards
• Specification:
  o 48” x 2” x 2” = 90 Deg, 16ga, Satin #4 (Brushed) Finish, Stainless Steel Corner Guard

10 14 15 – Interior Signage
• Provide and install all code required signage.
• Provide and install room signage. Room signage to match UW School of Medicine’s standard.
  • UW School of Medicine Vendor:
    o Doty + Associates, 11410 NE 124th #245, Kirkland WA 98034
    Contact: Marta Valdes, 206.441.9301, marta@dotysigns.com

DIVISION 12 - FURNISHINGS

12 24 13 - WINDOW TREATMENT
• UW Specification:
  o Mecho Manual Sunscreen Roller Shade, EutroVeil 5300 Series, Openness / Color TBD (depending on location / room finish coordination)

• All existing perimeter roller blinds to be bagged and cleaned to like-new condition.

• All perimeter glazing to receive blinds as indicated in drawings. Coordinate with building management. Match existing conditions, UON..

• Provide sample and cut sheet to architect for review.

DIVISION 15 - MECHANICAL

15 50 00 - FIRE PROTECTION
• Alter or install fire protection system per building standard, local regulations and ordinances.

• Provide all emergency lighting, exit signs, fire alarm speakers, strobes and bells as required by code. Design and install the same in compliance with the americans with disabilities act.

• Provide sprinklers, fire rater doors and frames, fire extinguishers, etc. As required by applicable local codes and laws.
• Fire extinguishers shall be by underwriters' laboratory 2a-10bc 5-lb, multipurpose. Extinguishers with squeeze type handle and flexible discharge hose with visible pressure gauge, UON.

• Fire extinguishers shall be installed per building standard requirements, UON. Verify location with fire marshall. When required by code, provide 1 wall mount type in each server room or laboratory.

• Design build fire protection drawings shall indicate:
  o Layout, location, and size of sprinkler lines and heads.
  o Pressure requirements.
  o Sprinkler head specifications.
  o Location of fire protection risers and wall hydrants.

• Contractor to provide installation design documents to architect and building owner for review and approval prior to installation. Include horns and strobes.

• All sprinkler heads shall be centered in acoustical ceiling tile, UON.

• Use of NFPA 13 quick response heads may be required. Contractor shall verify extent of quick response heads by the AHJ for this project.

END OF SECTION
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<tr>
<th>SECTION</th>
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<tr>
<td>21 10 00</td>
<td>AUTOMATIC FIRE SUPPRESSION SYSTEMS</td>
</tr>
</tbody>
</table>
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The following Sections apply to the Work in this Division with the exception of items specifically described in Division 21:

1. Section 230500 General Provisions
2. Section 230505 Project Closeout and System Start-Up
3. Section 230510 Basic Materials and Methods
4. Section 230520 Mechanical Demolition
5. Section 230550 Seismic Control
6. Section 230820 Systems Operations and Maintenance Manuals

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes design and construction for revisions to the existing fire suppression systems.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Authorities Having Jurisdiction (AHJs):
   1. Seattle Fire Department.
   2. Seattle Department of Planning and Design.

C. Codes and Standards:
   1. International Fire Code (IFC)

D. Fire Sprinkler System Contractor’s Qualifications for Preparation of Shop Drawings, Installations, Inspections, Maintenance, and Servicing (WAC 212-80-043):
   1. Only licensed fire protection sprinkler system contractors shall execute contracts for installation, inspection, maintenance, or servicing of fire protection sprinkler systems or any part of such system.
   2. Only licensed fire protection sprinkler contractors who have achieved at least State Level III licensure shall execute contracts for the installation, inspection, testing, maintenance and/or servicing of NFPA 13 and other systems per definition of fire protection sprinkler system or any part of such a system in the State of Washington.
3. Only those certificates of competency holders who have achieved at least State Level III certification shall supervise and/or certify the preparation of layout drawings (Shop Drawings) installation, inspection, testing, maintenance, servicing of, or installation of NFPA 13, and other systems per definition of fire protection sprinkler system in Chapter 18.160 RCW or any part thereof.

E. Grooved Joint Pipe Requirements: Grooved couplings, fittings, valves, and specialties shall be products of one manufacturer including grooving tools. Castings used for coupling housings, fitting, valve bodies, and similar items shall be date stamped.


G. Certificates Required: Individuals who install, inspect, test, and maintain life safety systems and equipment shall obtain certificate from the AHJ.

1.3 SYSTEM DESIGN CRITERIA

A. Survey site prior to submitting bid. Comply with requirements in Section 230500.

B. Design, furnish, and install operable fire suppression systems in accordance with the latest adopted editions of IBC, IFC, NFPA 13, and applicable city, county, and state laws, codes, and standards so that no parts of the fire suppression system interferes with doors, windows, heating, plumbing, air conditioning systems, and electrical equipment. Include accessories to meet requirements of the AHJs and aforementioned codes and standards.

C. In areas where local codes require coverage by either fire sprinklers or heat detectors, provide coverage by fire sprinklers.

D. Coverage: It is the requirement of this Section for complete fire sprinkler coverage of the entire area within the project scope of work as indicated on the drawings.

E. The Contractor and the fire suppression system subcontractor shall meet with the AHJs prior to preparation of the Shop Drawings and hydraulic and earthquake bracing calculations to review procedures for handling submittals, inspection, testing, and for general coordination and to verify sprinkler occupancy hazard classifications.

F. Obtain latest water supply engineering test data prior to design. Include 10 percent safety margin in system design. If test data is not available, conduct test to determine available flow and pressures to hydraulically design system.

G. Coordination With Other Trades:
   1. Coordinate fire suppression work with that of mechanical, sheet metal, plumbing, and electrical subcontractors so that best arrangement of equipment, piping, conduit, ducts, and similar items can be obtained.
   2. Identify points of conflict between this work and that of other trades so that conflict may be properly adjusted. Fire suppression system subcontractor shall remove and re-install work which interferes with work of other trades at no additional cost to the Owner.

H. No change orders will be issued for additions and deletions of sprinkler heads and associated piping except as such additions and deletions stem from changes in building design made subsequent to approval of the Shop Drawings.
1.4 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Pipe and fittings.
   2. Sprinkler heads.
   3. Piping specialties.

C. Shop Drawings and Calculations:
   2. Submit preliminary layout showing only head locations for review by the A/E. Include additional heads which may be required for coordinated ceiling pattern at no additional cost to the Owner, even though number of heads may exceed minimum code requirements. Indicate sprinkler head locations as follows:
      a. Suspended Accessible Ceilings: Locate heads in center of ceiling tiles up to 2 foot tile dimension, and 1/4 Section intervals for 4 foot tile dimension.
      b. Arrange heads in straight lines that are parallel and perpendicular to walls.
   3. After the A/E review of sprinkler head locations, submit the Shop Drawings and hydraulic and earthquake bracing calculations to the A/E of entire sprinkler system. The Shop Drawings shall be complete floor plans showing new work and sufficient extent of existing work, locations and types of heads, pipe sizes and cutting lengths, locations and sizes of required beam penetrations, locations and types of hangers, test valve, drain valves, and other related items. Indicate exposed work.
   4. Following review and approval by the A/E, submit the Shop Drawings and hydraulic and earthquake bracing calculations to the AHJs. Do not proceed with installation until the Shop Drawings have been approved by the AHJs.

D. Certificates Required: Submit copy of certificate from the fire code official.

E. Contractor’s Material and Test Certificate: Submit to certify material selection and testing results using form in NFPA 13. Complete applicable portions of form and sign and date it.

F. Obtain from each AHJ written certification that the permanent installation has been inspected and that it complies with the AHJs’ published regulations and requirements. Submit prior to Substantial Completion.
   1. Include fire suppression system pressure test.

G. Record Drawings:
   1. Provide in accordance with Division 01 and Section 230500.
   2. Submit one week minimum prior to system training.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer of equipment regularly engaged in the manufacture of components specified and with published catalogs listing pertinent specifications of items manufactured. Pipe and fittings shall be manufactured in the United States.

B. Manufacturers name and model identification used throughout this Section are to establish general configuration, function, size, performance and quality.

2.2 GENERAL

A. Equipment, Material, and Components Required by NFPA to be Listed: Listed in UL Fire Protection Equipment Directory or approved by FM and the AHJs.

2.3 PIPE AND FITTINGS

A. Pipe:
3. Pipe, other than Schedule 40 or Schedule 10, acceptable if UL listed and labeled, FM approved, and approved by the AHJs. CPVC pipe not acceptable.
4. Schedule 40 pipe used in cut groove joints and for sizes 2 inch and smaller with screwed joints and fittings.
5. Schedule 10 pipe used for rolled grooved joints. Rolled grooved joints for dry pipe sprinkler systems not acceptable.
6. Flexible sprinkler connections may be used at the Contractor option. If used, shall be braided type. Install with union joint threaded fittings. Include open-gate ceiling attachment bracket to allow sprinkler connection installation prior to installation of ceiling tile. The drop includes a male threaded nipple or Victaulic FireLock IGS Style 108 captured coupling for connection to branch line piping. UL approved Series AH1 hose with 3” bend radius and AH2 or AHC-CC with 2” bend radius. Pressure fit type fittings not acceptable. Oversized ring, sleeve, or adaptor through ceiling not required. Victaulic® VicFlex™, FlexHead Industries, EASYFLEX, or approved.

B. Fittings:
2. Minimum 125 psi class.
3. 2 Inch and Smaller: 150 pound black malleable or ductile iron, screwed, ASME B16.3 and ASTM A 197. Threadolet type fittings acceptable for Schedule 40 pipe only.
4. 2-1/2 Inch and Larger: Grooved joint fittings, ductile iron ASTM A 536 bodies. Flanged fittings, forged steel, or ductile iron.
5. Grooved Joint Couplings: UL listed and labeled for sprinkler service. 2 ductile iron ASTM A 536 housings. EPDM or chlorinated butyl gasket. Nuts and bolts ASTM A 449 and ASTM A183. Minimum 110,000 psi tensile.
   a. Rigid Type Couplings: Cast housings with offsetting, angle-pattern, bolt pads, and system support and hanging as required by NFPA 13. Victaulic 009-EZ and Style 107 N; installation-ready, for direct stab installation without field disassembly..
   b. Flexible Type Couplings: For seismic applications and in locations where vibration isolation and stress relief are required. Victaulic Style Installation-Ready 177, or Style 75, and Style 77.
6. Installation-Ready™ fittings for Schedule 10 grooved end steel piping in fire protection applications sizes NPS 1-1/4 thru 2-1/2 (DN 32 thru DN 65). Fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, red enamel coated. Fittings complete with prelubricated Grade “E” EPDM Type ’A’ gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be UL listed for a working pressure of 300 psi (2065 kPa) and FM approved for working pressure 365 psi (2517kPa).
7. Victaulic FireLock™ IGS Groove System for Carbon Steel Pipe - In lieu of threaded steel piping systems, the Victaulic FireLock IGS System with “Installation-Ready™ fittings and couplings may be used for NPS 1 (DN 25) Schedule 10 and Schedule 40 carbon steel pipe in fire protection applications. System rated for a working pressure to 365 psi (2517 kPa).
   b. Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.
   c. Fittings: Ductile iron housing conforming to ASTM A-536, Grade 65-45-12. Orange enamel coated or galvanized. Victaulic Style 101 (90-degree elbow), Style 102 (tee), and Style 108 (coupling) with Installation-Ready™ ends.
   d. Coupling: Style 108 single-bolt coupling provided with EPDM Type A pressure responsive gasket with Vic-Plus lubricant, and ASTM A449 compliant electroplated steel bolt and nut. CrMo alloy steel coupling linkage.

8. Plain End Couplings: Plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) not acceptable.

9. Hole Cut Outlets: Hole cut bolted branch outlet couplings may be used as approved by the AHJs. Hole cut outlets full bodied outlet (U-bolt outlets not acceptable). Victaulic Co. Style 920 and 920N.

2.4 SPRINKLER HEADS

A. Automatic sprinkler quick response heads of type as required by the AHJs and finish as required for areas and ceiling construction designated. Refer to Article “Sprinkler Heads Schedule” in this Section.

B. Operating Temperature: Comply with requirements in NFPA 13 and the AHJ. Select to compensate for the maximum temperatures which occur in a particular area during either winter or summer conditions from such sources as unit heaters and sunlight. In no case use heads rated less than 50 F higher than anticipated ambient temperature.

C. Sprinklers shall be glass bulb type, with hex shaped wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. (Wrenches provided by the sprinkler manufacturer that directly engage the cast wrench boss.)

D. Extended coverage sprinkler heads may be used subject to approval by the AHJs.

E. Include escutcheon, self-adjusting type, spring-loaded, or friction fit for each pendent sprinkler head fitting against ceiling.

F. Escutcheons shall be listed, and supplied for use with the sprinkler by the sprinkler manufacturer.

G. Manufacturers: Victaulic, Tyco, Viking or approved equal.

2.5 PIPING SPECIALTIES

A. Pipe Supports: Include metal pipe supports, flexible connections, sway braces, hangers, clamps, and other pipe support items in accordance with requirements in NFPA 13 and the AHJ. Seismically design pipe hangers and braces per IBC, ASCE 7, and NFPA 13. Do not use “C-Clamp” hangers unless they include integral seismic retaining strap.

B. Pipe Escutcheon Plates: Comply with requirements in Section 232116.
PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this Section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Cooperate with other trades to ensure adequate space for piping placement.

C. Review Drawings, Specifications, and the Shop Drawings of other trades to coordinate work and minimize unnecessary offsets and revisions to approved Shop Drawings. Failure to coordinate does not relieve fire suppression subcontractor from meeting performance standards specified in this Section.

1. Fire suppression piping shall not:
   a. Interfere with electrical equipment or access to mechanical units (including filters).

2. Install pipe and sprinkler heads to avoid conflicts with maintenance personnel's access to equipment.

3. Relocate piping and sprinkler heads which, in the opinion of the A/E, do not comply with preceding paragraph in manner acceptable to the A/E. Such relocation may be directed during the Shop Drawing review and during construction. If doubt should exist as to compliance of above, fire suppression system subcontractor shall review situation with the A/E prior to rough-in.

D. Do not order, fabricate, or install materials until approvals are received from the AHJs.

E. Install material in strict accordance with the Shop Drawings approved by the AHJs and reviewed by the A/E.

F. Service Interruptions: Comply with requirements of Section 230500. Obtain advance approval from the Owner and local fire department.

3.4 FIRE SUPPRESSION SYSTEMS INSTALLATION

A. Install piping concealed above furred ceilings to minimize obstructions. Offset, crossover, and route piping to install system in available space. Install to minimize obstruction to work of other trades. Expose only heads. Only fire suppression piping specifically called out on the Contract Documents as being exposed shall be below ceiling construction. Install piping through holes in beams where noted on the Drawings.
B. Hang piping from roof structure and not from the roof deck itself and not from work of other trades. Hanging pipes from ducts and equipment not acceptable except branch piping serving single sprinkler head below ducts and equipment. For branch piping hung below ducts and equipment, coordinate with those trades for design of duct and equipment hangers and supports to comply with requirements of NFPA 13.

C. Install piping system braced to withstand damage from earthquakes. Install flexible couplings and earthquake bracing in accordance with IBC, ASCE 7, and NFPA 13.

D. Grooved Joints: Install in accordance with the manufacturer’s latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative (direct employee) of the coupling manufacturer shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

E. Hole Cut Outlets: Use cutting tool to form opening in pipe. After “coupon” has been removed, securely attach it to bottom of pipe as evidence that it has not been left in pipe.

F. Escutcheons Plates: Install at exposed pipe penetrations of ceilings, floors, and walls.

G. Install sleeves through walls. Comply with requirements in Section 223510.

3.5 FIELD QUALITY CONTROL

A. Flush, test, and inspect fire suppression systems in accordance with NFPA 13 and NFPA 25. No leakage permitted in piping. Prior to performing pressure test, notify the AHJs and the A/E of pressure test schedule.

B. Notice: Give 1 week notice and arrange for field tests and inspections by the AHJs. Include paying for inspection fees and securing permits for same.

C. Approval and Acceptance: After fire suppression systems have been completely installed, tested, and Substantial Completion review items corrected, obtain approval and acceptance of system by the AHJs in accordance with NFPA 13. Retests due to failure to meet design requirements shall be at no additional cost to the Owner. Submit completed Contractor’s Material and Test Certificate using form in NFPA 13.

3.6 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Apply masking tape or paper cover to protect sprinkler heads, cover plates, and sprinkler escutcheons to protect from field painting. Remove after painting. Remove sprinkler heads having paint other than factory finish and provide new. Cleaning and reuse of painted sprinkler heads not acceptable.

C. Protect sprinkler heads from damage until Substantial Completion.
D. Fire suppression system subcontractor shall be responsible during installation and testing periods of sprinkler systems for any damage to work of others and to building and its contents caused by leaks in equipment, by unplugged or disconnected pipes and fittings and by overflow. Pay for necessary replacements or repairs to work of others damaged by such leakage.

3.7 SPRINKLER HEADS SCHEDULE

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<tr>
<th>Area/Ceiling</th>
<th>Head Type</th>
<th>Head Finish</th>
<th>Escutcheon Finish</th>
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<tr>
<td>Suspended or Hard Ceiling</td>
<td>Concealed</td>
<td>Satin Chrome</td>
<td>White</td>
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<td></td>
<td>Pendent</td>
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<tr>
<td>Areas without Suspended or</td>
<td>Upright</td>
<td>Satin Chrome</td>
<td></td>
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<tr>
<td>Hard Ceilings</td>
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<tr>
<td>22 11 16</td>
<td>DOMESTIC WATER SYSTEM</td>
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<tr>
<td>22 11 20</td>
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<tr>
<td>22 62 00</td>
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<tr>
<td>22 66 00</td>
<td>ACID WASTE AND VENT PIPING SYSTEM</td>
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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The following Sections apply to the Work in this Division with exception of items specifically described in Division 22:
1. Section 230500 General Provisions
2. Section 230505 Project Closeout and System Start-Up
3. Section 230510 Basic Materials and Methods
4. Section 230520 Mechanical Demolition
5. Section 230700 Mechanical Insulation
6. Section 232116 Piping Specialties

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes domestic water piping for potable and non-potable systems and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. Applicable plumbing code pertaining to materials, products, and installation of domestic water piping.
   3. ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   4. ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
   5. ASME B31.9, Building Services Piping.

C. Installer’s Qualifications for Copper Press Fitting Couplings: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Copper tubing including solder and flux.

C. Certificates:
   1. Certificates of Inspection by Authorities Having Jurisdiction (AHJ)
   3. Certificates of flushing and sterilization with approval by the AHJ.
PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish products of sizes, ratings, and characteristics indicated, which comply with manufacturer's standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation.

B. Pressure Ratings: Provide components with minimum pressure rating of 125 psig working pressure.

2.2 MANUFACTURERS

A. Copper Tubing: Cerro, Mueller, Wolverine, Cambridge Lee Brass.

B. Copper Tube Fittings: NIBCO®, Mueller, Elkhart.

2.3 COPPER TUBING

A. General: Copper tubing only. Sweat joint connections only.

B. Above Ground: Type L copper water tube, hard-drawn, ASTM B 88.

C. Fittings: Wrought copper fittings for soldered joints, ASME B16.22.

D. Solder Material: 95 percent tin, 5 percent antimony solder or 96 percent tin 4 percent silver conforming to ASTM B 32 and NSF 61. Lead free (not more than 0.2 percent lead). Flux water soluble conforming to ASTM B 813. J.W. Harris “Bridgit”, Rectorseal, Oatey, Superior Flux, Worthington Cylinders, BerzOmatic, or approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this Section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.
B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to the Owner.

3.4 PIPING INSTALLATION

A. General:
   1. Install piping, fittings, and appurtenances in accordance with recognized industry practices which will achieve permanently leakproof piping systems and capable of performing each indicated service without piping failure.
   2. Install each run with minimum joints and couplings, but with adequate and accessible unions or flanges for disassembly and maintenance replacement of valves and equipment.
   3. Reduce sizes (where indicated) by use of reducing fittings. Bushings not acceptable.
   4. Seal pipe penetrations through walls and floors with resilient sealant specified in Section 230548.

B. Align piping accurately at connections, with 1/16 inch misalignment tolerance.

C. Install pipe generally sloped to permit drainage at low points, free from sags, bends, and traps, and in a manner to conserve space for other work. Refer to other Sections for specific installation requirements.

D. Location of Piping:
   1. Piping plans, Sections, details, and diagrams are diagrammatic indicating general arrangement of piping installation. Locate piping and include offsets to avoid interference with building structural members, equipment, building openings, light fixtures, ductwork, electrical work, and other obstructions.
   2. Arrange piping to allow access for operation, service, disconnection, and removal and replacement of valves, fixtures, and equipment.
   3. In general, maintain the maximum possible headroom in ways of egress, including pedestrian walkways and maintenance aisles, minimum headroom of 6'-8” from floor to bottom of any component.
   4. Within buildings, conceal piping in walls and chases and above ceilings except where indicated in the Contract Documents to remain exposed. Do not cover or enclose work until completely inspected and approved by the AHJ. Should Work be covered or enclosed prior to inspections and approvals, uncover work as directed by the A/E. After Work has been inspected and approved by the AHJ, make repairs and replacements with materials as necessary to obtain approval of the A/E at no additional cost to the Owner.
   5. Route piping parallel to column lines and perpendicular to floor unless indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install fittings for changes in direction and branch connections. Install concrete thrust blocks and restraining rods for ductile iron fittings.

G. Install piping to allow application of insulation.

H. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

I. Clean interior of piping before making joints. Maintain cleanliness of piping throughout installation. Install caps or plugs on open ends of cleaned piping.
J. Install isolation valves specified in Section 221120 and drain existing piping to accommodate installation of new Work.

K. Install pipe supports in accordance with MSS SP-69 and Section 232116, whichever is more stringent.

L. Install isolation valves at all capped piping and as indicated on the Drawings.

3.5 SOLDERED JOINTS

A. Comply with applicable provisions of ASTM B 828 or “Copper Tube Handbook” by CDA for soldered joints.

B. Cut ends square and remove fins and burrs. Replace dents and damaged tubing with new tubing.

C. Remove grease and oil from joints by wiping with clean cloth saturated with suitable chemical solvent. Clean with emery cloth.

D. After cleaning, apply non-corrosive flux, apply heat and material and hold joint rigidly until hardened.

E. Wipe excess material from exterior of joint before hardening.

F. Before soldering, remove stems and washers of valves.

3.6 CLEANING AND INSPECTING

A. Clean exterior surfaces of installed piping systems of superfluous materials and prepare for application of specified coatings (if any).

B. Inspect each run of each system for completion of joints, supports, and accessory items.

C. Inspect pressure piping in accordance with procedures of ASME B31.1 and ASME B31.9

3.7 PRESSURE TESTING

A. Provide equipment and apparatus necessary for tests. Make tests in presence of the A/E. Notify the A/E at least 48 hours before expected tests.

B. Test piping systems before insulation has been applied.

C. Test Pressures and Duration: Test piping systems at pressure of 1-1/2 times design working pressure or at 100 psig, whichever is greater. Maintain test pressure for sufficient time to permit complete inspection of system under test. Minimum 2-hour duration. Test in Sections and test entire system when completely installed.

D. Test Procedure:
   1. Install calibrated test pressure gage in system to observe any loss in pressure.
   2. Test piping at metal temperature greater than 35 F.
   3. Open vents, and other connections which can serve as vents, during filling so that air is vented prior to applying test pressure to system.
E. Testing Media Requirements:
   1. Use clean, fresh city water for hydrostatic testing. Water temperature shall be not less than 60 F and not greater than 100 F.
   2. Drain water immediately after hydrostatic testing. Vent system while draining to avoid creating a vacuum.

F. Test Repairs:
   1. Repair defects which develop during testing and retest piping systems until they show no defect or weakness and are tight. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

G. Test Records: Make and submit records for each piping installation. Include copies in the Operations and Maintenance Manual. Include at a minimum, the following items:
   1. Date of test.
   2. Description and identification of piping tested.
   3. Test fluid.
   4. Test pressure.
   5. Test duration.
   6. Remarks to include such items as: Leaks (type, location); repairs made on leaks.
   7. Signature and date of person witnessing the test.
   8. Certification by the Contractor.

H. Systems Which Connect to Existing Piping: Isolate new piping system from existing system by the closest valve or valves to the existing system.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes valves and associated appurtenances for plumbing systems. Valves specific to a single system are specified in that particular Section.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
   3. MSS SP-110, Ball Valves Threaded, Socket-Welding, Socket Joint, Grooved and Flared Ends.

C. Domestic Water Systems: Products carrying and dispensing water for consumption through drinking and cooking shall be certified by an independent, ANSI-accredited, third party certification organization to requirements of NSF 61 and NSF 372 for 0.25 percent maximum lead content for wetted component base material.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Ball valves.

C. Test Reports:
   1. Field start-up and test reports.
   2. Submit completed copy of report and include copy in the Operations and Maintenance Manual.

D. Certificates: Compliance with NSF 61 and NSF 372 for no-lead/lead-free.
PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish factory-fabricated valves recommended by manufacturer for use in service indicated. Furnish valves of types and pressure ratings indicated but rated at not less than 125 psig. WSP to comply with installation requirements. Furnish sizes as indicated with connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is the Contractor's option. Refer to other Sections for higher working steam pressures.


2.2 BALL VALVES

A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material. Comply with MSS SP-110.

B. Bronze body, 600 pound, chrome plated ball and stainless steel stem, full port, screwed or solder joint ends, 2 piece construction, lever handle, Teflon seat and seal, memory stop, ASTM B 61, ASTM B 62, or ASTM B 584.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this Section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 INSTALLATION

A. Install valves where required in branch lines to isolate Sections of piping. Locate valves in accessible locations.

B. Valve Stem Position:
   1. Ball Valves: Install horizontal or above.
C. Install isolation valves where indicated on the Drawings and in the following locations:
   1. Branch lines.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes compressed air piping systems and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for the following.
   1. Indoor compressed air piping.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish products of sizes, ratings, and characteristics indicated which comply with manufacturer's standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation.

B. Pressure Ratings: Provide components with minimum pressure rating of 150 psig working pressure.

2.2 MANUFACTURERS

A. Copper Tubing: Cerroflow, Mueller Industries, Wolverine Tube, Inc., Cambridge-Lee Industries LLC.

B. Copper Tubing Fittings: NIBCO®, Mueller Industries, Elkhart Brass Mfg.
2.3 INDOOR COMPRESSED AIR PIPING

A. Copper Tubing for 2-1/2 Inch and Smaller:
   5. Solder Material: 95 percent tin, 5 percent antimony solder or 96 percent tin 4 percent silver conforming to ASTM B 32. Lead free (not more than 0.2 percent lead). Flux water soluble conforming to ASTM B 813. J.W. Harris “Bridgit”, RectorSeal, Oatey SCS, Superior Flux & Mfg. Co., Worthington Industries, BerzOmatic, or approved.

2.4 PIPING SPECIALTIES

A. Valves: Comply with requirements in Section 221120.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this Section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to Owner.

3.4 INDOOR PIPING INSTALLATION

A. Install with minimum uniform pitch of 1/8 inch per foot towards drain.

B. Install piping free of sags and bends.

3.5 PRESSURE TESTING

A. Comply with requirements in Section 230510.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes vacuum piping systems and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following.
   1. Piping.
   2. Piping specialties.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish products of sizes, ratings, and characteristics indicated which comply with manufacturer’s standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation.

2.2 PIPING

A. Copper Tubing for 2-1/2 inch and Smaller:

2.3 VACUUM SYSTEM

A. Valves: Comply with requirements in Section 221120.
PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this Section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of A/E at no additional cost to Owner.

3.4 PIPING INSTALLATION

A. Comply with requirements in Section 221116.

B. Install with minimum uniform pitch of 1 percent slope downward towards drain.

C. Install piping free of sags and bends.

3.5 PRESSURE TESTING

A. Comply with requirements in Section 221116.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes acid waste and vent piping and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Sections apply to the Work in this Section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Code and Standards:
   1. Applicable plumbing code pertaining to materials, products, and installation of acid waste and vent piping.
   10. UL 723, Test for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following.
   1. Piping and fittings

PART 2 - PRODUCTS

2.1 GENERAL

A. Basic piping materials and products required for work of this Section are specified in Sections 230510, 231300, and 232116. Furnish products of sizes, ratings, and characteristics indicated which comply with manufacturer’s standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation.
2.2 PIPELINE AND FITTINGS

A. Piping Materials (Contractor Options):
   1. Polypropylene:
      a. Above-Ground Pipe and Fittings in Non-Plenum Locations: Schedule 40 polypropylene with pipe and drainage pattern fittings dimensions and tolerances per ASTM F 1412 and ASTM F 1055, pipe extrusion from polypropylene resin with non-flame retardant material per ASTM D 4101. Coil fusion using socket fusion tools per ASTM F 1056.
      b. Joints: Coil fusion joint connection using imbedded electrical resistance wire in fittings per ASTM F 1290.
      c. Transition Couplings: Connections between polypropylene pipe and fittings and other pipe materials using adapters furnished by polypropylene pipe manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this Section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this Section. Store polypropylene and polyvinylidene piping in covered environment away from sunlight and UV light.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to Owner.

3.4 WORK PRIOR TO INSTALLATION

A. Borosilicate glass manufacturer’s authorized representative shall meet with the plumbing subcontractor at the job site for instructions as to cutting and joining pipe Sections and for hanger spacing requirements.

3.5 PIPING INSTALLATION

A. General:
   1. Comply with requirements in Section 221116.
2. Install with uniform pitch of at least 1/4 inch per foot for horizontal acid waste piping, unless otherwise indicated on the Drawings or allowed by the AHJ.
4. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab in piping and pull past each joint as completed.
5. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

B. Above-Ground Piping:
1. Support horizontal piping to maintain alignment, prevent grade reversals, and prevent sagging. Install hangers at spacing per pipe manufacturer's installation instructions. Locate hangers within 12 inch of each fitting and coupling.
2. Support vertical stacks at each floor with riser clamps and every 72 inch.

3.6 PRESSURE TESTING

A. Test drainage piping in accordance with applicable plumbing code. Comply with requirements in Section 221116. Test by water.

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes materials, equipment, labor, supervision, tools and items necessary for the construction, installation, connection, testing, and operation of mechanical work. This section applies to all Divisions 21, 22, and 23 sections.

B. General Requirements: General Conditions, Supplementary Conditions, and Division 01 sections apply to the Work in this section.

1.2 CODES AND STANDARDS

A. Perform work in accordance with requirements in the state in which the work is performed.

B. Conform to applicable industry standards, such as UL and ETL standards, ANSI standards, and other standards as noted.
   1. Notify the A/E of deviations in the Contract Documents to applicable codes and ordinances prior to installation of the Work. Perform changes in the Work after initial installation due to requirements of code enforcing agencies at no additional cost to the Owner.
   2. If conflict occurs between legally adopted codes and the Contract Documents, the codes prevail, except that this shall not be construed as relieving the Contractor from complying with requirements of the Contract Documents which may exceed code requirements and not contrary to same.
   3. Arrange for and pay for required permits, fees, and inspections.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and with additional requirements indicated in this article.

B. Electronic Product Data:
   1. Comply with requirements in Section 013300 and additional requirements indicated in this article.
   2. Submit entire project complete at one time (exceptions: shop drawings and controls products submittals) with a dedicated submittal number for each submittal and re-submittal. Include submittal number and date submitted in file name.
   3. Clearly mark catalog pages, equipment, and model number to be used. Indicate associated specification section and paragraph number on each page. Identify required options and accessories.
   4. Format:
      a. Adobe PDF file format.
      b. Bookmark each submittal to facilitate browsing to each specification paragraph number.
      c. Include table of contents for each specification section. Include catalog numbers or drawing numbers.
      d. Include the Contractor and manufacturer’s representative contact information for each product. Include job name (or abbreviation of job name), specification number, and contractor submittal number in file name.
C. Shop Drawings:
   1. Submit 2D shop drawings for systems specified in Divisions 21 and 23.
   2. Submit prior to starting fabrication and installation work. Do not fabricate or install until reviewed by the A/E. Include complete location dimensions, hanger and support sizes and dimensions.
   3. Complete drawings in timely manner and coordinate with construction schedule.
   4. “Typical” drawings and wiring diagrams not acceptable unless they specifically apply to this project.
   5. Show required coordination with work of other trades including electrical conduits, cable trays, structure, lighting fixtures and other items to be installed in ceilings, full height walls, and other items necessary to coordinate installation.
   6. Floor plan backgrounds are available in electronic format and shall be requested from the A/E.
   7. Direct use of the Drawings as the basis of the Contractor’s prepared Shop Drawings not acceptable.
   8. Format:
      a. 2D drawings using industry recognized software for systems and areas of the building.
      b. Minimum scale 1/4 inch per foot on same size sheets as the Drawings.
      c. Adobe PDF file format.
   9. Content:
      a. Fire Protection: Complete fire suppression installation consisting of detailed fire suppression drawings. Comply with requirements in 211000.
      b. Airside HVAC: Complete duct installation consisting of detailed sheet metal drawings. Show ducts, duct fittings, turning vanes, air devices, flexible ducts, volume dampers, hangers, supports, seismic bracing, and other HVAC components included in the Contract Documents. Indicate sizes of ductwork, installed ductwork bottom of duct (BOD) above finished floor, equipment dimensions, dimensioned location of equipment and height above finished floor, air device tags indicating same information included on the Drawings, and equipment tags.
      c. HVAC controls: Complete controls installation consisting of detailed controls drawings. Comply with requirements in Section 230900.

D. Approval: Approval of manufacturer’s name or Product by the A/E does not relieve the Contractor of responsibility for providing materials and equipment which comply in detail with requirements of the Contract Documents.

E. Re-Submittals: Clearly identify re-submittals. Provide revised tabs, indexes, page renumbering, and other formats to interface with original submittal. Identify changes and include date for project tracking.

F. Test Reports and Certificates: Submit as package prior to Substantial Completion.

G. Testing and Balancing Reports: Submit as indicated in Section 230593.

H. Certifications: Submit written certifications from governing building authorities stating that the Work has been inspected and accepted, and complies with applicable codes and ordinances.

I. Record Drawings: Comply with Article “Record Drawings” in this section.
1.4 SCHEDULE OF VALUES

A. Comply with requirements in Division 01 with additional requirements as indicated in this article.

B. Include labor and material costs as follows:
   1. Permit, Mobilization, Submittals, and Bond.
   2. Trailer, Services, Cranes, and Rentals.
   3. Foreman/Non-Labor.
   4. Project Closeout and System Startup.
   5. Punchlist.
   6. Record Drawings.
   7. Basic Materials and Methods.
   9. Mechanical Demolition.
  10. Systems Training.
  12. Fire Suppression Engineering and Shop Drawings.
  15. Testing, Adjusting, and Balancing.
  17. Mechanical Insulation, Material.
  29. Piping Specialties, Material.
  32. Automatic Temperature Controls (ATC), Labor.
  33. Automatic Temperature Controls (ATC), Material.
  34. ATC Engineering and Shop Drawings.
  35. ATC, Commissioning.
  36. ATC, Owner Training.
  40. Hydronic Piping, Material.
  41. Air Distribution, Labor.
  42. Air Distribution, Material.
  43. Air Distribution Accessories, Labor.
  44. Air Distribution Accessories, Material.
  45. Air Devices, Labor.
  46. Air Devices, Material.
1.5 DEFINITIONS AND ABBREVIATIONS

A. Refer to Division 01 sections for definitions and abbreviations. Additional definitions and abbreviations are as follows.

B. “Approved” or “Approval” means written approval by the Owner or “Owner’s agent” (A/E).

C. “Codes” means the AHJ adopted codes, rules, and ordinances and additional codes as specified herein.

D. “Concealed and Concealed Work” means Work installed in spaces out of sight. For example, above ceilings, below floors, between double walls, within furred-in areas, within pipe and duct shafts, behind cabinets, and similar locations and spaces not exposed to view.

E. The word “Contractor”, as used in Divisions 21, 22, and 23 sections, means fire suppression, plumbing, or HVAC subcontractor.

F. “Coordination”, “Coordinating”, and “Coordinate” mean to bring, or bringing, into common action, movement, or combination so as to act together in smooth concerted way.

G. “Directed”, “Requested”, “Accepted”, and similar terms mean these terms imply “by the A/E” unless otherwise indicated.

H. “Exposed” means open to view of occupants in normally occupied areas. Work installed in mechanical, electrical, and equipment rooms is defined as exposed. Likewise for Work installed within accessible air distribution plenums, pipes installed in tunnels, and pipes installed in a room not covered by other construction.

I. “Furnish” means supply and deliver to Project site ready for unloading, unpacking, assembly, installation, and similar activities.

J. “Indicated” and “Indicated on the Drawings” means shown on the Drawings by notes, graphics or schedules, or written into other portions of the Contract Documents. Terms such as “shown”, “noted”, “scheduled” and “specified” have same meaning as “indicated”, and are used to assist reader in locating particular information.

K. “Install” means to place in position for service or use. Includes operations at Project site, such as unloading, unpacking, assembly, erection, placing, preserving, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar activities.

L. “Provide” means furnish and install for complete, finished, and operable system and ready for intended use.

M. “Shop Drawings” means documents which fully detail equipment and intended installation relative to this specific Project.

N. “Substantial Completion” shall mean that entire project (or readily definable portion thereof if so designated in the Contract Documents) is acceptable to code enforcement authorities and to extent required by such authorities, has been inspected and approved by such authorities, and is suitable for occupancy by the Owner or occupant for purpose intended. Refer to Divisions 00 and 01 sections for additional requirements.

O. “Work” or “Project” means entire scope of work required by the Contract Documents.
1.6 MATERIALS

A. Where two or more manufacturers are listed, select for use any of those listed. The first mentioned, in general, was used as basis of design. Bids on any manufacturer named acceptable as long as that manufacturer meets every aspect of the Contract Documents. Where several manufacturers are specified by name for one use, select for use any of those specified. Note that equipment layout is based on equipment listed in equipment schedules.

B. Ensure that equipment will fit within available space. Where other than basis of design manufacturer is selected for the Project, the Contractor is responsible for verifying equipment will fit within available space and meet manufacturer’s and code required clearances.

C. Where other than basis of design manufacturer is selected for the Project, include cost of resulting additional work, coordination with other trades, and redesign of associated building services and structure as required to accommodate selected equipment. Include redesign drawings with submitted Shop Drawings.
D. Should any proposed Product require redesign work by the A/E to accommodate proposed Product, costs for such redesign work shall be included in the Bid amount. The Owner will compensate Engineer through the A/E at rate of $150.00 per hour for time and expense for required review of submittals and additional coordination for redesign work. Amount of compensation will be deducted from Final Payment to the Contractor.

1.7 STANDARDS OF QUALITY

A. Furnish products of single manufacturer for items which are used in quantity. A Product, for purpose of this paragraph, is assembly of components such as fans, air handling units, chillers, valves, and similar items. Materials such as pipe, fittings, pipe and duct insulation, and similar items not requiring maintenance are not included in single manufacturer requirement of this paragraph.

B. Products shall be new unless indicated otherwise in the Contract Documents.

1.8 SUBSTITUTIONS

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Substitutions will be considered following bid award only when a product becomes unavailable through no fault of the Contractor.

C. Where “manufacturer” paragraphs include the words “or approved”, prior approval of the proposed substitution is required. The A/E is sole judge of quality of proposed substitution.

D. When the A/E approves a substitution request, approval is given with understanding that the Bidder:
   1. Has investigated proposed Product and determined that it meets or exceeds quality level of specified Product.
   2. Will provide same warranty for substitution as for specified Product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Provide as specified certain products, materials, and systems where “manufacturer” paragraphs are followed by the words “No substitutions”.

F. Substitutions will not be considered when they are indicated or implied on the Shop Drawings or product data submittals, without separate written prior approval, or when approval will require revision to the Contract Documents.

1.9 DRAWINGS AND SPECIFICATIONS

A. General: Mechanical drawings are diagrammatic. Complete details of building features which affect fire suppression, plumbing, and HVAC installations may not be shown. For additional details, refer to other Contract Documents. Report any discrepancies to the A/E along with suggested revisions. Obtain written response from the A/E before proceeding with changes.

B. Depiction of the Work: The Drawings do not show exact characteristics of the Work, piping and air distributions configurations, or necessary number of fittings and offsets. Base work on actual field measurements and conditions. Provide work required to complete installation.
C. Dimensions: Do not scale drawings. Dimensional accuracy is not guaranteed, and field verification of dimensions, locations, and levels to suit field conditions is required.

D. Discrepancies: Field verify dimensions and existing conditions prior to performing the Work. Bring to the A/E’s attention any discrepancies within the Contract Documents and between the Contract Documents and field conditions. Also, for any design and layout changes required due to specific equipment selection, prior to the Contractor’s work (equipment and material purchasing and installation). Any corrective work required by the Contractor after his discovery of such discrepancies, inconsistencies, or ambiguities shall be performed at no additional cost to the Owner.

E. Specifications: These specifications are written in imperative mood and streamlined form. Imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

1.10 RECORD DRAWINGS

A. Comply with requirements in Division 01, with additional requirements indicated in this article.

B. Prepare Record Drawings. Record Drawings shall be new black line prints (pencil and black pen not acceptable) and shall show measured locations of portions of the Work and changes the Contractor has made.

C. Record corrections and changes made during progress of the Work, showing work as actually installed. In general, acceptable tolerance plus or minus 1'-0" from actual location in horizontal plane. Indicate exact installed invert elevations for underground piping. Neatly hand-draft on daily basis. Keep readily available at project site. Use latest revisions and keep neat and clean. Do not use the Contractor’s working drawings.

D. Record Drawings are subject to review by the A/E on regular basis throughout construction. At end of construction, check drawings for completeness and accuracy.

E. Drawings shall show addendum items, change orders, clarifications, supplemental instructions, and deviations from the Drawings.

F. Per project closeout procedures, submit in AutoCAD format along with corrected black line drawings. Each sheet shall be noted as “RECORD DRAWING”.

1.11 COORDINATION

A. Coordinate Divisions 21, 22, and 23 Work with other trades.

B. Be aware of restricted space for installation of fire suppression, plumbing, and HVAC systems. Include offsets and perform rerouting and coordination to fit elements in available space. Include provisions for such requirements in bid.

C. Equipment, ductwork, and piping shown are based on existing drawings as available and on limited project site observations to extent possible under current conditions. Field verify existing conditions prior to commencement of Work. Obtain specific locations of structural and architectural features or equipment items from referenced drawings, field measurements, or trade providing material or equipment.
D. Coordinate ductwork and piping installations to clear light fixtures and electrical cable trays. Include clearance over light fixtures to allow removal and replacement. Include minimum 6 inch clearance above and to sides of cable trays. Coordinate routing of ductwork and piping with each other and other trades so grade of piping can be accomplished and fit in available space.

E. Coordinate clearance requirements with piping installation for piping insulation applications and duct installation for duct insulation applications. Before preparing piping and duct Shop Drawings, establish and maintain clearance requirements for insulation applications and field-installed insulation jackets and finishes and for space required for maintenance.

F. Ductwork takes precedence over piping for available space and routing. Coordinate installation based on this precedence.

G. Do not install ductwork and piping over electrical panels and where clearance is required by code and for maintenance.

H. Existing Conditions:
   1. General Construction:
      a. Installation of fire suppression, plumbing, and HVAC work will require openings, removal and replacement of ceilings, sleeves, and restoration of general construction to match existing. Some work occurs in areas not requiring alterations as part of architectural work. Coordinate new openings and restoration work so that there is no additional cost to the Owner.
      b. General construction work shown on architectural drawings may require removal, relocation, and reinstallation of existing fire suppression, plumbing, and HVAC work. Since existing conditions cannot be completely detailed on the Drawings, survey site and perform required Work at no additional cost to the Owner.
   2. Piping: Verify exact location, flow direction and service before making connections to such piping. Remove and provide new piping where existing piping is damaged or broken during construction.
   3. This project may require work in presence of asbestos containing material (ACM). Division 23 does not provide for or cover identification, removal, encapsulation, or disposal of such material. If presence of ACM is suspected, notify the general contractor prior to proceeding in vicinity of ACM.

   1.12 WORKMANSHIP

   A. Work shall be in accordance with best trade practices. Remove substandard workmanship and provide new material at no additional cost to the Owner.

   1.13 SITE VISIT

   A. The Contractor shall visit site during bidding period to note conditions affecting installation of the Work. No additional charges allowed due to failure to adequately review conditions.
1.14 CERTIFICATION

A. By submitting a Bid for fire suppression, plumbing, and HVAC systems, the Contractor and his subcontractors acknowledge and certify the following:

1. That they have carefully examined and fully understand the Drawings and Specifications including but not limited to architectural, site, utility, mechanical, structural, and electrical drawings, and their specifications. In addition, they have determined that the Drawings and Specifications are adequate to complete fire suppression, plumbing, and HVAC systems and that they can provide complete finished and operable system in accordance with the Contract Documents.

2. That they have had reasonable opportunity to discover any ambiguities in the Contract Documents and such ambiguities have been brought to attention of the A/E in writing prior to submitting the Bid.

3. That they have reviewed project progress schedule with general contractor, fully understand schedule, and they have verified, prior to submitting a Bid, availability of necessary labor and materials, including supervision and office backup, and can comply with schedule requirements.

4. That there may be changes to scope of work and that they understand that any proposal submitted for performance of additional work shall include costs associated with such change including but not limited to labor, materials, subcontracts, equipment, taxes, fees, schedule impact, loss of efficiency, supervision, overhead, and profit.

5. That the Contract requires them to coordinate their work with that of other trades and that responsibility for coordination includes rerouting, offsets, and similar provisions, to fit the Work and address manufacturer's recommended clearances for service access, maintenance, and replacement of equipment in manner that is compatible with the Work of other trades in same area.

6. That routing of elements of fire suppression, plumbing, and HVAC systems shown on the Drawings is schematic only and that offsets and rerouting will be required in installation and that labor and materials for offsets and rerouting have been included for such in their bids.

7. That they have consulted with affected utilities and included in their bids labor and materials to meet requirements which may be imposed by each utility and have included in their bids costs and fees to be paid to such utilities, including temporary services and temporary and permanent connections unless specifically excluded in the Contract Documents.

8. That they understand submittals of material and equipment to the A/E is for the purpose of establishing what they are providing for the Project. Any review undertaken by the A/E does not relieve them of their responsibilities to furnish and install materials and equipment required for the Work in the Project nor does such review relieve them of their responsibilities for coordination with other trades and designers to ensure that such materials and equipment will fit and be suitable for purpose intended.

9. That they agree to receive payment for bid amounts as full compensation for furnishing materials and labor which may be required in prosecution and completion of the Work required under the Contract Documents, and in respects to complete the contract work to satisfaction of the A/E.

10. That they include in their bids costs to furnish bonds as specified in the Contract Documents.
1.15 WARRANTY

A. Conform to requirements in General Conditions, Supplementary Conditions, and Division 01. Where not so prescribed or defined, the period shall be 1 year. Warranty periods within Divisions 21, 22, and 23 shall not commence until final acceptance date. Contractor shall extend longer warranties specified in other sections.

1.16 DEMONSTRATION

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Following installation of fire suppression, plumbing, and HVAC work and prior to final acceptance, demonstrate that equipment and systems operate as indicated in the Contract Documents and in accordance with manufacturer’s recommendations.

C. Perform in presence of the A/E and the Owner’s representative, unless otherwise directed by the A/E. Give minimum 1 week notice prior to demonstrations.

D. Provide instruments and personnel required to conduct demonstrations.

1.17 SUBSTANTIAL COMPLETION

A. Comply with requirements in Divisions 00 and 01.

B. Prepare list of items that are not complete prior to asking for the Substantial Completion review by the A/E.

C. Review of the Work: The A/E’s fee for mechanical work includes 2 final construction observation reviews. First one is the Substantial Completion review of the Work and will be in response to the Contractor’s notice of final completion of the Work. If necessary, second one is post-Substantial Completion review of the Work and will occur after notification by the Contractor that deficiencies noted during the Substantial Completion review have been corrected.

D. Cost of Additional Reviews: If additional reviews by the A/E are required due to Contractor’s failure to correct deficient work, the Owner will compensate the A/E on a time and expense basis at rate of $150.00 per hour. Amount of additional compensation for additional reviews will be deducted from the Final Payment to the Contractor.

1.18 CONTINUITY OF EXISTING UTILITY SERVICES

A. Shutdown Duration: Comply with requirements in Division 01. Perform work without shutdown of more than 4 hour duration of existing systems. Schedule each shutdown in writing with the Owner at least 7 days in advance of shutdown and obtain advance written approval from the Owner.

B. Owner Occupancy:
   1. Perform the Work in existing building with respect for necessity of the Owner’s employees to perform their regular work.
   2. Plan installation of new work and connections to existing work to assure minimum interference with regular operation of existing facilities. Do not remove, disconnect, or shutdown systems without prior review by the Owner to confirm that areas needed to remain in operation are not affected.
3. Provide temporary piping, ductwork, wiring, controls, and similar systems and connect to existing systems to keep existing fire suppression, plumbing, and HVAC systems in operation to service areas that need to remain occupied.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes material and labor required to perform start-up of equipment and systems installed in project, to perform checkout of systems, and to verify completeness of project requirements.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 and Sections 230500, 230510, and 230593 apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Submit within 6 weeks of award of Contract the following for review and approval by the A/E.
   1. Checklist for each piece of scheduled equipment indicating items that will be verified for proper operation and completeness of installation. Include an area for comments and completion date for correction of deficiencies. Use of the equipment manufacturer’s standard start-up/checkout form is acceptable.
   2. Checklist of controls by system or piece of equipment indicating items that will be checked, sequences that will be checked, and completeness of the installation. Include an area for comments and completion date for correction of deficiencies.
   3. Checklists shall have a place at each item for the person doing checkout to initial item indicating task has been completed and date it was completed.
   4. Preliminary schedule indicating sequence of events involved with pre-functional check-out, equipment start-up, testing and balancing (TAB), TAB verification, and functional testing. Schedule shall indicate approximate time intervals required for completion of respective tasks.
   5. Prepare and submit a list of items that are not complete prior to requesting substantial completion review by the A/E.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PROJECT CLOSEOUT PROCEDURES

A. Complete the Work described in this section prior to time of Substantial Completion.

B. Schedule pre-startup coordination meeting with the Architect and the Owner for the specific purpose of achieving a coordinated systems start-up.
C. Representatives for the mechanical subcontractor, plumbing subcontractor, sheet metal subcontractor, temperature control subcontractor and TAB subcontractor shall be present at the pre-startup meeting and at the initial startup of each mechanical system.

D. Mechanical subcontractor shall bear prime responsibility for startup of heating and cooling and plumbing systems.

E. If a piece of equipment is not performing satisfactorily during TAB, TAB subcontractor shall notify the installing subcontractor for corrective action.

F. All subcontractors shall comply with the decision of the Construction Manager and the A/E of any conflict of responsibility.

G. Include completed checklists in the Operation and Maintenance Manuals.

3.2 SYSTEM START-UP PROCEDURES

A. As a minimum, the items listed in this article shall be completed. Include recommendations by manufacturers of systems and equipment.

B. Inspect bearings for cleanliness and alignment and remove foreign materials found. Grease in accordance with manufacturer's recommendations. Replace bearings that run rough or noisy.

C. Adjust tension in V-belt drives for required equipment speed. Change belts and sheaves to obtain proper equipment speed, remove any foreign materials from sheaves and belts before starting operations, adjust drives for alignment of sheaves and V-belts. "Required equipment speed" is that speed which produces intended performance. Adjust fans and rotating equipment to maintain operation within the performance curve provided by manufacturer without over speeding equipment or causing excess vibration.

D. Inspect automatic control valves, clean bonnets and stems, tighten packing glands to ensure no leakage, but permit valve stems to operate properly. If leaking, replace packing in valves to retain maximum adjustment after system is judged complete. Replace packing in any valve that continues to leak after adjustment, remove and repair bonnets that leak, coat packing gland threads and valve stems with surface preparation similar to MolyCote or FelPro after cleaning.

E. Inspect and make certain that automatic control valve seats are free from foreign material and are properly positioned for intended service.

F. Inspect screwed joints for leakage and remake each joint that appears to be faulty. Do not wait for rust to form. Clean threads on both parts, apply compound and remake joint.

G. Clean strainers, orifices, and valve seats in fluid systems after systems have been placed in operation to ensure they are free from foreign materials.

H. Adjust pipe hangers and supports for correct pitch and alignment.

I. Repair damaged insulation.

J. After each system has been put into operation, repeat certain checks described in preceding paragraphs.
K. Complete applicable start-up procedures described in preceding articles and paragraphs prior to Substantial Completion.

L. Provide adjustment services as necessary to ensure proper functioning of systems after building occupancy and during warranty period.

3.3 SCHEDULE OF VALUES

A. Include a line item in schedule of values for doing the project closeout and system start-up work. Value shall include the time for preparing initial checklists, for checking out project, and for starting up systems. Value shall accurately reflect amount of time and material Contractor estimates to spend on these tasks.

3.4 FINAL ACCEPTANCE

A. Final acceptance of the Work will not occur until functional testing is complete and outstanding issues resolved.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes equipment supports, sleeves, identification, appurtenances, and miscellaneous work. This section applies to all Divisions 21, 22, and 23 sections.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. UL Compliance: Where UL fire-resistance rating is indicated for construction penetrated by access units, furnish UL listed and labeled units, except for those units which are smaller than minimum size requiring ratings as recognized by governing authority.

C. Codes and Standards:
   1. ASME A13.1, Scheme for the Identification of Piping Systems for lettering size, colors and installed viewing angles of identification devices unless other requirements are specified.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Sleeves
   2. Pipe markers and color bands
   3. Valve tags

C. Test Reports: As required in specific specification sections.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer’s recommendations, using means and methods to prevent damage, deterioration, and loss, including theft.

B. Deliver products to site in manufacturer’s original containers, complete with labels.

C. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
D. Store products subject to damage by weather conditions above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer’s instructions.

E. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign material.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall be new and of manufacturers specified herein. They shall bear the UL, ETL or CSA labels where possible.

2.2 SLEEVES

A. Materials, General: Schedule 40 galvanized steel pipe with unthreaded ends, cast iron pipe, or minimum 26 gage galvanized sheet steel. Use steel pipe for sleeves through floor slabs.

B. Sleeves in Fire Rated Walls and Floors: Same material and thickness as was used when firestopping material was tested in accordance with procedures specified in Division 07. Firestopping will be furnished by a specialty subcontractor. Coordinate with requirements in Division 07.

2.3 PIPE MARKERS AND COLOR BANDS

A. General: Manufacturer’s standard preprinted, flexible or semi-rigid, permanent, color-coded, plastic sheet pipe markers. Comply with ASME A13.1 for label color and lettering size. Color code markers in accordance with UW Standards. Obtain standard color code from UW. Include flow direction arrows.

B. Small Pipes: For external diameters less than 6 inch (including insulation), full band pipe markers.

C. Lettering: Indicate piping system using full name or abbreviation as indicated on the Drawings. Manufacturer’s standard pre-printed nomenclature which best describes piping system in each instance acceptable, as selected by the A/E in cases of variance with names indicated on the Drawings.

D. Manufacturers: Seton, Brady Corp., Craftmark Pipe Markers, Marking Services Inc., or approved.

2.4 VALVE TAGS

A. General: Manufacturer’s standard solid plastic valve tags with printed enamel lettering, piping system abbreviation in approximately 3/16 inch high letters, sequenced valve numbers approximately 3/8 inch high, and 5/32 inch hole for fastener. Coordinate naming convention with the Owner.

B. Fasteners: Manufacturer’s standard solid brass beaded type chain, length as required for proper attachment of tags to valves manufactured specifically for that purpose.
2.5 PAINTING

A. General: Painting of work specified in mechanical sections which is exposed, including exterior exposed mechanical work, is specified in Division 09.

PART 3 - EXECUTION

3.1 MEASUREMENTS

A. Verify measurements at job site. Locate equipment and fixtures on centers of walls, openings, spaces, and similar locations except where noted otherwise. Check that piping, ducts, and similar elements clear openings.

3.2 CUTTING AND PATCHING

A. General: Include in cost of fire suppression, plumbing, and HVAC work, cutting, coring, patching, and painting of existing walls, ceilings, and floors as required to accommodate work as indicated in the Contract Documents and specified in Divisions 21, 22, and 23 work, except where specifically shown on architectural drawings. Employ skilled workmen to perform cutting and patching and restore disturbed surfaces to original condition. Material and workmanship for patching shall be as specified in respective sections for general construction. If not specified, patch and paint to match existing surfaces. In addition, comply with requirements in Division 01.

B. Coordinate cutting work with other trades to minimize patching work and to protect existing finishes and structure from damage. Trenching shall not exceed 2'-0" in width unless approved by the A/E. Cutting of structural members shall be done with the A/E’s approval.

C. During demolition efforts, cover duct open-ends and grille openings with taped on plastic sheet to keep construction dust out of the ducted system. Comply with requirements of Section 230520.

3.3 SLEEVES AND SEALING OF SLEEVES

A. Install sleeves for pipes and ducts for penetrations through non-rated floors and fire rated floors. Seal air and watertight.

B. Dimensions:
   1. Annular Clear Space, General: Include annular clear space of approximately 1/4 to 1/2 inch. Size to accommodate insulation passing through sleeve.
   2. Annular Clear Space for Sleeves through Fire Rated Floors: Include annular clear space between sleeve and insulated or uninsulated surfaces of pipe, tubing, conduit, and wiring per firestopping manufacturer’s installation requirements. Coordinate with requirements in Division 07 and insulation thicknesses specified in Section 230700.

C. Extension: Wherever piping passes through floor slab above occupied space or equipment, install pipe sleeves extending 1 inch above floor.

D. Setting: Core drill existing concrete floor construction.

E. Sealing of Sleeves:
   1. Through Floors: Fill both ends of sleeve with non-hardening silicone sealer as specified in Division 07.
2. Through Fire Rated Floors: Firestopping will be installed by a specialty subcontractor as specified in Division 07.

F. Sheet Metal Dams: Install 16 gage galvanized sheet metal dams around opening on top of floor for core drilled, saw cut, and formed openings through floor slabs without concrete curbs above occupied or equipment spaces. Solder or weld watertight. Seal and anchor to floor watertight. Install with minimum 1 inch projection above floor with 2 inch wide flange on floor.

3.4 ACCESSIBILITY

A. General: Locate valves, controls, and similar components to be readily accessible.

B. Equipment:
   1. Install equipment which requires periodic servicing or repairs to be readily accessible, except where specifically shown on architectural drawings. Otherwise, obtains A/E approval of location.
   2. Piping, ducts, and conduit shall not interfere with required access.
   3. Locate fire suppression, plumbing, and HVAC equipment above ceilings within 2 feet of access doors. If access to equipment is from bottom of unit, locate access door directly under unit sized large enough to accommodate access to internal components.

C. Access Tile Identification: Apply circular dot stickers on ceiling grid frame to indicate location of valves, dampers, and controls that requires maintenance. Color as selected by the A/E.

3.5 PIPE MARKERS AND COLOR BANDS

A. Install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Install to be visible on sides or bottom of pipe.

B. Locate pipe markers and color bands as follows wherever piping is exposed in occupied spaces, accessible maintenance spaces, and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs 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 and floors/ceilings or enter non-accessible enclosures.
   4. At change in direction of pipe.
   5. At access doors, manholes and similar access points which permit view of concealed piping.
   6. Near major equipment items and other points of origination and termination.
   7. Spaced intermediately at maximum spacing of 30 feet along each piping run, except reduce spacing to 15 feet in congested areas of piping and equipment. Stagger alternately on adjacent pipes.

3.6 VALVE TAGS

A. Install valve tags on valves and control devices in each piping system. Install wherever destination or identity of pipe is not visible from valve. Fasten with chain to valve stem.
B. Tags for shutoff valves at HVAC terminal devices and similar rough-in connections of end-use equipment not required.

C. Install valve schedule in mechanical rooms and in custodial rooms or as directed by the A/E.

3.7 PAINTING

A. Touch-up: Cover scratches, abrasions, and similar damages to equipment with factory finished surfaces using matching factory furnished paint.

B. Grilles, Registers and Diffusers: Paint inside surface of ducts, visible through grilles, registers, diffusers, and other openings with 1 coat of flat black paint to a point 2 feet from opening on straight ducts or around bend. Similarly, paint pipes and conduits visible through ceiling relief grilles.

3.8 REVISIONS, ALTERATIONS, AND CONNECTIONS TO EXISTING MECHANICAL SYSTEMS

A. General: Concealed equipment, piping, and ducts of record are indicated in the Contract Documents. Since these are not necessarily exact with respect to location or completeness, take the following steps:
   1. Inspect existing conditions of work, including existing equipment, piping, and ducts, and compare to the Contract Documents for extent and description of new work.
   2. Where connections are required to existing piping and ducts, keep shutdown period to a minimum and restore services promptly to existing building. Comply with requirements of Article “Continuity of Existing Utility Services” in Section 230500.
   3. Should any unknown piping and ducts be encountered during course of work, notify the A/E of such discovery.

3.9 CLEANING AND HOUSEKEEPING

A. General: Comply with requirements in Division 01 and Section 233400 for air handling equipment.

B. Remove debris, cuttings, crates, cartons, and similar items, created by Divisions 21, 22, and 23 Work at regular intervals. Perform at sufficient frequency to eliminate hazard to the public, other trades personnel, building, and the Owner’s employees.

C. Before Substantial Completion, carefully clean equipment, fixtures, exposed ducts and piping, and similar items. Remove construction labels, dirt, dust, cuttings, paint, plaster, mortar, concrete, and similar items.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes selective demolition of existing fire suppression, plumbing, and HVAC work as indicated in the Contract Documents.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 GENERAL

A. Dust Control: Provide protective measures to minimize transfer of noise, dust, dirt, and refuse to adjacent areas of building. Such measure may include dust-tight barriers, temporary walls, portable exhaust fans, vacuum systems, and temporary partitioning.

B. Extent: Keep areas of demolition as clean and orderly as physically possible. Do not allow demolition debris to accumulate. Gather debris and dispose daily. Broom or vacuum-clean work areas on daily basis.

C. Protection: Protect existing equipment, furnishing, and systems with protective coverings. Protect finished surfaces including floors, ceilings, and walls.

3.2 DAMAGES

A. Repairs: Promptly repair damage to existing surfaces, equipment, finishes, or adjacent facilities at no cost to the Owner and to the satisfaction of the A/E and the Owner.

3.3 CONTINUITY OF EXISTING UTILITY SERVICES

A. Comply with requirements in Section 230500.

3.4 DEMOLITION

A. General: Provide demolition work required in existing building for removal of existing fire suppression, plumbing, and HVAC equipment, ductwork, controls, and piping and for installation of new ductwork, controls, and piping. Relocate and modify existing controls, piping, and ductwork as required by general construction alterations and by installation of new ductwork, controls, and piping in existing building to achieve a complete and functioning installation.

B. Extent: Remove and dispose of existing materials indicated on the Drawings to be removed.
C. Termination of Demolition: Where existing piping and ductwork is removed, cut back to stack or riser. Provide isolation valve and cap piping and ductwork at the edge of the project area. Remove unused branch piping and ductwork and piping in walls to be demolished, and cap remaining piping and ductwork.

D. Insulation: Replace damaged sections as specified for new systems where existing insulation is damaged due to cutting and connection to new systems.

E. Reuse: Do not reuse existing products unless indicated on the Drawings.

F. Materials to the Contractor: Materials other than those reserved by the Owner.

G. Existing Conditions: Comply with requirements in Division 01. Verify specific demolition work and operating conditions to be encountered from on-site review and coordination with the Owner. Maintain service to existing equipment and devices during new construction work as required by construction sequencing/scheduling provisions. In areas adjacent to new construction work, provide temporary services as necessary to meet these conditions. Protect active piping and wiring encountered. Notify the A/E of utilities encountered whose services are not known.

H. Drilling of Concrete: Drill openings through existing concrete with diamond tipped rotary core-drilling equipment or carbide tipped drills.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Disposal: Remove debris, rubbish, and other materials resulting from demolition operations from building site unless reinstalled or delivered to the Owner as indicated in the Contract Documents. Transport and legally dispose of material off site.

B. Burning: Burning of removed materials is not permitted on project site.

3.6 CLEAN-UP AND REPAIR

A. Clean-Up: Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protection and leave interior areas clean.

B. Repair: Repair demolition performed in excess of that required at no additional cost to Owner. Return structures and surfaces to conditions existing prior to commencement of demolition work or as directed by the Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes seismic restraints for mechanical equipment and distribution systems

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data for the following:
   1. Seismic restraints

C. Calculations: Sizing and weight distribution for seismic restraints. Calculations shall be stamped and signed by a professional engineer licensed in engineering in the state in which the Work is performed.

D. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints. Include the following:
   1. Anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
   2. Overturning force calculations and other design calculations.
   3. Seismic brace layouts indicating locations of seismic bracing.
   4. Details for seismic restraints and attachment to structure.
   5. Additional design information as required by IBC and ASCE 7.

E. Procedures: Submit procedures and installation instructions for setting and adjusting seismic restraints.

F. Final Inspection Report: Seismic restraint manufacturer shall prepare and submit written report documenting final inspection and certifying that seismic restraints are properly installed and adjusted.

1.4 CONTRACTOR RESPONSIBILITY FOR SEISMIC RESTRAINTS

A. General: A single supplier shall furnish seismic restraints, sway braces, and related hardware for the project unless otherwise specified.

B. Responsibility: This supplier shall be responsible for selection and installation supervision of seismic restraints. Prepare engineering drawings and details and submit to the A/E. Perform installation supervision and provide adjustment instructions.
C. Seismic Restraints:
   1. Design and select restraint devices for ducts to meet seismic requirements in IBC and ASCE 7. Retain a structural engineer to determine the following coefficients as listed in IBC and ASCE 7 as they pertain to this project. Pay structural engineering service fees.
      a. Seismic Design Category.
      b. Component Importance Factor, IP.
      c. Occupancy Category.
      d. Design Spectral Response Acceleration at Short Periods, SDS.
      e. In-Structure Component Amplification Factor, AP.
      f. Component Response Modification Factor, RP.
      g. Mapped Spectral Acceleration for Short Periods, SS.
      h. Site Coefficient, FA.
      i. Site Class.
   2. Retain an engineer, specialty consultant, or seismic restraint device manufacturer to design and develop seismic restraint systems and perform calculations based on actual equipment data.
   3. Engineer, specialty consultant, or seismic restraint device manufacturer shall coordinate attachments to structure to verify that attachment points on equipment and structure can accept seismic, weight, and other loads imposed. Pay any additional structural engineering services fee.
   4. Shop Drawings, details, and calculations shall be stamped and signed by a professional engineer licensed in engineering in the state in which the Work is performed.

1.5 SEISMIC RESTRAINTS, GENERAL

A. Description:
   1. Seismic restraint of ducts as indicated in the Contract Documents and listed in Article “Seismic Restraint Schedule” in this section.
   2. Provide components or materials not specifically mentioned herein, but necessary for proper seismic control of equipment.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers: Mason Industries, Inc., Amber/Booth, Kinetics Noise Control, Vibration Mountings and Controls, Vibro-Acoustics®, Korfund Dynamics Corporation, California Dynamics Corp (CalDyn), TOLCO™, or approved. Mason Industries model numbers are listed.

2.2 SEISMIC RESTRAINTS

A. General:
   1. Restraints capable of safely accepting external forces as defined in IBC and applicable state and local codes without failure to maintain mechanical equipment, piping, and duct in captive position.
   2. Seismic devices not to interfere with vibration isolators during normal operation.
   3. Seismic mounts shall have State of California OPA number verifying maximum certified horizontal and vertical load ratings.
B. Seismic Restraint E-1:
   1. Description: Pre-stretched galvanized steel cable assembly with swivel end connections using 2 clamping bolts. Vertical rods at seismic brace locations braced with and rod clamp assembly to accept compressive loads.
   2. Application: Cables sized to accommodate loads with minimum safety factor of 2.
   3. Manufacturer and Model: Mason Industries SCB with SSB rod clamp assembly.

2.3 FACTORY FINISHES

A. Apply manufacturer’s standard paint to factory-assembled and tested equipment before shipping.
   1. Mechanically galvanized hardware. Hot dipped galvanize metal components where installed outdoors.
   2. Baked enamel for metal components where installed indoors.

PART 3 - EXECUTION

3.1 INSPECTION

A. Description: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. Description: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Assistance: Seismic restraint supplier shall provide assistance to Contractor to ensure correct installation and adjustment of seismic restraints.

3.4 DUCT SEISMIC RESTRAINTS

A. General: Comply with requirements in IBC and ASCE 7 unless otherwise indicated in the Contract Documents.
3.5 SEISMIC RESTRAINT SCHEDULE

A. Seismic restraint designations are keyed to items specified in this section.

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<th>EQUIPMENT</th>
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<td>Suspended Ducts Outside of Mechanical Rooms</td>
<td>IBC</td>
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</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes testing, adjusting, and balancing (TAB) of mechanical systems.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. AABC, National Standards for Total Systems Balance.

C. TAB Subcontractor:
   1. General: TAB work performed by independent subcontractor, not affiliated with the Contractor.
   2. Qualifications: Certified by National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC).
   3. Experience: Minimum 5 years on projects of similar scope and complexity.
   5. Obtain associated Product Data and Shop Drawings required to determine design--to--actual operating data (coil pressure drops, fan curves and similar data).

1.3 SUBMITTALS

A. General: Comply with requirements in Division 01 and Section 230500.

B. Preliminary Data: Submit the following within 30 days after award of contract:
   1. Name of TAB subcontractor.
   2. Individual qualifications of persons responsible for supervising and performing the work of this project.
   3. TAB agenda listing methods and procedures and including blank forms applicable to this project. Include blank system readiness checklists for air systems, hydronic systems, and controls. Include sample field reports and corrective action log.
   4. List of projects completed by TAB subcontractor of similar size, scope and equipment. Include name of the Contractor and the Owner contacts.
   5. List of test instruments.
   7. Sample executive summary that will be included in final report.
C. Pre--Balance System Check--Out Report: Prior to commencement of TAB work, Contractor shall confirm in writing to TAB subcontractor, with copies of notice to the A/E and the Owner, that equipment and system check--out has been performed as described in Article “Work by Contractor”.

D. Balancing Report:
1. Provide complete balancing report in accordance with NEBB or AABC requirements, including the following:
   a. System floor plans.
   b. Fan curves.
   c. List of test instruments and dates of last calibrated.
   d. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
2. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   a. Title page.
   b. Name and address of testing, adjusting, and balancing Agent.
   c. Project name.
   d. Project location.
   e. Architect’s name and address.
   f. Engineer’s name and address.
   g. Contractor’s name and address.
   h. Report date.
   i. Signature of testing, adjusting, and balancing supervisor who certifies report.
   j. Summary of contents, including the following:
      1) Design versus final performance.
      2) Notable characteristics of systems.
      3) Description of system operation sequence if it varies from the Contract Documents.
   k. Nomenclature sheets for each item of equipment.
   l. Data for terminal units, including manufacturer, type size, and fittings.
   m. Test conditions for fan performance forms, including the following:
      1) Fan drive settings, including settings and percentage of maximum pitch diameter.

1.4 JOB CONDITIONS

A. Make 2 site visits to assess system readiness prior to start of TAB work.

B. Do not proceed with TAB work until work has been completed and is operable. Ensure that there is no latent residual work still to be completed.

C. Partial Owner Occupancy: The Owner may occupy completed areas of building before Substantial Completion. Cooperate with the Owner during TAB operations to minimize conflicts with the Owner’s operations.

1.5 COORDINATION

A. Attend and participate in 1 field coordination meetings, contributing air and water balancing requirements to field coordination documents. Arrange with the Contractor to have representatives of mechanical, electrical, sheet metal, and control subcontractors be present at each meeting.
B. Give 7 days’ advance notice to parties needing to be present or to participate with tests and to the A/E for each test. Include scheduled test dates and times.

C. Perform TAB work after leakage and pressure tests on air and water distribution systems have been satisfactorily completed. Refer to Section 233100 for allowable duct leakage requirements.

1.6 SEQUENCING/SCHEDULING

A. General: Phase in properly with the A/E reviewed/accepted Construction Schedule with respect to flooring work (carpet laying and tiling), ceiling installation, final building cleaning, fire alarm system testing, and similar activities that would affect TAB work.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. General: Furnish materials and equipment necessary to measure system capacities, electrical voltage and current, fan speeds, static pressures, air velocities and other readings necessary to evaluate system performance and adjust quantities to those indicated. Materials and equipment shall remain in possession of TAB subcontractor after project is completed.

B. Instrumentation: Use in accordance with manufacturer’s instructions.

C. Calibration: At least every 12 months.

PART 3 - EXECUTION

3.1 INSPECTION

A. Description: Verify installation conditions as satisfactory to receive the Work of this section. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 PERFORMANCE

A. Description: Perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, more stringent requirements govern.

3.4 SYSTEM READINESS PRIOR TO TAB WORK

A. System Performance: The Contractor is responsible for performance of equipment and systems. Do not assume that supplier will ship equipment adjusted to meet project requirements.
B. Equipment Operation:
1. Check equipment for proper operation as soon as electrical power is available. Perform adjustments required for proper operation.
2. Report malfunctions to manufacturer and take corrective action immediately to prevent delay of work.
3. Check-out equipment for electrical problems, check rotation of motors, read voltage and current in each leg of each motor, heater, and similar devices, and check readings against nameplate. Lubricate per manufacturer’s recommendations.
4. Before testing, adjusting, and balancing commences, operate (test run) equipment for minimum 1 week.
5. Complete pre-functional equipment and systems checklists specified in Section 230800 and submit signed and dated copies to the Owner, the A/E, and TAB subcontractor.

C. Air Distribution System Inspection: Check out air distribution system to ensure that fans are connected to ducts, that outlets are connected to branch ducts, and that a volume damper exists for each air device (supply, return, and exhaust) and is in the wide-open position. Verify installation and function of branch volume dampers.

D. Hydronic Systems: Check out hydronic systems to ensure that piping has been completed, flushed, and filled. Ensure that properly operating air vents are installed at system high points and that those systems are free of air. Ensure that temperature/pressure test ports are installed across system components including but not limited to, pumps, coils, heat exchangers, or similar items and as required for balancing.

E. Controls Operation: Check out and calibrate control components under equipment and system operation service. These components include, but are not limited to, thermostats and temperature sensors to ensure they are connected to appropriate devices, respond to temperature changes, and perform correct action compatible with controlled devices.

F. Strainers: After equipment and system check-out work has been completed, and prior to commencement of TAB work, perform the following:
1. Clean strainers in hydronic systems.

G. Fan Adjustment and Drive Changes: Perform necessary drive changes as directed by TAB subcontractor, including furnishing required sheaves and belts.

H. Instrument Test Holes: Install at locations as directed by TAB subcontractor. Refer to Section 233100.

I. Cleaning: Clean equipment and devices after check-out and test run period prior to TAB work.

3.5 WORK BY TAB SUBCONTRACTOR

A. General: Adjust quantities to within percent of design values as follows:
1. Supply air outlets and fans 0 to plus 10 percent
2. Return and exhaust fans 0 to plus 10 percent
3. Return and exhaust air inlets 0 to minus 10 percent
4. Heating and cooling flows 0 to minus 10 percent

B. Systems: Include, but are not limited to, the following:
1. Supply air systems.
2. Exhaust air systems.
3. Heating water systems.

C. Existing Air Handling Systems: Perform TAB for those portions of existing air handling systems that are modified as part of this project. TAB work shall include same activities as for new systems.

D. Readings:
   1. General: Take readings including, but not limited to, the following:
      a. Air Quantities:
         1) Supply, return, exhaust, and outdoor air at each terminal.
         2) Perform duct transverse at branch mains conveying minimum 2000 cfm and for system total air.
      b. Air Temperatures:
         1) Supply air leaving equipment.
      c. Air Handling Equipment:
         1) Fan RPM
         2) System static pressure and fan suction and discharge pressures.
         3) Sheave make, sizes, and shaft size.
         4) Number of belts, make, and size.
      d. Hydronic Pressures and Flows:
         1) Flow--measuring devices in system.
      e. Hydronic Temperatures:
         1) Inlet and outlet of convectors.
      f. Electrical:
         1) Measured voltage and amps on each phase of each motor (for example, fans) while equipment is under maximum normal load.
         2) The nameplate voltage and current for each motor.
   2. Compare pressure drop readings to manufacturers' rating sheets to determine actual flow through equipment.
   3. Explain readings out of range.

E. System Difficulties: Obtain readings on each unit or piece of equipment as early as possible such that discrepancies can be resolved before anticipated close of job.

F. Fan Adjustment and Drive Changes:
   1. Inform the Contractor as to which sheaves and belts need to be changed. Take final readings and make required sheave adjustments.

G. Inspection and Recheck:
   1. Upon request, recheck random selections of up to 10 percent of readings recorded in Balancing Report in presence of the Owner's representative.
   2. Balancing Report will be rejected if more than 20 percent of rechecked readings deviate more than 10 percent of recorded readings in report. In this event, perform complete rebalancing of system.

H. Marking of Adjustments:
   1. After final inspection and recheck, permanently mark dampers, valves, and other adjustment devices to allow adjustment to be restored if disturbed in the future.
   2. If recheck requires re--balancing, eradicate previous markings and re--mark.
   3. Set and lock valve memory stops.

I. Final Field Activities: Prior to final acceptance, perform the following:
   1. Leave systems in proper working operation.
2. Reinstall belt guards.
3. Close access doors.
4. Reinstall covers on electrical J-boxes and switch boxes.
5. Restore thermostat settings to original settings.
6. Patch holes in insulation, ductwork and equipment housing, which have been cut or drilled for TAB work in manner recommended by insulation subcontractor.
7. Adjust vanes on adjustable grilles and diffusers and modular type diffusers to eliminate drafts and to prevent stratification for air circulation acceptable to the A/E.
8. Reinstall ceiling tiles.

3.6 ADDITIONAL TESTS

A. Within 90 days of completing TAB work, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

3.7 COMMISSIONING

A. Equipment and systems referenced in this Section shall be commissioned by the Owner. The Contractor and TAB subcontractor have specific responsibilities for scheduling, coordination, test development, testing and documentation.

B. Submit preliminary report of balance data to the Owner and the A/E. This documentation shall be requirement for final functional performance testing.

C. Participate in selected (maximum of 2) commissioning meetings for coordination and support of commissioning process.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes insulation for plumbing and HVAC piping and ductwork.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. Applicable energy code.
   20. National Commercial & Industrial Insulation Standards (NCIIS)

C. Insulation Subcontractor's Qualifications: Specialty contractor normally engaged using products from manufacturers specified in this section.

D. GREENGUARD Environmental Institute™ Certification: Include for pipe insulation and duct wrap and rigid board duct insulation.
1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data, installation data, and certifications for the following:
   1. Piping system insulation
   2. Duct system insulation
   3. Inserts
   4. Insulation shields
   5. Jacketing

1.4 DEFINITIONS AND ABBREVIATIONS

A. Definitions:
   1. “Exposed” and “Concealed” are defined in Section 230500.
   2. “Cold Plumbing Piping” includes the following down to 0 F:
      a. Laboratory cold water.
   3. “Hot Plumbing Piping” includes the following:
      a. Laboratory hot water and laboratory hot water circulation.
   4. “Hot HVAC Piping” includes the following up to 850 F:
      a. Heating water supply and return.
   5. “Conditioned Air Duct” is duct for air that is heated, cooled, or humidified, and includes supply air ducts.
   6. “Duct Within Conditioned Space” is duct for air that is located inside the building envelope.
   7. “Piping” includes pipe, fittings, valves, and appurtenances.

B. Abbreviations:
   1. ASJ: All-service jacket.
   2. FSK: Foil-scrim-kraft jacket.
   3. PCF: Pound per cubic foot density.
   4. Perm: Water vapor transmission rate (permeability).
   5. SSL: Self-sealing lap.

1.5 SURFACE BURNING CHARACTERISTICS

A. Provide composite or component ratings per ASTM E 84 and UL 723 with flame spread rating not greater than 25 and smoke developed rating not greater than 50.

B. Composite includes insulation, jacketing, and adhesive used to secure jacketing or facing.

C. Components include PVC jacketing and fittings, adhesive, coating, mastic, cement, tape, and cloth.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fiberglass Pipe Insulation: ASTM C 547, Type 1. Include factory applied ASJ/SSL. K-value not greater than 0.23 at 75 F mean temperature.
B. Fiberglass Pipe Fitting Insulation: Thermal blanket, ASTM C 553, Type I or II. K-value not greater than 0.26 at 75 F mean temperature.

C. EDPM Elastomeric Pipe Insulation: ASTM C 534, Type I for tubular materials, Grade 1. K-value not greater than 0.27 at 75 F mean temperature. Water vapor transmission not greater than 0.05.

D. Calcium Silicate Pipe Insulation: ASTM C 533, Type 1. Include factory stucco embossed jacket. K-value not greater than 0.68 at 700 F mean temperature. 14.5 PCF.

E. Cellular Glass Pipe Insulation: ASTM C 552, Type II. K-value not greater than 0.29 at 75 F mean temperature. 7.5 PCF.

F. Fiberglass Duct Insulation: ASTM C 553, Type I, II, or III, ASTM C 1290, ASTM C 1139, Type III (faced), ASTM E 84, and ASTM C 1136, Type II for FSK jacket. 0.75 PCF for duct wrap and 3 PCF for concealed and 6 PCF for exposed rigid board.

G. EDPM Elastomeric Duct Insulation: ASTM C 534, Type II for sheet materials, Grade 1. K-value not greater than 0.245 at 75 F mean temperature. Water vapor transmission not greater than 0.03.

H. Staples, Bands, and Wires: As recommended by insulation manufacturer for applications indicated.

I. Adhesives, Sealants, Coatings, Mastics, and Protective Finishes:
2. FSK and Metal Jacket Flashing Sealants: Childers CP-76 Chil-Byl®, Foster® 95-44™ Elastolar®, Pittsburgh Corning Corporation Pittseal® 444N or approved.
3. Vapor Barrier Coatings: Water based suitable for indoor use on below-ambient services. Childers CP-34, or Vimasco Corporation 749 or approved. Water vapor permeance per ASTM F 1249, 0.08 perms or less at 45 mil dry. White color. Foster® 30-65™ Vapor-Fas™ WB or approved.
4. Vapor Barrier Coatings: Water based suitable for indoor use on below-ambient services. ASTM D 5590 with 0 growth rating. Water vapor permeance per ASTM F 1249, 0.08 perms or less at 45 mil dry. White color. Foster® 30-80AF™ Vapor-Safe® or approved.
5. Weather Barrier Breather Mastic: Water based suitable for indoor and outdoor use on above-ambient services. Water vapor permeance: ASTM F 1249, 1.8 perms at 0.0625 inch dry film thickness. White color. Childers CP-10 Ak-Cryl™ and CP-11 Ak-Cryl™, Foster® 46-50™ Weatherite, Vimasco WC-1 and WC-5, or approved.
7. Elastomeric Insulation Adhesive: Foster® 85-75™Drion®, Armacell® 520, Aeroflex USA, Inc. Aeroseal™, or approved.
8. Lagging Adhesive: For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Childers CP-50A HV2 Chil-Seal, Foster® 30-36™ Sealfas®, Vimasco Corporation 713 and 714 or approved.
9. Lagging Adhesive: For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Foster® 30-36 AF™ Sealfas® or approved.
2.2 MANUFACTURERS

A. Fiberglass Pipe and Duct Insulation: CertainTeed, Knauf Insulation Earthwool®, 1000º, Manson Insulation ALLEY-K™, Johns Manville, Owens-Corning, or approved.

B. EPDM Elastomeric Pipe and Duct Insulation: Aeroflex USA Inc., Aerocel-SSPT (Stay-Seal® with Protape® and Cel-Link II®), K-Flex® USA, Armacell®, or approved.

C. Calcium Silicate Insulation: Industrial Insulation Group, LLC Thermo-12 Gold®.

D. Cellular Glass Insulation: Pittsburg Corning Foamglas® or approved.

E. Adhesives, Sealants, Coatings, Mastics, and Protective Finishes: Foster, Childers, Pittsburgh Corning, Vimasco, Armacell®, K-Flex®, Aeroflex USA, Inc., or approved.

2.3 PIPING SYSTEM INSULATION

A. Insulation materials and thicknesses shall meet or exceed insulation requirements of applicable energy code. Where insulation thickness indicated on the Drawings or specified in this section is thicker than that listed in applicable energy code, use thicker values. Refer to Schedule of Piping Insulation on the drawings.

B. Insulate cold plumbing piping with fiberglass or elastomeric insulation.

C. Insulate cold plumbing piping at wall supports with elastomeric, same thickness as adjacent fiberglass or elastomeric pipe insulation. Aerofix-U™ Insulating Pipe Hanger Support or approved. At Contractor’s option, insulated pipe hangers specified in Section 232116 acceptable.

D. Include factory applied ASJ/SSL on fiberglass or elastomeric pipe insulation. For below ambient piping, seal seams with vapor barrier coating.

E. Fittings:
   1. General: Thickness equal to adjacent pipe insulation.
   2. Indoor: Preformed fiberglass or elastomeric insulation, mitered sections of pipe insulation, or fiberglass or elastomeric insulation blanket. For below ambient piping, coat insulated elbows and fittings with vapor barrier coating and reinforcing mesh. Finish with one-piece premolded PVC fitting covers.

F. Adhesives, Mastics, and Cements: Compatible with piping insulation.

2.4 DUCT SYSTEM INSULATION

A. Insulation materials and thicknesses shall meet or exceed insulation requirements of the applicable energy code. Where insulation thickness specified is larger than those listed in the applicable energy code, use the larger values. Refer to Schedule of Duct Insulation on the drawings.

B. Duct Wrap: Flexible fiberglass duct wrap or elastomeric insulation with factory applied FSK facing (vapor barrier) consisting of aluminum foil reinforced with fiberglass scrim laminated meeting ASTM E 84 and UL 723. Finish duct insulation seams with tape and vapor barrier coating.
C. Adhesives, Mastics, Coatings, Sealants, and Cements: As specified in Article “Materials” in this section. Compatible with duct and plenum insulation.

2.5 INSERTS BETWEEN PIPES AND PIPE HANGERS

A. Material: Hydrous calcium silicate insulation or other heavy density insulating material for hot plumbing and hot HVAC piping, minimum 12 inch long inserts, thickness equal to adjoining insulation. Insulating material suitable for required temperature range. For cold plumbing and cold HVAC piping, use Aerofix-U™ Insulating Pipe Hanger Support or approved. At Contractor’s option, insulated pipe hangers specified in Section 232116 acceptable.

2.6 INSULATION SHIELDS

A. Material: Minimum 12 inch long, galvanized steel, 18 gage for pipe sizes 4 inch and smaller and 14 gage for pipe sizes 6 inch and larger. Anvil International, Fee & Mason, Elcen, or approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, manufacturer’s installation instructions and directions, and requirements described in NCIIS. Where these may be in conflict, the more stringent requirements govern.

3.4 TIME OF APPLICATION

A. General: Apply insulation only after piping and ducts have been pressure tested and certified by the A/E as ready for insulation. If insulation is applied prior to pressure testing, necessary removals, repairs, and modifications to insulation due to leaks that may occur shall be made at no additional cost to the Owner.

B. Manufacturer’s Instructions: Follow with regard to ambient temperature requirements and special techniques.

3.5 EXTENT OF INSULATION

A. Insulate piping, conditioned air ductwork, and equipment, except as indicated in the Contract Documents.
B. Do not Insulate the Following:
   1. Piping:
      a. Temperature/pressure test ports (Pete’s Plugs).
      b. Heating water pipes within fin tube and unit ventilator enclosures.
   2. Ducts:
      a. Transfer, exhaust, and relief ducts except as specified in this section.
      b. Return ducts in suspended ceiling spaces located within building insulation envelope.
      c. Return ducts exposed in conditioned space.
      d. Factory-insulated flexible ducts.
      e. Supply ducts exposed within a space that serves that space only.
      f. Duct flexible connections.

C. Ducts Specified to Have Soundlining and Factory Soundlined Ducts: Refer to Section 233100. Need not be insulated unless additional insulation is required to meet thickness requirements of this section.

3.6 INSTALLATION, GENERAL

A. Apply in a workmanlike manner by skilled workmen regularly engaged in this type of work.

B. Apply to clean and dry surfaces.

C. On cold piping and duct surfaces, apply with continuous, unbroken vapor barrier. Vapor seal seams with vapor barrier coating. Insulate and seal supports, anchors, and other projections and penetrations that are secured to cold surfaces with vapor barrier coating. Apply vapor stops or vapor dams at butt joints at every fourth pipe section joint and at each fitting.

D. Extend surface finishes to protect raw edges, ends, and surfaces of insulation.

E. Install piping and duct insulation continuous through walls, ceilings, and floor openings and sleeves, except where firestop materials are required.

F. Install with joints tightly butted or adhered per manufacturer’s requirements.

G. Install insulation to allow access to equipment for inspection and repairs.

H. Bevel and seal insulation around equipment nameplates and ASME labels.

I. Do not allow fiberglass insulation to get wet or absorb moisture. Remove and dispose of wetted and moist fiberglass insulation and replace with new, dry material. Drying out wetted fiberglass insulation not acceptable.

3.7 PIPING SYSTEM INSULATION

A. PVC Covers for Fittings and Valves: Seal circumferential edges by 2 inch minimum overlap onto adjacent pipe insulation using PVC tape or ASJ/SSL butt strip material.

B. Glass Fabric and Vapor Barrier Finish for Below Ambient, Insulated Fittings and Valves: Lap 2 inch onto adjacent pipe insulation.
C. Cold Piping:
   1. Secure fiberglass or elastomeric insulation ends with SSL butt strips, minimum 3 inch wide. Vapor seal ASJ seams with vapor barrier coating. Adhere elastomeric butt joints per manufacturer’s requirements.
   2. Secure joints and exposed ends at fittings, valves, and equipment with vapor barrier coating. Ensure that vapor barrier for insulation system is continuous from piping to exterior of system to prevent moisture migration into insulation envelope.
   3. Vapor seal joint connections to insulated pipe hangers specified in Section 232116.

D. Hot Piping:
   1. Secure fiberglass or elastomeric ends with ASJ/SSL butt strips, minimum 3 inch wide. Secure ASJ laps and butt strips with suitable lap adhesive.
   2. Secure PVC covers with tacks, PVC tape, or solvent type PVC adhesive.

3.8 DUCT SYSTEM INSULATION

A. Cut insulation slightly longer than circumference of duct to insure full thickness at corners. Apply insulation with edges tightly stitched with staples. Tape stitched seam with 3 inch wide pressure sensitive aluminum foil or FSK tape or seal joints with 2 coats of vapor barrier mastic reinforced with one layer of open weave glass fabric.

B. Secure insulation to bottom of rectangular and square ducts 18 inch and wider with welded pins and speed clips on 18 inch centers. Cut off protruding ends of the pins flush after speed clips have been installed. Seal vapor barrier facing where pins have pierced through with tape of same material by applying vapor barrier adhesive to both surfaces as recommended by manufacturer.

C. Install fiberglass duct wrap with maximum 25 percent compression.

D. Seal other joints and penetrations of vapor barrier facing with 3 inch wide pressure sensitive aluminum foil or FSK tape and vapor barrier coating. Seal cuts and tears with strips of aluminum foil or FSK tape and apply vapor barrier coating.

E. Rectangular transfer ducts will be fabricated with 1 layer of soundlining as specified in Section 233100.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes training the Owner’s personnel in operation, maintenance, and management of fire suppression, plumbing, and HVAC systems.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 SCOPE OF WORK

A. HVAC systems training shall be field sessions to introduce operation, maintenance and management personnel to Operations and Maintenance Manuals, drawings, and other documents and aids available to operate and maintain equipment. Training shall occur following installation of HVAC work and prior to final acceptance. Commence instruction periods with approved Operations and Maintenance Manuals.

B. Conduct extensive hands-on training during HVAC systems preliminary commissioning so that actual operations and maintenance of equipment and systems could be the responsibility of operation, maintenance and management personnel at completion of preliminary commissioning if the Owner so chooses. Conduct instructions in appropriate sessions. Comply with total minimum hours specified in individual specification sections.

1.3 TRAINING TIME ALLOWANCE

A. General: Include in Bid total hours listed below for each section. Refer to specific section for additional training requirements.
   1. DIVISION 23:
      a. SECTION 230800 MECHANICAL SYSTEMS COMMISSIONING: Total of 2 hours.
      b. SECTION 230900 AUTOMATIC TEMPERATURE CONTROLS: Total of 2 hours.
      c. SECTION 232113 HYDRONIC PIPING SYSTEMS: Total of 0.5 hours.
      d. SECTION 232120 HYDRONIC VALVES: Total of 0.5 hours.
      e. SECTION 233100 AIR DISTRIBUTION: Total of 1 hour.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 HVAC SYSTEMS TRAINING

A. General: Operator training shall provide a complete overview of equipment, components, and systems with an emphasis on:
   1. Documentation in the preliminary Operations and Maintenance Manuals.
   2. How to use the Operations and Maintenance Manuals.
   3. System operational procedures for all modes of operation.
   4. Acceptable tolerances for system adjustments in operating modes.
   5. Hazards and safety.
   6. Automatic temperature control sequences of operation.
7. Review of maintenance and operations in relation to written applicable warranties, agreements to maintain and service and similar continuing commitments.

8. Seasonal de-commission and re-commission.

B. Schedule: Submit training schedule and agenda to the A/E and the Owner for approval 4 weeks prior to first training session.

C. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain equipment, systems, and subsystems. Furnish educational materials and tools needed to conduct training sessions.

D. Typical Agenda as Follows:
   1. Opening remarks.
   2. Introduction.
   3. Description of HVAC Systems:
      a. Air Side:
         1) Cooling.
         2) Heating.
         3) Ventilation.
      b. Wet Side:
         1) Heating.
   4. Description of HVAC Equipment and Systems (Individual Suppliers Shall Discuss Equipment):
      a. Wet Side:
         1) Hydronic:
            a) Piping and valves.
            b) Controls.
         2) Insulation.
      b. Air Side:
         1) Air Handling Units and Fans:
            a) Fans.
            b) Dual duct boxes.
            c) Controls.
            d) Insulation.
   5. Walk-through of building (project).
   6. Operation Procedure:
      a. Occupancy considerations.
      b. Seasonal considerations (changeover).
   7. Maintenance of Fire Suppression and HVAC Systems:
      a. Routine.
      b. Preventive.
      c. Service.
      d. Lubrication.
      e. Overhaul.
      f. Factory.
      g. Cleaning.
      h. Access provisions.
   8. Warranties:
      a. What they cover.
      b. How to use them.
   9. Spare Parts.
10. Tools:
   a. Normal tools, supplies and equipment.
   b. Special tools.

11. Hands-on operation of HVAC system equipment in conjunction with preliminary commissioning.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes preparation of mechanical systems Operations and Maintenance Manuals.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 SCOPE OF WORK

A. General:
   1. Comply with requirements in Division 01 with additional requirements indicated in this article. Provide total of 1 electronic copy.

B. Product Data and Parts List: Include local source of supply for parts and replacement. List parts and components of equipment stating catalog number (serial number and ratings, such as HP, voltage, and GPM.) and size of part used in or on equipment. Include information pertinent to specific project and annotate each page to clearly identify specific product or part installed and identify data applicable to installation. Delete references to inapplicable information.

C. Master Preventive Maintenance Schedule and Procedures: Include safety precautions and safety features.

D. For Equipment and Components:
   1. Troubleshooting Guide: Include equipment functions, operating characteristics, and limiting conditions.
   2. Manufacturer’s Installation Instructions: Include assembly, installation, wiring diagrams, alignment, adjustment, and checking instructions.
   3. Manufacturer’s Service Instructions. Include suggested frequency of maintenance and list of lubricants.
   4. Start-up Instructions with Certificates of Start-up and Verification: Include test data and performance curves, routine and normal operation, regulation and control, shutdown and emergency conditions.
   5. Final approved submittals.

E. Warranties: Copy of each warranty, guarantee, bond, and maintenance/service contract issued. Include information for the Owner’s personnel indicating proper procedures in event of failure and instances which might affect validity of warranties. State warranty start date and duration of components.

F. Final testing, adjusting, and balancing reports.

G. Belts: Include sizes, quantities, and locations.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.
B. Submit preliminary copy of the Operations and Maintenance Manual in 1 package. Incomplete, “piece-meal” submittals not acceptable and will be returned unreviewed.

C. Submit completed preliminary copy of Operations and Maintenance Manuals to the A/E for review and approval. Submit approved Operations and Maintenance Manuals to the Owner minimum 60 days before instruction periods as specified in Section 230810. Commence with review comments and corrective measures identified during these procedures being incorporated. Following instruction periods, incorporate corrective measures and submit final Operations and Maintenance Manuals.

D. Final Operations and Maintenance Manuals in both hard and electronic formats.

1.4 TABLE OF CONTENTS

A. Warranty

B. Preventative Maintenance Schedule

C. Belt List

D. Final TAB Report

E. DIVISION 21 - Fire Suppression:
   1. Grooved piping and couplings.
   2. Valves.

F. DIVISION 23 - HVAC:
   1. Valves.
   2. Temperature Controls:
      a. Thermostats.
      b. Dual duct controls components.
      c. Sequences of operation with final setpoints.
      d. Control valves.
      e. Actuators.
      f. Floor plans of building with locations of controllers, actuators, sensors and transformers.

PART 2 - PRODUCTS

2.1 FORMAT

A. Submit preliminary electronic copy of the Operations and Maintenance Manual to the A/E for review and approval.

B. Submit final Operations and Maintenance Manual to the A/E and the Owner electronic format.
   1. Electronic Copy: Assemble Operations and Maintenance Manual in one single Adobe PDF with bookmarks for each division, specification number, and part number.

C. Include overall table of contents of items submitted organized by system (not by specification section).

D. Include names, addresses and phone numbers of equipment suppliers.
E. Include Record Drawings.

PART 3 - EXECUTION

Not used.

END OF SECTION
PART 1 - GENERAL

1.1 SYSTEM OF PNEUMATIC CONTROLS

A. Provide pneumatic controls to achieve the performance specified in the following clauses and sequence of operations described on the drawings.

B. Acceptable Manufacturers:
   1. Siemens, Johnson Controls, Alerton.

C. The control system shall be installed by the control manufacturer using personnel directly and regularly employed by the manufacturer. The system may be installed by the control manufacturer's authorized representative provided the complete installation has the control manufacturer's back-up of engineering capabilities and warranty. The various system components shall be the product of a single manufacturer.

D. Shop drawings shall include single line pneumatic control diagram to enable easy visual comprehension. With each diagram provide details of all component parts in order that each function is clearly displayed. Submit a written description indicating sequence of operation.

E. The control contractor shall provide technical instruction to operating personnel as necessary and shall also provide assistance during balancing operation to make sure all systems are in proper operating condition.

F. Participate in system commissioning, start-up, balancing, and in training for Owner. Operate controls through full sequence of operation and through any other tests to be conducted in accordance with the FPT requirements to be set by the Commissioning Agent.

1.2 CALIBRATION

A. Set control points immediately after installing new controls.

B. Set up and calibrate the existing as well as new controls during initial start-up of the systems and check, recalibrate and readjust as necessary during the Owner's Demonstration and Instruction Period.

PART 2 - PRODUCTS

2.1 CONTROL AIR SUPPLY

A. Modify and/or extend the existing control air copper piping from its nearest source in the ceiling to suit the specified controls requirements.

2.2 CONTROL AIR TUBING

A. Scope:
   1. Hard drawn copper tubing shall be used on all pneumatic control lines (except as noted in item 2 below). Tubing shall be supported every four feet (4’) maximum from the adjoining structure. Tubing shall not be secured to duct work, plenums or to any piping.
   2. Plastic polyethylene type "FR” tubing may be substituted for hard drawn copper for up to a maximum distance within 12 inches from sensors, actuators or controllers that have factory-installed barb fittings.
B. Minimum Requirements:
   1. Copper tubing:
   2. shall be hard drawn, seamless type
   3. Polyethylene tubing and polyethylene jacketed tubing bundles:
      a. maximum operating pressure: 80 psig at 140 degrees Fahrenheit
      b. ambient operating temperature range: -100 degrees Fahrenheit to +175 degrees Fahrenheit
      c. number coded tubing in polyethylene jacketed tubing bundles
   4. "FR" stamped along entire length of tubing
   5. Tubing shall be sized so that the total system pressure drop due to air flow does not exceed 2 psi

C. Notes:
   1. Conceal tubing wherever possible, run parallel to building lines wherever exposed.

2.3 ROOM THERMOSTAT

A. Minimum Requirements:
   1. Adjustable sensitivity and set point (single temperature).
   2. Pneumatic: new thermostats and controllers shall be compatible with the existing pneumatic controls system.
   3. Provide non-aspirating thermostats with standard brushed chrome metal cover
   4. Concealed thermometers and set-point adjustment (or removable key adjustment)
   5. To be initially set to provide heating when room temperature drops below 70°F and cooling when room temperature exceeds 75°F.

B. Notes:
   1. Mount pneumatic instruments on standard wall mounting box or pipe head rough-in fittings which shall be fastened to structure.
   2. Install instruments at a height of five feet above the finished floor unless otherwise indicated.
   3. Locate instruments in the same vertical centerline as light switches when at same location.

2.4 CONTROL VALVES, HYDRONIC MODULATING, TERMINAL EQUIPMENT

A. Application: Heating water fin-tube convectors. Flow rate 2 gpm and less.

B. Configuration: Ball valve, two way.

C. Characteristics: Equal percentage.

D. Sizing: Size for pressure drop of 4 psig at design flow rate. Actual pressure drop at design flow rate not less than 75 percent nor greater than 125 percent of specified pressure drop. Size valve taking into consideration both pressure drop of valve and added pressure drop incurred when reducing down from line the size to control valve size (adjustment of Cv for piping geometry factor, Fp.). Valve size no more than 2 sizes smaller than line size.

E. Standards: ASME B16.5.

F. Working Pressure Rating: 600 psig WOG, cold, non-shock.

G. Shut-off Pressure Rating: 50 psig differential pressure across valve.
H. Temperature Rating: Minimum continuous operating temperature of 250 F.
I. Leakage Rating: 0.01 percent of design flow rate at specified pressure drop.
J. Body, 2 inch and Smaller: Bronze body, two piece construction, threaded ends.
K. Trim: Stainless steel ball and stem, reinforced TFE seats, and high performance graphite impregnated stem seals. Standard RTFE stem seals not acceptable.
L. Stem Design: Blow-out proof, stem packing gland adjustable to compensate for wear.
M. Testing: Each valve tested with air under water at each end of travel by manufacturer.
N. Actuator Brackets: Metallic, designed to minimize heat transfer from valve to actuator.
O. Manufacturers: Belimo Aircontrols (USA), Inc., Dodge Engineering & Controls Inc., Bray Controls, or approved.

2.5 PNEUMATIC ACTUATORS FOR PNEUMATIC CONTROL VALVES

A. Description: Direct drive (direct shaft mounted) pneumatic actuators for valve control applications.
B. Positive means of preventing slippage of actuated device shaft.
C. When operated at rated pressure, capable of delivering torque required for continuous uniform movement of valve.
D. Proper function with range of 85 to 110 percent of control pressure.
E. Fiber or reinforced nylon gears may be used for torques less than 16 inch pounds.
F. Mechanical spring return for heating water control valves. Other applications as indicated on the Drawings.
G. Proportioning operators capable of stopping at points in cycle and starting in either direction from any point.
H. Normally open to result in valve position under failure of control pressure to device.
I. Manufacturers: Belimo Aircontrols (USA), Inc., Dodge Engineering & Controls Inc., Bray Controls, or approved.

2.6 DAMPER ACTUATORS FOR DUAL-DUCT CONSTANT VOLUME AIR TERMINAL BOXES

A. Field verify existing conditions. Provide new pneumatic damper actuators and volume regulators for the existing dual-duct constant volume air-terminals.
PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATIONS

A. Refer to the controls Sequence of Operations described on the drawings.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes natural gas piping and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Indoor gas piping.
   2. Gas cocks.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish products of sizes, ratings, and characteristics indicated which comply with manufacturer’s standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation. Furnish materials and products complying with ASME B31.2 where applicable with pressure rating on natural gas piping system selected for maximum design pressures.

2.2 INDOOR NATURAL GAS PIPING

A. Pipe and Fittings:
   1. Pipe: Black steel, Schedule 40, standard weight, ASTM A 53, Grade A or B, or ASTM A 106, Grade A, B, or C.
   2. Fittings: 150 pound WSP black malleable iron, screwed for pipe sizes 2-1/2 inch and smaller where acceptable to the AHJ, otherwise forged steel socket weld joints. Butt welded joints for 3 inch and larger low pressure and all sizes of medium and high pressure.
2.3 VALVES

A. Gas Cocks 2-1/2 Inch and Smaller: 175 psig non-shock WOG, bronze straightway, flat or square head, threaded ends. Include handle. Nordstrom No. 142, NIBCO, or approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to Owner.

3.4 INDOOR PIPING INSTALLATION

A. Comply with requirements in NFPA 54 for installation and purging of natural gas piping.

B. Install pipe supports in accordance with MSS SP-69 and this section, whichever is more stringent.

C. Remove cutting burrs before assembling piping.

D. Use sealants which are chemically resistant to natural gas on metal gas piping threads. Use sealants sparingly and apply to only male threads of metal joints.

E. Install gas valves at demolition terminations. Locate to be accessible and protected from possible injury.

3.5 FLUSHING OF NATURAL GAS PIPING

A. After completion of natural gas piping installation and prior to pressure testing, flush interior surfaces by injecting dry nitrogen or carbon dioxide into open ends of piping just prior to making final connections to equipment and utility services. Extend and terminate discharge piping directly outdoors.
3.6 PRESSURE TESTING

A. Test natural gas piping in accordance with ASME B31.2, and local utility requirements and this section.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes HVAC hydronic piping and associated appurtenances for heating water systems.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASME B16.11, Forged Fittings, Socket-Welding and Threaded.
   2. ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   3. ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
  11. CAN/ULC 102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for each type of piping, fittings, and associated appurtenances for the following.
   1. Copper tubing including solder and flux
   2. Pressure independent flow control valves.
   4. Piping specialties.

C. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operations and Maintenance Manual.
1.4 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 230548 - Vibration Isolation: Flexible connectors.

B. Section 230900 - Automatic Temperature Controls: Control valves and actuators and similar components.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish products of sizes, ratings, and characteristics indicated which comply with manufacturer's standard materials, design, and construction in accordance with published product information. Furnish quantity of piping and appurtenances required for complete installation.

B. Pressure Ratings: Provide components with minimum pressure rating of 125 psig working pressure.

2.2 MANUFACTURERS

A. Copper Tubing: Cerroflow, Mueller Industries, Wolverine Tube, Inc., Cambridge-Lee Industries LLC.

B. Copper Tube Fittings: NIBCO®, Mueller Industries, Elkhart Products Corporation.

2.3 COPPER TUBING

A. Tubing, Above Ground: Type L copper water tube, hard-drawn, ASTM B 88.


D. Solder Material: 95 percent tin, 5 percent antimony solder or 96 percent tin 4 percent silver conforming to ASTM B 372 and NFS 61. Lead free (not more than 0.25 percent lead). Flux water soluble conforming to ASTM B 813. J.W. Harris "Bridgit", RectorSeal, Oatey SCS, Superior Flux & Mfg. Co., Worthington Industries, BerzOmatic, or approved.

2.4 PRESSURE INDEPENDENT FLOW CONTROL VALVES

A. Description: Pressure independent with electronic dynamic modulating 2-way control valve. Maximum flow setting adjustable to 55 different settings within range of valve size by changing actuator programming.

B. Control Valve Actuator: Driven by 24 VDC motor by 2 to 10 VDC, 4 to 20 mA, 3 point floating, or pulse width modulation electric signal. Actuator to include 4 to 20 mA or 2 to 10 VDC feedback signal to DDC system. Actuator to include external LED readout of valve position and maximum valve position setting. Actuator furnished by control subcontractor as specified in Section 230900 for installation at factory by pressure independent flow control valve manufacturer.
C. Control Valve Housing: Ductile iron per ASTM A 536, Class 60-45-18 rated no less than 580 psig static pressure at 478 F.

D. Flow Regulation Unit: Type 304 stainless steel and hydrogenated acrylonitrile butadiene rubber or Type 316 stainless steel and EDPM depending on valve size. Include 2 temperature/pressure test ports as specified in Section 232116.

E. Tags: Include indelibly marked metal tag with Cv, model number, and location.

F. Manufacturers: Griswold® Controls Model MPV®, Belimo, Danfoss, Nexus Valve, or approved.

2.5 MANUAL AIR VENTS

A. Description: Needle valve, 1/2 inch, with 2 feet of soft drawn copper tubing.

2.6 PIPING SPECIALTIES

A. Pipe Sleeves: Comply with requirements in Section 230510.

B. Section Pipe Hangers and Supports: Comply with requirements in Section 232116.

C. Pipe Escutcheons: Comply with requirements in Section 232116.

D. Valves: Comply with requirements in Section 232120.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to Owner.
3.4 PIPING INSTALLATION

A. General:
   1. Install piping, fittings, and appurtenances in accordance with recognized industry practices which will achieve permanently leakproof piping systems and capable of performing each indicated service without piping failure.
   2. Install each run with minimum joints and couplings, but with adequate and accessible unions or flanges for disassembly and maintenance replacement of valves and equipment.
   3. Reduce sizes (where indicated) by use of reducing fittings. Bushings not acceptable.

B. Align piping accurately at connections, with 1/16 inch misalignment tolerance.

C. Minimum 1/2 inch pipe size.

D. Install pipe generally sloped to permit drainage at low points, free from sags, bends, and traps, and in a manner to conserve space for other work. Refer to other sections for specific installation requirements.

E. Location of Piping:
   1. Piping plans, sections, details, and diagrams are diagrammatic indicating general arrangement of piping installation. Locate piping and include offsets to avoid interference with building structural members, equipment, building openings, light fixtures, ductwork, electrical work, and other obstructions.
   2. Arrange piping to allow access for operation, service, disconnection, and removal and replacement of valves, fixtures, and equipment.
   3. In general, maintain maximum possible headroom in ways of egress, including pedestrian walkways and maintenance aisles, minimum headroom of 6’-8” from floor to bottom of any component.
   4. Within buildings, conceal piping in walls and chases and above ceilings except where indicated in the Contract Documents to remain exposed. Do not cover or enclose work until completely inspected and approved. Should Work be covered or enclosed prior to inspections and approvals, uncover work as directed by the A/E. After the Work has been inspected and approved, make repairs and replacements with materials as necessary to obtain approval of the A/E at no additional cost to the Owner.
   5. Route piping parallel to column lines and perpendicular to floor unless indicated otherwise.

F. Install fittings for changes in direction and branch connections.

G. Install piping to allow application of insulation.

H. Clean interior of piping before making joints and placing in position by blowing clean with steam or compressed air. Maintain cleanliness of piping throughout installation. Install caps or plugs on open ends of cleaned piping.

I. Install isolation valves specified in Section 221120 and drain existing piping to accommodate installation of new Work.

J. Install pipe supports in accordance with MSS SP-58 and Section 232116, whichever is more stringent.
K. Control Components: Install control valves and similar components furnished under Section 230900.

L. Air Vents:

M. Valves: Install at branch connections.

3.5 SOLDERED JOINTS

A. Comply with applicable provisions of ASTM B 828 or “Copper Tube Handbook” by CDA for soldered joints.

B. Cut ends square and remove fins and burrs. Replace dents and damaged tubing with new tubing.

C. Remove grease and oil from joints by wiping with clean cloth saturated with suitable chemical solvent. Clean with emery cloth.

D. After cleaning, apply non-corrosive flux, apply heat and material and hold joint rigidly until hardened.

E. Wipe excess material from exterior of joint before hardening.

F. Before soldering, remove stems and washers of valves.

3.6 CLEANING AND INSPECTING

A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any).

B. Inspect each run of each system for completion of joints, supports, and accessory items.

C. Inspect pressure piping in accordance with procedures of ASME B31.1 and ASME B31.9.

3.7 FLUSHING

A. Flush piping with clean water prior to connecting to existing systems and pressure testing.

B. Isolate equipment from piping during flushing. Provide bypass piping and remove after flushing is completed. Provide cap, plug, or blind flange at pipe connections.

C. Remove strainer screens during flushing except those protecting control equipment. Clean screens protecting control equipment during flushing and after flushing is completed. Coordinate with controls system subcontractor to have automatic control valves fully open during flushing.

D. Flush designated piping systems by circulating water through 100 mesh screen at 7-1/2 feet per second for 1 hour minimum.

E. Flush heating water piping.
F. Following initial flushing but before the systems are refilled, reinstall strainer screens, coordinate with chemical treatment specialist specified in Section 232500 and provide assistance with chemical cleaning and addition of chemical treatment to systems.

3.8 PRESSURE TESTING

A. Provide equipment and apparatus necessary for tests. Make tests in presence of the A/E. Notify the A/E at least 48 hours before expected tests.

B. Test piping systems after the lines have been cleaned, before insulation has been applied, and before backfilling.

C. Test Pressures and Duration: Test piping systems at pressure of 1-1/2 times design working pressure or at 100 psig, whichever is greater. Maintain test pressure for sufficient time to permit complete inspection of system under test. Minimum 2 hour duration. Test in sections and test entire system when completely installed.

D. Testing Media Requirements:
   1. Use clean, fresh city water for hydrostatic testing. Water temperature shall be not less than 60 F and not greater than 100 F.
   2. Drain water immediately after hydrostatic testing. Vent system while draining to avoid creating a vacuum.

E. Test Repairs:
   1. Remove materials such as gaskets and bolts damaged during tests and flushing and provide new components.
   2. Use new gaskets each time a flanged joint is made up.
   3. Repair defects which develop during testing and retest piping systems until they show no defect or weakness and are tight. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

F. Test Records: Make and submit records for each piping installation.

G. Include at a minimum, the following items:
   1. Date of test.
   2. Description and identification of piping tested.
   3. Test fluid.
   4. Test pressure.
   5. Test duration.
   6. Remarks to include such items as: Leaks (type, location); repairs made on leaks.
   7. Signature and date of person witnessing the test.
   8. Certification by the Contractor.

H. Systems Which Connect to Existing Piping: Isolate new piping system from existing system by the closest valve or valves to the existing system.

I. Test Procedure:
   1. Before tests, remove or valve off from the system gages, traps, pressure reducing valves, pumps, and other apparatus which may be damaged by test pressure.
   2. Install calibrated test pressure gage in system to observe any loss in pressure.
3. Test piping at metal temperature greater than 35 F.
4. Open vents, and other connections which can serve as vents, during filling so that air is vented prior to applying test pressure to system.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes pipe specialties that apply to multiple systems. Specialty components specific to single system are specified in that particular section.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASME B31.1, Power Piping.
   4. ASTM A 666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

C. Pipe hangers and clamps and related components installed in ceiling spaces used as a return air plenum shall have ratings per NFPA 255, ASTM E 84, and UL 723 with flame spread rating not greater than 25 and smoke developed rating not greater than 50.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for the following. Include MSS reference in product data for pipe hangers and supports.
   1. Pipe hangers and supports.
   2. Insulated pipe hangers.
   3. Y-type strainers.
   4. Temperature/pressure test ports.
   5. Pipe escutcheons.
PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish factory-fabricated piping specialties recommended by manufacturers for use in services indicated. Furnish piping specialties of types and pressure ratings indicated but rated at not less than 125 psig. WSP to comply with installation requirements. Furnish sizes as indicated with connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Contractor's option. Refer to other sections for higher working steam pressures.

B. Except as otherwise indicated, furnish factory-fabricated pipe hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected to suit piping systems, in accordance with MSS SP-58 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit around piping insulation with saddle and shield for insulated piping and where insulated pipe hangers are used.

C. Materials: Match piping material at point of contact with piping:
   1. Carbon steel, cast or malleable iron for black steel pipe.
   2. Carbon steel, cast or malleable iron with epoxy coating galvanized steel pipe and zinc coating for piping installed outdoors.
   3. Carbon steel or malleable iron with copper finish or plastic coated, or copper for copper pipe.

2.2 PIPE HANGERS AND SUPPORTS

A. Horizontal Piping:
   1. Adjustable Steel Clevises: MSS SP-58 Type 1.
   2. Yoke Type Pipe Clamps: MSS SP-58 Type 2.
   5. Split Pipe Rings: MSS SP-58 Type 11.
   6. Trapeze Hanger: MSS SP-58 Type 59, shop or field fabricated made from structural-steel shapes with hanger rods, nuts, saddles, and U-bolts. Comply with requirements in Section 200510 for formed steel channels.

B. Hanger Rods: Hot rolled steel, ASTM A 36. Refer to Article “Hanger Rod Schedule” in this section.

C. Vertical Pipes at Walls and Columns: Supporting pipes from walls and columns not acceptable.

D. Riser Clamp for Vertical Pipes between Floors: MSS SP-58 Type 8 and Type 42.

E. Hanger Rod Attachments:
   2. Steel Clevises: MSS SP-58 Type 14.

F. Building Attachments:
   1. Steel or Malleable Concrete Inserts: MSS SP-58 Type 18 or UL listed.
G. Cushion Clamp for Un-Insulated Pipes:
   1. Description: Steel clamp assembly with cushion insert for use with formed steel channels. Clamp with electro-galvanized finish. Cushion insert manufactured from thermoplastic elastomer for temperature range from 50 F to 300 F. Unistrut Cush-A-Clamp or approved.


2.3 INSULATED PIPE HANGERS

A. Description: Hydrous calcium silicate or polyisocyanurate foam (urethane) insulation which covers 100 percent of the pipe and extends beyond overlapping full wrap galvanized steel or PVC jacket. Thickness of insulation same as specified in Section 230700 for specific pipe systems.

B. Manufacturers: KB Enterprises SNAPP ITZ for both hot and cold pipe applications or approved.

2.4 Y-TYPE STRainers

A. Description: Line size of connecting piping with ends matching piping system materials. Select strainers for minimum 125 psi working pressure. Include ASTM A 666 Type 304 stainless steel screens, unless specified otherwise, with 3/64 inch perforations at 233 per sq. in. and blowout connection with ball valve and capped nipple or gate valve with plug.
   1. Solder Ends, 2 Inch and Smaller for Copper Pipe: Cast bronze body with brass screen.

2.5 TEMPERATURE/PRESSURE TEST PORTS (PETE’S PLUGS)

A. Description: Brass, 1/4 inch NPT with extension for insulated piping, length to suit insulation thickness.


2.6 PIPE ESCUTCHEONS

A. Description: Select with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated, and to completely cover pipe penetration hole in floors, walls or ceilings including pipe sleeve extension. Nickel or chrome finish for occupied areas and prime paint finish for unoccupied areas.
   1. Pipe Escutcheons for Dry Areas: Sheet steel escutcheons, solid or split hinged.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.
3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 PIPE HANGERS AND SUPPORTS

A. General: Install building attachments at required locations for piping support. Install additional supports at concentrated loads, including valves, strainers, and at changes in direction of piping. Install insulated pipe hangers for insulated hot pipes 2 inch and larger and for all sizes of insulated cold pipes specified in Section 230700.

B. Install hangers, supports, clamps, attachments and support systems to support piping securely from building structure. Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible, MSS SP-58 Type 59. Where piping of various sizes are supported by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Use of wire, perforated metal or scrap framing materials to support piping not acceptable.

C. Install hangers and supports complete with necessary insert, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

D. Spacing of Hangers and Supports:
   1. Maximum spacing between supports for straight runs of piping listed in Article “Spacing of Hanger and Supports Schedule” in this section.

E. Pipe Ring Diameter:
   1. Uninsulated Pipes: Ring diameter to suit pipe size.
   2. Insulated Pipes: Ring diameter to suit outer diameter of insulated pipe hanger.

F. Supporting Piping:
   1. Fabricate hangers used for support of 2 inch nominal pipe size and larger to permit adequate adjustment after erection while still supporting the load.
   2. Use wall brackets where pipes are adjacent to walls or other vertical surfaces which may be used for supports.
   3. Fabricate supports to carry weight of piping and fluid and to maintain proper alignment.
   5. Install hangers and supports for indicated pipe slope, and so that maximum pipe deflections allowed by ASME B31.1 are not exceeded.
   6. Hang individual pipes and multiple pipes by trapeze hangers separately from roof structure and not from the roof deck itself and not from work of other trades. Hanging pipes from ducts and equipment not acceptable.
7. Install formed steel channel as specified in Section 230510 where required for pipe hangers and supports.
8. Install supports for horizontal pipe within 1-1/2 inch of each elbow.

3.5 PIPE HANGER AND SUPPORT APPLICATIONS

A. Horizontal Piping: Unless otherwise indicated, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS SP-58 Type 1): For suspension of noninsulated or insulated stationary pipes.
   2. Yoke Type Pipe Clamps (MSS SP-58 Type 2): For suspension of 120 F to 450 F pipes, 4 to 16 inch sizes, requiring up to 4 inch of insulation.
   3. Steel Pipe Clamps (MSS SP-58 Type 4): For suspension of cold and hot pipes, 1/2 to 24 inch sizes, if little or no insulation is required.
   4. Adjustable Band Hangers (MSS SP-58 Type 9): For suspension of noninsulated stationary pipes, 1/2 to 8 inch sizes.

B. Vertical-Piping Clamps: Unless otherwise indicated, install the following types:
   1. Extension Pipe or Riser Clamps (MSS SP-58 Type 8): For support of pipe risers, 3/4 to 20 inch sizes.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS SP-58 Type 42): For support of pipe risers, 3/4 to NPS 20 inch sizes, if longer ends are required for riser clamps.

C. Hanger-Rod Attachments: Unless otherwise indicated, install the following types:
   1. Steel Turnbuckles (MSS SP-58 Type 13): For adjustment up to 6 inch for heavy loads.
   2. Steel Clevises (MSS SP-58 Type 14): For 120 F to 450 F piping installations.

D. Building Attachments: Unless otherwise indicated, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS SP-58 Type 18 or UL listed): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS SP-58 Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS SP-58 Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. C-Clamps (MSS SP-58 Type 23): For structural shapes.

3.6 LOW PRESSURE Y-TYPE STRainers

A. Install strainers full size of pipelines, in pipe ahead of the following items and equipment, and elsewhere as indicated, if integral strainer is not included:
   1. Control valves.

3.7 TEMPERATURE/PRESSURE TEST PORTS (PETE'S PLUGS)

A. Installation: Install so that thermometer dial and pressure gage can be inserted and easily readable by personnel from normal standing position on floor or grating. Where installed in insulated pipes, install with coupling to extend test port through insulation and jacket.

B. Tag: 1-1/2 inch round tag, 19 gage brass with 1/4 inch letters, labeled “TEST TAP”. Attach with brass chain.
3.8 PIPE ESCUTCHEONS

A. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings. Escutcheons not required where sleeves project above floor.

3.9 HANGER ROD SCHEDULE

<table>
<thead>
<tr>
<th>ROD DIAMETER (INCH)</th>
<th>PIPE SIZE (INCH)</th>
<th>LOAD AT 650 F (POUNDS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8</td>
<td>2 and smaller</td>
<td>730</td>
</tr>
<tr>
<td>1/2</td>
<td>2-1/2 and 3-1/2</td>
<td>1,350</td>
</tr>
</tbody>
</table>

3.10 SPACING OF HANGERS AND SUPPORTS SCHEDULE

<table>
<thead>
<tr>
<th>PIPE SIZE (INCH)</th>
<th>STEEL AND IRON PIPE MAXIMUM SPAN (FEET)</th>
<th>COPPER TUBING MAXIMUM SPAN (FEET)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WATER SERVICES</td>
<td>STEAM, GAS, AND AIR SERVICES</td>
</tr>
<tr>
<td>1/2 and smaller</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>3/4</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>1-1/4</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>1-1/2</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes valves and associated appurtenances for hydronic systems. Valves specific to single system are specified in that particular section.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. ASME B31.1, Power Piping.
   4. ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Ball valves.
   2. Balancing valves.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish factory-fabricated valves recommended by manufacturer for use in service indicated. Furnish valves of types and pressure ratings indicated but rated at not less than 125 psig WSP to comply with installation requirements. Furnish sizes as indicated with connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Contractor’s option. Refer to other sections for higher working steam pressures.


2.2 BALL VALVES

A. General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material. Comply with MSS SP-110.
B. Bronze body, 600 pound, chrome plated ball and stem, full port, screwed or solder joint ends, 2 piece construction, lever handle, Teflon seat and seal, memory stop, ASTM B 61, ASTM B 62, or ASTM B 584. Include extended stem, protective sleeve, and fully adjustable memory stop after insulation is applied where valves are insulated.

2.3 BALANCING VALVES

A. Description: Valves for precise flow measurement and balancing with minimum of one 360 degree turn of handwheel. Positive shutoff.

B. Construction: Globe style design, non-ferrous metal parts, Teflon disc ring, meter connections for portable differential pressure meter with integral shutoff valves, calibrated handwheel with adjustment scale, locking memory stop.

C. Sizing: Size smaller than line size to result in minimum 1 foot pressure drop at design flow as close to line size as possible.

D. Manufacturers: Armstrong Fluid Technology CBV-T, -G, or -A, Victaulic Co., or Amtrol, Bell & Gossett, or NIBCO. Other manufacturers not acceptable.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 INSTALLATION

A. Install valves where required for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping. Locate valves to be accessible. Install gate valves 6 inch and larger with separate support so that valve weight is not imposed on adjacent piping.

B. Valve Stem Position:
   1. Ball Valves: Install horizontal or above.

C. Check Valves:
   1. Swing type check valves installed in vertical pipes not acceptable.
   2. Install non-slam type check valves in pump discharge pipes and in vertical pipes.
D. Install isolation valves where indicated on the Drawings and in the following locations:
   1. Branch lines.

E. Install balancing valves with reducers upstream and downstream of valve connections. Install valves with straight pipe upstream and downstream as required by manufacturer's installation instructions.

3.5 HVAC SYSTEMS TRAINING

A. Comply with requirements in Section 230810.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes sheet metal work and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:

2. ASTM A 653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
18. NAIMA Duct Liner Installation Standards.
22. SMACNA HVAC Duct Construction Standards, Metal and Flexible (SMACNA).
23. SMACNA Rectangular Industrial Construction Standards, (SMACNA Rectangular).
25. UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
26. UL 181B, Standard for Closure System for Use with Flexible Air Ducts and Air Connectors.
27. UL 723, Standard for Test for Surface Burning Characteristics of Building Materials.
28. UL 1381, Outline of Investigation for Aerosol Duct Sealant.

C. Duct Cleanliness Requirements:
1. Prevent damage to ducts during transportation and off-loading. Deliver only when ducts can be stored under permanent cover. Plastic tarp covering of ducts on jobsite not acceptable.
2. Keep site storage areas clean and dry with minimal exposure to dust.
3. Keep working area clean and dry and protected from weather elements.
4. Prior to installation of individual duct sections, inspect to ensure they are free from debris and wipe internal metal surfaces.
5. Cover duct risers to prevent entry of debris.
6. Cover open ends of ducts and downward facing and horizontal duct openings.
7. If, in the opinion of the A/E, ducts and fittings are not kept clean or completely dry, replace ducts and fittings or clean interior of affected ducts and fittings to satisfaction of the A/E at no additional cost to the Owner.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Sheet metal work, general.
   2. Flexible ducts.
   3. Duct soundlining, non-fiberglass.
   4. Fasteners.
   5. Hangers for sheet metal work.

C. Test Reports:
   1. Test apparatus calibration certificate for duct leakage testing.
   2. Pressure testing for leakage.
   3. Submit completed copy of reports and include copy in the Operations and Maintenance Manual.

PART 2 - PRODUCTS

2.1 SHEET METAL WORK, GENERAL

A. Duct Construction:
   1. Comply with SMACNA. Standing seams not acceptable for exposed ducts.
   2. Galvanized steel in general with G-90 zinc coating, ASTM A 653, minimum 26 gage.
   3. Galvanized steel prepped or ducts finished with Paint Grip for field painting where exposed in finished spaces as scheduled in Division 09.

B. Pressure Classifications:
   1. Ducts downstream of Dual Duct Terminal Units: 2 inch w.g.
2. Exhaust Ducts: Plus 2 inch downstream of fans and minus 2 inch w.g. upstream of fans for fan design static pressure scheduled on the Drawings at 1.0 inch w.g. and above.

3. Transfer Ducts: 0.5 inch w.g.

C. Round and Flat Oval Ducts: Spiral seam with beaded sleeve at transverse joints for round ducts less than 34 inch diameter and flat oval ducts with minor dimension less than 24 inch and major dimension less than 42 inch.

D. Fittings:
1. Comply with SMACNA as follows:
   a. Round and Flat Oval Elbows: 5 piece segmented or stamped for 2 inch w.g. ducts. Adjustable elbows not acceptable.
   b. Rectangular Elbows: Full radius (R/W=1.5) where minimum 5 duct widths is available downstream of elbow fitting prior to branch take off. If straight length not available, use square throat elbow with turning vanes.
   c. Round and Flat Oval Tees and Laterals: Conical fitting or tap per SMACNA Figure 3-6, 90 degree tee with oval to round tap, 45 degree lateral fitting, tap, or saddle tap, or 45 degree rectangular lead-in per SMACNA Figure 3-5. 90 degree tee not acceptable. Saddle tap connections for exposed ducts in finished spaces not acceptable.
   d. Rectangular Laterals: 45 degree entry fittings per SMACNA Figure 4-6.
   e. Offsets: Full radius (R/D=1.5 for round and flat oval and R/W=1.5 for rectangular) where space allows. Mitered offset (Type 2) with 30 degree maximum offset angle per SMACNA Figure 4-7. Angle offset (Type 1) not acceptable.


E. Turning Vanes:
1. Description: Airfoil design, smoothly-rounded entry nose, extended trailing edge, continuous internal tubes for stiffening and rigidity of section, adaptable to duct sizes. Maximum generated sound power level 54 decibels in octave band 4 at 2000 fpm velocity in 24 inch by 24 inch duct size.

2. Assembly Fabrication: Side rails by same manufacturer as turning vanes. Vanes installed on 2.4 inch centers across full diagonal dimension of elbow per SMACNA Figure 4-3. Rail systems with non-standard tab spacing not acceptable.

3. At Contractor’s option, double wall turning vanes fabricated from same material as adjacent duct acceptable. Include mounting rails with friction insert tabs that align vanes automatically.

F. Acoustical Turning Vanes:
1. Double wall, perforated, glass fiber fill, polyester liner.

2. Manufacturer: Ductmate Industries Inc. or approved.

G. Soundlined Ducts: Fabricate with duct soundlining such that no gap will result between sections of duct lining after assembly of duct sections. Fabrication and installation shall result in adjacent soundlining sections butted together without gaps, bulges, or other discontinuities.
H. Duct Sealant, Traditional Method (Contractor Option)
   1. Indoor Locations: UL 181 listed and labeled. Low odor, non-toxic vapors, surface burning characteristics for maximum flame spread of 25 and maximum smoke developed of 50 when in a dry state. Rated for air temperature range of minus 20 F to plus 150 F. Rated to 10 inch w.g., minimum 65 percent solid content. Foster® 32-19™ Duct-Fas, Childers CP-146 Chil-Flex™, McGill AirSeal LLC, United Duct Sealer™ (Water Based), Biddle Aqua-Crylic HVAC, Hardcast Iron-Grip 601, Design Polymeric DP1010, Ductmate Industries Inc. PROsealEZ or EZseal™, or approved.

I. Aerosol-Based Sealing Method (Contractor Option): Application performed by manufacturer trained and approved service provider. Sealant cured within 2 hours of application with no VOC off-gassing and remain elastic, UL 1381 listed. Mastic and fiberglass mesh tape used for repairing leaks UL 181 listed and labeled. Aerosel, LLC, or approved.

2.2 FLEXIBLE DUCTS

A. Description: Factory-insulated with low permeability vapor barrier jacket constructed of reinforced metalized laminate film, suitable for medium and low pressure applications, 1 inch thick fiber glass insulation, coated steel spring helix reinforcement bonded to chlorinated polyethylene liner.
   1. Ratings: UL 181 listed and labeled as a Class 1 flexible duct with maximum flame spread rating 25, maximum smoke-developed rating 50.
   2. Length: Assemblies in 5 foot length with galvanized male and female fittings attached to liner and vapor barrier jacket acceptable.

B. Manufacturers: Thermaflexflex MK-E, Wiremold 57K, Flexmaster U.S.A.® 8m, or approved.

2.3 DUCT SOUNDLINING, NON-FIBERGLASS

A. Description: Non-fiberglass acoustical and thermal insulation, 1 inch thick unless noted otherwise on the Drawings.

B. Standards and Ratings: ASTM C 1534, NFPA 90A, and NFPA 90B, and UL 181 for preformed duct coverings and linings. K-value 0.25 Btu/hr/sq ft/F at 75 F mean temperature per ASTM C 177 or ASTM C 518.

C. Composition:
   1. Fiber-free, formaldehyde-free, low VOCs, non-particulating, closed cell structure with Microban® antimicrobial product protection per ASTM G 21 and ASTM C 1338. Composite surface burning characteristics for maximum flame spread of 25 and maximum smoke developed of 50 per ASTM E 84, NFPA 255, and UL 723. Type I closed cell EPDM elastomeric duct soundlining acceptable.
   2. Temperature limit 180 F per ASTM C 411.
   3. Velocity rated for erosion resistance to 10,000 fpm per ASTM C 1071.

D. Duct Soundlining Adhesive: Pressure sensitive adhesive system for non-pinned field applications. ASTM C 916.

E. Manufacturers: Armacell® AP Armaflex® SA Duct Liner for 1 inch thickness, Armacell® AP Armaflex® FS SA Duct Liner for 1-1/2 and 2 inch thicknesses, Armacell® AP Spiraflex Spiral Duct Liner for 1 inch thickness, Armacell® AP Coilflex™ Duct Liner for 1 inch thickness, Ductmate Industries Inc. PolyArmor™, Aeroflex USA, Inc. Aerocel AC, or approved.
2.4 FASTENERS

A. Description: Use blind rivets, sheet metal screws, or bolted connections where required by SMACNA for attachment purposes for sheet metal. Sheet metal screws and rivets minimum length required for secure fastening. Where rivets are specifically called for in this section, sheet metal screws may be used.

B. Locations: For ducts, grilles, and accessories exposed to view in finished rooms, include finish-type fasteners.
   1. Permanent Work: Blind stainless steel pop rivets.
   2. Removable Items and Grilles: Cadmium-plated pan head or countersunk tapping screws.

2.5 HANGERS FOR SHEET METAL WORK

A. Description: Hangers, supports, and anchor bolts for sheet metal work and equipment, same material as for duct construction.

B. Building Attachments: Concrete inserts and structural-steel fasteners appropriate for construction materials to which hangers are being attached. Comply with requirements in Section 230510.

C. Duct Sizes: Refer to maximum cross-section dimension at location of hangers.

D. Horizontal Rectangular and Round Ducts: Comply with SMACNA. Wire hangers not acceptable.

E. Contractor’s Option for Horizontal Rectangular and Round Ducts: Adjustable cable hanging system tested and certified to comply with SMACNA for upper and lower attachment methods. System consists of matching components including steel cables, spring loaded, serrated clamping mechanism, and miscellaneous hardware selected for its corresponding load rating. Ductmate Industries Inc. Clutcher Cable Hanging System, Gripple Hang-Fast Duct Hanging System, or approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. Description: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance”, provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.
B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to the Owner.

3.4 DUCT INSTALLATION

A. General:
1. Install in workmanlike manner. Fabrications, fittings, joints, take-offs, attachments, turning vanes, dampers, and sealing in accordance with requirements of SMACNA as specified in this section and as indicated on the Drawings. If used as part of duct fabrication process, install duct labels on outside of ductwork. Installation of duct labels on inside of duct not acceptable.
2. Comply with requirements in Section 230548 for seismic restraints of ducts and for penetrations through mechanical room walls and floors and acoustical walls.
3. Hang ducts from roof structure and not from the roof deck itself. Provide formed steel channels or supplementary steel framing as specified in Section 230510 to span between roof structural members.
4. Locate ducts with sufficient clearance around equipment to allow for inspection, repair, replacement, and service.
5. Cap incomplete duct ends with temporary closures of taped polyethylene to prevent construction dust from entering ducts.
6. Install duct collars where exposed ducts pass through non-fire rated walls and ceilings. Fasten tight to ducts.
7. Duct sizes may be changed as long as the new dimensions are equivalent to those indicated and do not exceed 4 to 1 aspect ratio.
8. Transitions:
   a. Where transitions are required to fit into available space, fabricate to maintain equivalent free area of duct sizes with angle less than 15 degrees.
9. Drawings do not show offsets which may be required. Make offsets with fittings with as small an angle of offset as possible. Install turning vanes in square corner elbows.
10. Install acoustical turning vanes in return air square throat elbows.
11. Install ducts, unless otherwise indicated on the Drawings, horizontally and parallel and perpendicular to building lines.
12. Install return air and transfer air openings above ceilings with minimum 2’ - 0” clearance to obstructions.

B. Duct Sealing, Traditional Method (Contractor Option): SMACNA Seal Class A. Apply duct sealer to transverse joints, longitudinal seams, fitting connections, corners of four-bolt or corner clip duct connection system, and fitting seams except continuous welded type. Spiral seams, continuous welded seams, and transverse joints for 4-bolt or corner clip duct connection system are not required to be sealed unless visible and audible leaks exist or duct leakage exceeds that allowed by leakage test specified in this section. Comply with manufacturer’s recommendations.

C. Duct Sealing, Aerosol-Based Sealing Method (Contractor Option):
1. Preparation:
   a. Inspect air distribution systems for leakage sites and accumulation of dust and debris. Remove debris and dust and dirt greater than 1/8 inch thick.
   b. Coordinate with other subcontractors to temporarily remove or protect control devices and fire and smoke detectors from aerosol particles as required by aerosol manufacturer.
   c. Temporarily disable fire alarm devices and notify the AHJ.
   d. Temporarily isolate air distribution equipment and cover air devices and similar items as required by aerosol manufacturer.
e. Protect occupied spaces from aerosol particles.

2. Duct Sealing:
   a. Repair major leakage locations greater than 1/2 inch wide using mastic and fiberglass mesh tape per SMACNA.
   b. Seal ducts internally using automated aerosolized sealant injection.
   c. Prepare pre-sealing, post-sealing, and sealing profile reports for duct sections sealed.
   d. Repair injection and test holes per SMACNA.

3. Duct Testing: Comply with requirements in Article “Pressure Testing for Leakage” in this section

4. Duct Re-assembly and Cleanup:
   a. Coordinate with other subcontractors to reinstall control devices and fire and smoke detectors.
   b. Coordinate with other subcontractors to enable fire alarm devices and notify the AHJ.
   c. Remove isolation for air distribution equipment and remove covers from air devices and similar items and enable air distribution equipment.
   d. Cleanup sealant residue from surfaces in occupied spaces.

3.5 FLEXIBLE DUCTS

A. Install per SMACNA Figures 3-10 and 3-11 except as noted below.

B. Connect to metal ducts with slip joint made using fire-resistant mastic and stainless steel or plastic machine-applied clamp. Cloth tape adhesive and duct tape not acceptable.

C. Five foot maximum length, fully extended. Generally, install with straight sections, without bends. If bends are required, install with maximum one-90 degree bend, R/D=2.5 or greater. No kinks allowed. Sheet metal elbows to result in straight flexible duct runs acceptable.

D. Hang flexible duct on 5’ - 0” centers and at 90 degree bend with 1 inch wide flat steel strap to span at least 3 spiral wires. Maximum 1/2 inch sag per foot. Support shall not cause out-of-round shape.

E. Installation in corridor ceiling spaces where fire rating is required not allowed.

3.6 DUCT SOUNDLINING, NON-FIBERGLASS

A. General: Install duct soundlining per manufacturer’s requirements. Install sheet metal nosings at leading edge of lining when air stream velocity exceeds 4,000 fpm. Duct dimensions indicated on the Drawings are net inside dimensions. Increase sheet metal dimensions to accommodate duct soundlining thickness.

B. Extent:
   1. Transfer ducts.

C. Transportation and Handling:
   1. Transport and handle in accordance with manufacturer’s instructions.
   2. Promptly inspect shipments to ensure that materials comply with requirements and are undamaged.
   3. Provide equipment and personnel to handle materials by methods to prevent soiling, disfigurement, or damage.
   4. Clean sheet metal surfaces prior to duct lining application per manufacturer’s instructions.
D. Storage and Protection:
   1. Store and protect in accordance with manufacturers’ instructions.
   2. Store with seals and labels intact and legible.
   3. Store in weathertight, climate controlled enclosures in an environment favorable to materials.
   4. Exterior storage not acceptable.
   5. Use off-site storage and protection when site does not permit on-site storage or protection.
   6. Use equipment and personnel to store materials by methods to prevent soiling, disfigurement, or damage.
   7. Arrange storage of materials to permit access for inspection. Periodically inspect to verify materials are undamaged and are maintained in acceptable condition.

E. Protection of Installed Work:
   1. Provide temporary and removable protection for installed soundlining. Use durable sheet materials.
   2. Control activity in immediate work area to prevent damage.
   3. Install protective coverings at openings.
   4. Prohibit traffic or storage upon installed surfaces.

F. Installation: For soundlined ducts, use care during installation to insure that soundlining remains clean and dry, and that no gap will result between sections of duct soundlining after assembly of duct sections. For multi-layer applications, stagger seams. Installation shall result in adjacent soundlined sections butted together without gaps, bulges, or other discontinuities. Ensure that mating edges are sealed in the field.

3.7 PRESSURE TESTING FOR LEAKAGE

A. Description: Test supply ducts including rectangular, round, and flat oval duct systems. Test random sampling of 10 percent of low pressure (2 inch w.g. and less) ductwork systems as selected by the A/E. If tests achieve leakage rates in accordance with requirements of this section, remainder of systems do not need to be tested. If any test fails to meet requirements of this section, test low pressure (2 inch w.g. and less) duct systems in their entireties.

B. Test Standard: SMACNA Leakage.

C. Leakage Class (CL) is defined as CL = F/P^{0.65} where:
   1. F is leakage rate in cfm per 100 sq. ft of ductwork surface area.
   2. P is static pressure at which test is conducted and duct construction class as specified in this section.

<table>
<thead>
<tr>
<th>Duct Construction Class (Pressure Classification)</th>
<th>Leakage Class (CL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch w.g.</td>
<td>16</td>
</tr>
<tr>
<td>1 inch w.g.</td>
<td>16</td>
</tr>
<tr>
<td>2 inch w.g.</td>
<td>8</td>
</tr>
</tbody>
</table>

D. Test Apparatus: Portable blower with volume adjustment, flow measuring assembly for determining cfm of air being added to duct consisting of calibrated orifice mounted in straight tube with straightening vane and pressure taps, U-tube manometer, and calibration curve for orifice assembly. Submit test apparatus calibration certificate.
E. Test Procedures:
   1. Test duct before insulation is installed.
   2. Close off and seal openings in duct section to be tested. Connect test apparatus to duct by means of flexible duct.
   3. Test for audible leaks as follows:
      a. Start blower with its control damper closed.
      b. Gradually open control damper until duct pressure reaches specified pressure classification.
      c. Survey joints and seams for audible leaks. Mark each leak and repair after shutting down blower. Do not retest until sealants have set.
   4. After audible leaks have been sealed, retest. Seal and retest as necessary until maximum leakage is less than allowable amount as determined by defined leakage class as specified in this section.
   5. Submit duct section data, calculations, and test results for each duct section.
   6. Summation of leakage for sections shall not exceed total allowable system leakage. Base allowable leakage on total surface square footage of installed duct.
   7. Test of each duct section may be witnessed by the A/E. Give at least 7 calendar days prior notice before such tests.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes accessories for air distribution systems and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. AMCA 500-D, Laboratory Methods of Testing Dampers for Rating.
   2. AMCA 511, Certified Ratings Program – Product Rating Manual for Air Control Devices.
   3. ARI 885, Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for the following:
   1. Volume dampers and quadrants.

1.4 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 230900 – Automatic Temperature Controls: Dual duct air terminal unit controllers and actuators.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA.
2.2 VOLUME DAMPERS AND QUADRANTS

A. General: Fabricate in accordance with SMACNA, same material as for duct construction.

B. Quadrants Where Ducts are Accessible:
   1. Description: Handle regulator set with hex nut and acorn nut. Full length shaft, sizes meeting SMACNA Standards for damper blade sizes. Include closed end cast alloy bearing and standoff bracket for ducts with external insulation, height to accommodate insulation thickness specified in Section 230700.

PART 3 - EXECUTION

3.1 INSPECTION

A. Description: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance”, provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Do not cover up or enclose work until inspected and approved. If in non-compliance, uncover work, remove, and provide new to satisfaction of the A/E at no additional cost to the Owner.

3.4 VOLUME DAMPERS

A. General: Install damper in duct to each supply and exhaust opening and for branch mains serving more than 1 opening.

B. Construction and Installation: In general, arrange with axis of blade in long dimension of rectangular duct. Install bearing on each end. Seal installation airtight.

C. Location: Install dampers in accessible locations. Locate as far from outlet and inlet as possible.

D. Setting: Set and lock in full open position, prior to TAB work.

E. Install 12 inch long orange colored 1/2 inch wide surveyors' tape on quadrant of volume dampers located above ceilings.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: The Work includes grilles, diffusers, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   2. ASHRAE 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.
   5. UL 2518, Outline of Investigations for Air Dispersion Systems Materials.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 230500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for each type of the following:
   1. Grilles, registers, and diffusers.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

A. Except as otherwise indicated, furnish manufacturer’s standard grilles and diffusers of size, shape, capacity and type as indicated on the Drawings for complete installation.

B. Performance: Furnish grilles and diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each grille and diffuser type and size as listed in manufacturer’s current data.

C. Ceiling Compatibility: Furnish with border styles compatible with adjacent ceiling systems specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to architectural drawings and specifications for types of ceiling systems.

D. Seismic Restraints for Grilles and Diffusers Weighing Less than 20 Pounds: Include means to positively attach grilles and diffusers to ceiling grid system.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive the Work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing the Work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from the Work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the Work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of grilles and diffusers with other work.

C. Install grilles and diffusers level and plumb.

D. Install grilles and diffusers with airtight connection to ducts and to allow service and maintenance of adjustable components.

E. Ceiling-Mounted Air Devices: Drawings indicate general arrangement of ducts, fittings, and accessories. Grille and diffuser locations have been indicated on the Drawings to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated on the architectural reflected ceiling plans. For grilles and diffusers installed in lay-in ceiling panels, locate in center of panel. Where architectural features or other items conflict with installation, notify A/E for determination of final location.

F. Seismic Restraints:
   1. For Grilles and Diffusers Weighing Less than 20 Pounds: Positively attach grille and diffuser to ceiling grid system.
   2. For Grilles and Diffusers Weighing 20 to 56 Pounds: In addition to positively attaching grille and diffuser to ceiling grid system, install two No. 12 gage hanger wires connected to grille and diffuser to ceiling system hanger or to structure above.

3.4 ADJUSTING

A. After installation, adjust grilles and diffusers to air patterns indicated on the Drawings, or as directed by the A/E before starting air balancing.
3.5 CLEANING

A. After installation of grilles and diffusers, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Remove and provide new grilles and diffusers that have damaged finishes.

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes materials, equipment, labor, supervision, tools and items necessary for the construction, installation, connection, testing and operation of electrical work. This section applies to all Divisions 26, 27, and 28 sections.

B. General Requirements: General Conditions, Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 CODES AND STANDARDS

A. Perform work in accordance with requirements of the state in which the work is performed.

B. Conform to applicable industry standards, UL standards, NEMA standards, and other standards as noted.

1. Notify the A/E of deviations in Contract Documents to applicable codes and ordinances prior to installation of the Work. Perform changes in the Work after initial installation due to requirements of code enforcing agencies at no additional cost to the Owner.

2. If conflict occurs between legally adopted codes and the Contract Documents, the codes prevail, except that this shall not be construed as relieving the Contractor from complying with requirements of the Contract Documents which may exceed code requirements and not contrary to same.

C. Operating Conditions:
   1. Temperature: Minus 20 deg C to plus 40 deg C.
   2. Altitude: Up to 3,300 feet (1,000 meters).

1.3 PERMIT INFORMATION

A. Permit Application: Arrange for and pay for all required permits, fees, and inspections required for work included in Division 26, 27, and 28.

B. Permit Submittal Plan Review: Submit the following to the AHJ as required to support the permit application:
   1. Fire Alarm Permit: Submit Shop drawings

C. Approved Permit Plans Printing: Print and have available for the inspector a full size color set of the approved plan review drawings. A digital set of approved drawings will be provided electronically and will be the same size and sheet count as the Bid Documents.

1.4 SUBMITTALS

A. Comply with requirements in Division 01 and with additional requirements indicated in this article.

B. Electronic Product Data:
   1. Comply with requirements in Section 013300 and additional requirements indicated in this article.
2. Submit each specification section complete at one time with a dedicated submittal number for each section. For example, submit products for Section 260519 under one submittal number and products for Section 260533 under a different submittal number. Submitting multiple sections at one time acceptable as long as each section has a dedicated submittal number. Include submittal number and date submitted in file name.

3. Submit one hard copy of product data.

4. Submit signed letter indicating 3D model coordination has started and will continue through construction. 3D model not required to be submitted/reviewed during construction phase.

5. Partial product submittals not acceptable and will be returned without review except as follows:
   a. Section 260573 Power Studies including representative one-line diagram of distribution system (with bus numbers as described herein) indicating which devices will be presented in protective device coordination study and indicate additional information required to complete the study.
   b. Section 260923 Lighting Controls including products and materials for first submittal and Shop Drawings for second submittal.
   c. Sections 265100 Lighting and 265561 Stage Lighting Systems including products and materials for first submittal and Shop Drawings for second submittal.
   d. Section 283111 Fire Alarm and Detection Systems including products and materials for first submittal and Shop Drawings for second submittal.
   e. Long lead items.
   f. Site and underground work.

6. Clearly mark catalog pages, equipment, and model number to be used. Indicate associated specification section and paragraph number on each page. Identify required options and accessories.

7. Format:
   a. Adobe PDF file format.
   b. Bookmark each submittal to facilitate browsing to each specification paragraph number.
   c. Include table of contents for each specification section. Include catalog numbers or drawing numbers.
   d. Include the Contractor and manufacturer’s representative contact information for each product. Include job name (or abbreviation of job name), specification number, and contractor submittal number in file name.

C. Shop Drawings:
   1. Submit as specified in the individual specification sections. Submit minimum 30 days prior to starting fabrication on installation work. Do not fabricate on install until reviewed by the A/E. Include complete location dimensions, and hanger and support sizes and dimensions.
   2. “Typical” drawings and wiring diagrams not accepted unless they specifically apply to this project.
   3. Drawings shall be drawn at sufficient scale to show details clearly on same size sheets as Drawings.
   4. Show required coordination with work of other trades.
   5. Identify details and show their locations in Project.
   6. Include description of configuration and operation of proposed systems.
   7. Include outline drawings of proposed equipment in plan and elevation views including overall dimensions, weights, and clearance required.
   8. Include one-line electrical diagrams required for control and sensing.
9. Floor plan backgrounds are available in electronic format and shall be requested from the A/E.
10. Direct use of the Drawings as the basis of Contractor’s prepared Shop Drawings not acceptable.
11. Format:
   a. Adobe PDF file format.

D. Approval: Approval of a manufacturer’s name or product by the A/E does not relieve the Contractor of the responsibility for providing materials and equipment which comply in detail with requirements of the Contract Documents.

E. As-Built Drawings: Daily updates and markups that reflect all changes made in the specifications and working drawings during the construction process, and show the exact dimensions, geometry, and location of all elements of the work completed under the contract.

F. Re-Submittals: Clearly identify re-submittals. Provide revised tabs, indexes, page renumbering, and other formats to interface with original submittal. Identify changes and include date for project tracking.

G. Test reports and Certificates: Submit as a package prior to Substantial Completion.

H. Certifications: Submit written certifications from the governing building authorities stating that work has been inspected and accepted, and complies with applicable codes and ordinances.

I. Record Drawings: Conformed set of as-builts developed during the construction process. Drawings shall be a single digital copy for each sheet in the contract documents and developed at the end of the construction phase. Comply with Article “Record Drawings” in this section.

J. Schedule of Values:
   1. Comply with the requirements in Division 01 with additional requirements as indicated in this paragraph.
   2. Include costs in Schedule of Values as follows:
      a. Mobilization.
      b. Submittals.
      c. Electrical Permit.
      d. 3D Coordination
      e. Lighting Systems – Fixtures & Lamps Material.
      g. Lighting Systems – Branch Circuit Raceway Rough-in, Material.
      i. Lighting Systems – Branch Circuit Wiring, Material.
      t. Low Voltage – Fire Alarm Rough-in, Material.
v. Low Voltage – Fire Alarm Trim, Material.
w. Low Voltage – Fire Alarm Trim, Labor.
x. Punch List and Close Out.
y. Testing Commissioning and Training.

1.5 DEFINITIONS AND ABBREVIATIONS

A. Refer to Division 01 for definitions and abbreviations. Additional definitions and abbreviations are as follows.

B. “Approved” or “Approval” means written approval by the owner or “Owner’s agent” (A/E).

C. “Codes” means AHJ adopted codes, rules, and ordinances and additional codes as specified herein.

D. “Concealed” means spaces out of sight. For example, above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.

E. The word “Contractor”, as used in Divisions 26, 27, and 28 sections, means the electrical subcontractor.

F. “Coordination”, “Coordinating”, and “Coordinate” means to bring, or the bringing, into a common action, movement, or combination so as to act together in a smooth concerted way.

G. “Directed”, “Requested”, “Accepted”, and Similar Terms means these terms imply “by the A/E” unless otherwise indicated.

H. “Exposed” means open to view. For example, raceways installed in a tunnel or raceways installed in a room and not covered by other construction.

I. “Furnish” means supply and deliver to the project site ready for unloading, unpacking, assembly, installation, and similar activities.

J. “Indicated” and “Indicated on the Drawings” means shown on Drawings by notes, graphics or schedules, or written into other portions of Contract Documents. Terms such as “shown”, “noted”, “scheduled” and “specified” have same meanings as “indicated”, and are used to assist the reader in locating particular information.

K. “Install” means to place in position for service or use. Includes operations at project site, such as unloading, unpacking, assembly, erection, placing, preserving, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar activities.

L. “Provide” means furnish and install for a complete, finished, and operable system and ready for intended use.

M. “Shop Drawings” means Document which fully details equipment and intended installation relative to this specific Project.

N. “Structural Members” means all above and below grade elements associated with the structural support of the building or structure.
O. “Substantial Completion” shall mean that the entire project (or readily definable portion thereof if so designated in the Contracted Documents) is acceptable to code enforcement authorities and to extent required by such authorities, has been inspected and approved by such authorities, and is suitable for occupancy by the Owner or occupant for the purpose intended. Refer to Divisions 00 and 01 for additional requirements.

P. “Work” or “Project” means entire scope of work required by the Contract Documents.

Q. Abbreviations:
- A/E  Architect
- ADS  Acoustical Distinguishable Space
- AFCI  Arc Fault Circuit Interrupter
- AHJ  Authorities Having Jurisdiction
- ANSI  American National Standards Institute
- ASTM  American Society for Testing and Materials
- ATP  Acceptance Test Procedure
- BMS  Building Management System
- BOM  Bill-of-Material
- C  Degrees Celsius
- CEC  Canadian Electrical Code
- CCT  Correlated Color Temperature
- CIS  Common Intelligibility Scale
- CSA  Canadian Standards Association
- CR  Controlled Receptacle
- CRI  Color Rendering Index
- CU  Coefficient of Utilization
- DAS  Distributed Antenna System
- EBS  Educational Broadband Service
- EMS  Energy Management System
- EMT  Electrical Metallic Tubing
- EPO  Emergency Power Off
- ETL  Environmental Technology Laboratory
- EUSERC  Electric Utility Service Equipment Requirements
- F  Degrees Fahrenheit
- FC  Foot-candle
- FM  Factory Mutual Engineering Corporation
- GB  Ground Fault Circuit Interrupter Breaker
- GFCI  Ground Fault Circuit Interrupter
- GUI  Graphical User Interface
- HDPE  High-density polyethylene
- HID  High-intensity discharge
- HVAC  Heating, Ventilation and Air Conditioning
- IC  Insulation contact
- IBC  International Building Code
- IDF  Intermediate distribution frame
- IEC  International Electrotechnical Commission
- IEEE  Institute of Electrical and Electronics Engineers
- IES  Illuminating Engineering Society
- IMC  Intermediate Metal Conduit
- K  Kelvin
- kVA  Kilo Volt Amps
- LED  Light-emitting diode
- LPI  Lightning Protection Institute
- MC  Metal Clad
MDF  Main distribution frame
NEC  National Electrical Code, NFPA 70 (latest adopted edition with Amendments)
NEMA  National Electrical Manufacturer's Association
NETA  International Electrical Testing Association
NFPA  National Fire Protection Association
NRTL  Nationally Recognized Test Laboratory
OSHA  Occupational Safety and Health Administration
PCB  Polychlorinated Biphenyl
PDU  Power Distribution Units
PF  Power factor
RMC  Rigid Metal Conduit
RMS  Root Mean Square
RTRC  Reinforced thermosetting resin conduit
SCCR  Short Circuit Current Rating
SPD  Surge Protective Devices
STC  Factory Standard Test Condition
STI  Sound transmission index
STIPA  STI for public address systems
TCLP  Toxicity characteristic leaching procedure
THD  Total Harmonic Distortion
TIA  Telecommunications Industry Association
UL  Underwriters Laboratories Inc.
UPS  Uninterruptible Power Supply
V  Volts
VOIP  Voice Over Internet Protocol
VRLA  Valve Regulated Lead Acid Batteries

1.6 MATERIALS

A. Where two or more manufacturers are listed, select for use any of those listed. The first mentioned, in general, was used as the basis of design. Bids on any manufacturer named acceptable as long as that manufacturer meets every aspect of the Contract Documents. Note that equipment layout is based on equipment listed in equipment schedules.

B. Ensure that equipment will fit within available space. Where other than basis of design manufacturer is selected for the Project, the Contractor is responsible for verifying equipment will fit within available space and meet manufacturer’s and code required clearances.

C. Where other than basis of design manufacturer is selected for the Project, include cost of resulting additional work, coordination with other trades, and redesign of associated building services and structure as required to accommodate selected equipment. Include redesign drawings with submitted Shop Drawings.

D. Should any proposed product requires redesign work by A/E to accommodate proposed Product, costs for such redesign work shall be included in the Bid amount. The Owner will compensate Engineer through the A/E at rate of $150.00 per hour for time and expense for required review of submittals and additional coordination for redesign work. Amount of compensation will be deducted from Final Payment to the Contractor.

1.7 STANDARDS OF QUALITY

A. Materials and Equipment: UL listed and labeled or other AHJ approved testing laboratory and in compliance with other industry standards as specified.
B. Equipment shall be manufacturer's regularly catalogued items and shall be supplied as a complete unit in accordance with manufacturer's standard specifications and any optional items required for proper installation for equipment unless otherwise noted. Equipment and materials shall be installed in accordance with the manufacturer's recommendations and best trade practices.

C. Products shall be new unless indicated otherwise in the Contract Documents.

D. Fabricator and Manufacturer Qualifications: Specialists with at least 5 years’ experience and regularly engaged in manufacture of equipment and materials specified.

E. Furnish products of a single manufacturer for items which are used in quantity. A Product, for the purpose of this paragraph, is an assembly of components such as switchboards, transformers, panelboards, and similar items. Materials such as wire and cable, raceways, outlet boxes, and similar items not requiring maintenance are not included in the single manufacturer requirement of this paragraph.

F. Installer Qualifications: Specialists with at least 5 years’ experience and regularly engaged in the installation of the system, equipment, and materials specified. Where required by the AHJ, employ licensed trades persons.

1.8 SUBSTITUTIONS

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Substitutions will be considered following bid award only when a product becomes unavailable through no fault of the Contractor.

C. Where “Manufacturer” paragraphs include the words "or approved", prior approval of the proposed substitution is required. The A/E is sole judge of quality of proposed substitution.

D. When the A/E approves a substitution request, the approval is given with the understanding that the Bidder:
   1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
   2. Will provide the same warranty for the Substitution as for the specified Product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.

E. Whenever a Product is described by detail, specification, trade name, manufacturer's name or catalog reference, use only such Product, unless written approval is given for substitution prior to bid. Submit written requests on substitution request form included in Division 01. Approved substituted manufacturers will be listed by Addendum. There are no prior approvals for this project.

F. Provide as specified certain products, materials, and systems where “manufacturer” paragraphs are followed by the words "no substitutions".

G. Substitutions will not be considered when they are indicated or implied on Shop Drawings or product data submittals, without separate written prior approval, or when approval will require revision to the Contract Documents.
1.9 DRAWINGS AND SPECIFICATIONS

A. General: The electrical drawings are diagrammatic. Complete details of building features which affect electrical installation may not be shown. For additional details, refer to other Contract Documents. Report any discrepancies to the A/E along with suggested revisions. Obtain written response from the A/E before proceeding with changes.

B. Depiction of Work: Drawings do not show the exact characteristics of the work including, physical arrangement of equipment, lengths of wiring or conduit runs. Base work on actual field measurements and conditions. Provide work required to complete the installation.

C. Dimensions: Do not scale drawings. Dimensional accuracy is not guaranteed, and field verification of dimensions, locations, and levels to suit field conditions is required.

D. Since the Drawings of floor, wall, and ceiling installation are made at small scale, outlets, devices, equipment, and similar items are indicated only in their approximate location. Locate outlets and apparatus symmetrically on floors, walls, and ceilings where not dimensioned and coordinate such locations with work of other trades to prevent interferences.

E. Discrepancies: Field verify dimensions and existing conditions prior to performing work. Bring to the A/E’s attention any discrepancies within the Contract Documents and between the Contract Documents and field conditions. Also for any design and layout changes required due to specific equipment selection, prior to the Contractor’s work (equipment and material purchasing and installation). Any corrective work required by the Contractor after his discovery of such discrepancies, inconsistencies, or ambiguities shall be at no additional cost to the Owner.

F. Specifications: These specifications are written in imperative mood and streamlined form. The imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

1.10 RECORD DRAWINGS

A. Comply with requirements in Division 01, with additional requirements as indicated in this article.

B. Prepare As-Built drawings: As-Built Drawings shall be red line prints in digital or hand drawn format (pencil and black pen not acceptable).
   1. Corrections and Changes: Record during the progress of the Work, showing work as actually installed.
      a. Show the measured locations of portions of the Work and changes the Contractor has made.
      b. In general, tolerance plus or minus 1'-0” from actual location.
      c. Show addendum items, change orders, clarifications, supplemental instructions, and deviations from the Drawings. Show device or equipment changes and indicate where the change was originated. Only indicating the document where the change originated from will not be accepted.
   2. Updates: Neatly hand-draft on daily basis and kept readily available at project site. Updates are subject to review by the A/E on a regular basis throughout construction. Updates are to include the following at a minimum:
      a. Feeder routing indicating upstream and downstream equipment.
      b. Installation locations for underground raceways and where they transition to above grade.
c. Device locations and mounting heights.
d. Junction and pull boxes with two or more home runs.
e. Junction and pull boxes with one home run.
f. Circuit information.
g. Shop Drawings: Update shop drawings with changes or deviations from the Original Shop Drawings. Provide updates to manufacturer/vendor for inclusion in Record Drawings.

C. Record Drawings: Develop a digital set of Record Drawings for the project utilizing the as-built drawings. Digital Record Drawings can be in AutoCAD or PDF format. At end of construction, check drawings for completeness and accuracy.

D. Shop Drawing Record Drawings: Provide updated shop drawings based on As-Built drawings for use as Record Drawings.

E. Per project closeout procedures, submit in Digital Record Drawings and a copy of the As-Builts. Each sheet shall be noted as “RECORD DRAWING”.

1.11 COORDINATION

A. Coordinate Divisions 26, 27, and 28 work with other trades.

B. Be aware of restricted space for installation of electrical systems. Include offsets and perform rerouting and coordination to fit elements in available space. Include provisions for such requirements in bid.

C. Electrical equipment and systems shown are based on existing drawings as available and on limited project site observations to the extent possible under current conditions. Field verify existing conditions prior to commencement of work. Obtain specific locations of structural and architectural features or equipment items from referenced drawings, field measurements, or trade providing material or equipment.

D. Coordinate raceway installations to clear light fixtures and electrical cable trays. Include clearance over light fixtures to allow removal and replacement. Include minimum 6 inch clearance above and to sides of cable trays.

E. Existing Conditions:
   1. General Construction:
      a. Installation of electrical, telecommunications, and electronic safety and security work will require openings, removal and replacement of ceilings, sleeves, and restoration of general construction to match existing. Some work occurs in areas not requiring alterations as part of architectural work. Coordinate new openings and restoration work so that there is no additional cost to the Owner.
      b. General construction work shown on the architectural drawings may require removal, relocation, and reinstallation of existing electrical, telecommunications, electronic safety and security work. Since existing conditions cannot be completely detailed on the Drawings, survey the site and perform required Work at no additional cost to the Owner.
   2. This project may require work in the presence of asbestos containing material (ACM). Division 26 does not provide for or cover the identification, removal, incapsulation, or disposal of such material. If the presence of ACM is suspected, notify the Owner prior to proceeding with in the vicinity of ACM.
F. Be responsible for beam penetrations as they relate to the electrical work. Submit sizes and locations to the structural engineer for review and determination of structural details.

G. Coordinate attachments to structure to verify that attachment points on equipment and structure can accept seismic, weight, and other loads imposed.

H. Refer to architectural and structural drawings for location of expansion and seismic joints. Provide flexible loops for raceways and cable trays crossing expansion and seismic joints.

1.12 WORKMANSHIP

A. Work shall be in accordance with best trade practices. Remove substandard workmanship and provide new material at no extra cost to the Owner.

1.13 SITE VISIT

A. The Contractor shall visit site during bidding period to note conditions affecting installation of Work. No additional charges allowed due to failure to adequately review conditions.

B. Investigate each space through which equipment must be moved. Where necessary, arrange with equipment manufacturers to ship equipment in sections with suitable dimensions for moving through restricted spaces. For movement through occupied spaces, ascertain from the Owner as acceptable times of day or night that movement could occur. Include costs in bid for off hours labor, reassembly, and field testing.

1.14 CERTIFICATION

A. By submitting a bid for the electrical, telecommunications, electronic safety and security systems, the Contractor and his subcontractors acknowledge and certify the following:

1. That they have carefully examined and fully understand the Drawings and Specifications (including but not limited to architectural, site, utility, mechanical, structural and electrical drawings and specifications. In addition, they have determined that the Drawings and Specifications are adequate to complete the electrical systems and that they can provide a complete finished and operable system in accordance with the Contract Documents.

2. That they have had a reasonable opportunity to discover any ambiguities in the Contract Documents and such ambiguities have been brought to the attention of the A/E in writing prior to submitting the bid.

3. That they have reviewed the project progress schedule with the general contractor, fully understand the schedule, and they have verified, prior to submitting a bid, availability of necessary labor and materials, including supervision and office backup, and can comply with the schedule requirements.

4. That there may be changes to the scope of work and that they understand that any proposal submitted for performance of additional work shall include costs associated with such change including but not limited to labor, materials, subcontracts, equipment, taxes, fees, schedule impact, loss of efficiency, supervision, overhead and profit.

5. That the Contract requires them to coordinate their work with that of other trades and that responsibility for coordination includes rerouting, offsets, and similar provisions, to fit Work and address manufacturer’s recommended clearances for service access, maintenance, and replacement of equipment in a manner that is compatible with work of other trades in the same area.

6. That routing of elements of electrical systems shown on the Drawings is schematic only and that offsets and rerouting probably will be required in installation and that labor and materials have been included for such in their bids.
7. That they understand submittals of material and equipment to the A/E is for the purpose of establishing what they are providing for the project. Any review undertaken by the A/E does not relieve them of their responsibilities to furnish and install materials and equipment required for work in the project nor does such review relieve them of their responsibilities for coordination with other trades and designers to ensure that such materials and equipment will fit and be suitable for purpose intended.

8. That they agree to receive payment for bid amounts as full compensation for furnishing materials and labor which may be required in prosecution and completion of work required under the Contract Documents, and in respects to complete the contract work to the satisfaction of the A/E.

9. That they include in their bids costs to furnish bonds as specified in the Contract Documents.

1.15 WARRANTY

A. Conform to requirements in General Conditions, Supplementary Conditions, and Division 01. Where not so prescribed or defined, the period shall be 1 year. Warranty periods within Divisions 26, 27, and 28 shall not commence until Substantial Completion. Contractor shall extend longer warranties specified in other sections.

1.16 EQUIPMENT FURNISHED BY OWNER INSTALLED BY CONTRACTOR (FOIC)

A. Material Handling and Delivery: Coordinate delivery of FOIC equipment. Receive, off load, transport, store, hoist, unpack, dispose of packing, same as for other project equipment arriving at job site. Requirements of the Contract Documents apply to FOIC equipment.

B. Operation and Maintenance Data: Obtain from the Owner operation and maintenance data for the FOIC equipment and incorporate them into the Operations and Maintenance Manuals.

C. Start-up and Warranty:
   1. FOIC equipment suppliers will pass on to the Contractor start-up information, maintenance and parts information, and warranty provisions of their products in accordance with the equipment suppliers contract requirements. Organize and coordinate start-up and warranty requirements for the FOIC equipment.
   2. Include one year warranty on FOIC equipment starting at Substantial Completion regardless of shorter time limits by FOIC suppliers.

1.17 DEMONSTRATION

A. Comply with requirements in Division 01 with additional requirements indicated in this article.

B. Following installation of electrical work and prior to final acceptance, demonstrate that equipment and systems operate as indicated in the Contract Documents and in accordance with manufacturer’s recommendations.

C. Perform in presence of the A/E and Owner’s representative, unless otherwise directed by the A/E. Give minimum 1 week notice prior to demonstrations.

D. Provide instruments and personnel required to conduct demonstrations.

1.18 SUBSTANTIAL COMPLETION

A. Comply with requirements in Division 01.
B. Prepare list of items that are not complete prior to asking for a substantial completion review by the A/E.

1.19 ALTERNATES

A. General: See Bid Form and Alternates described in Division 01 for possible effect on work of Divisions 26, 27, and 28.

1.20 CONTINUITY OF EXISTING UTILITY SERVICES

A. Shutdown Duration: Comply with requirements in Division 01. Perform work without shutdown of more than 4 hour duration of existing systems. Schedule each shutdown in writing with the Owner at least 7 days in advance of shutdown and obtain advance written approval from the Owner.

B. Temporary Services: Provide during necessary interruptions of existing utilities.

C. Owner Occupancy:
   1. Perform work in the existing building with respect for the necessity of the Owner’s employees to perform their regular work.
   2. Plan installation of new work and connections to existing work to assure minimum interference with regular operation of existing facilities. Do not remove, disconnect, or shutdown systems without prior review by the Owner to confirm that areas needed to remain in operation are not affected.
   3. Provide temporary, wiring, lighting, and similar systems and connect to existing systems to keep existing electrical systems in operation to service areas that need to remain occupied.

1.21 OPERATION AND MAINTENANCE MANUALS

A. Prepare Operation and Maintenance Manuals for equipment and materials furnished under Divisions 26, 27, and 28.

B. Comply with requirements in Division 01 with additional requirements indicated in this article.

C. Submit one hard copy and one electronic PDF format of Operation and Maintenance Manuals for review at least 4 weeks prior to Substantial Completion date. Assemble hard copy Operation and Maintenance Manual in 3-ring binder(s). Use multiple binders if pages in a single binder would exceed 4 inch thickness. Separate binders for each category, such as Electrical, Telecommunications, and Electronic Safety and Security. Where one subject matter encompasses more than one binder, differentiate by volume numbers. Include indexed tabs for each binder. Engrave cover with the project title in 1/2 inch high letters and name and address of the Contractor in 1/4 inch high letters. Provide same information in 1/8 inch high letters on spine.

D. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Include serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, and similar information. Each item of equipment shall have its own individual sheet. (Example: If 2 items of equipment A and D appear on the same sheet, individual sheet shall be included for each unit specified.)

E. Include the Following Information:
   1. Identifying name and mark number.
   2. Certified outline drawings and Shop Drawings.
3. Parts list.
4. Performance curves and data.
5. Wiring diagrams.
6. Manufacturer's recommended operating and maintenance instructions.
7. Vendor's name, address and telephone number for all parts and equipment.
8. Name, address and telephone number of Contractor performing the work.
9. Test reports.
10. Product data and Record Drawings.

1.22 TESTING

A. Comply with requirements in Section 260810.

1.23 PROJECT TRAINING

A. Upon completion and testing of equipment and system installation, assemble equipment factory representatives and subcontractors for system training with Owner's representatives as required in specific specification sections.

B. Each representative and subcontractor shall assist in start-up, check out, and training for their respective system and remain on-site until the total system operation is thoroughly reviewed by the Owner's representatives and are thoroughly trained. Return for additional training sessions as required to completely train Owner's Representatives.

C. Factory representative and system subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and operation personnel. To certify acceptance of operation and instruction by the Owner's representative, prepare a written statement as follows:
   1. This is to certify that the factory representative and system subcontractor for each system listed below have performed start-up and final check out of their respective systems.
   2. The Owner's maintenance and operation personnel have received complete and thorough instruction in the operation and maintenance of each system.

   SYSTEM                      FACTORY REPRESENTATIVE

   (List systems included)  (List name and address of factory representative.)

   Owner's Representative  Contractor

D. Submit copy of acceptance to A/E.

1.24 PUNCHLIST AND FINAL REVIEWS

A. At the time of punchlist and final reviews, the project electrical foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested to allow review of entire electrical system.

B. Punch List: Review each punch list item; update field conditions to address items or provide comment response for reason the item has not been addressed in the field.
1.25 PROJECT CLOSEOUT

A. Engineering services required beyond the final completion date shall be paid by the Contractor at a rate of $150 per hour.

B. Punchlists will be done at Substantial Completion and final completion dates. Submit Record Drawings and final Operation and Maintenance Manuals prior to Substantial Completion date. Subsequent reviews shall be paid by the Contractor at a rate of $125 per hour.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes basic electrical requirements specifically applicable to Divisions 26, 27, and 28 sections including general material and installation requirements and site work.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to the Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. UL Compliance: Where UL fire-resistance rating is indicated for construction penetrated by access units, furnish UL listed and labeled units, except for those units which are smaller than minimum size requiring ratings as recognized by governing authority.

C. Codes and Standards:
   1. ASTM D 1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³).

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer’s recommendations, using means and methods to prevent damage, deterioration, and loss, including theft.

B. Deliver products to site in manufacturer’s original containers, complete with labels.

C. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

D. Store products subject to damage by weather conditions above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer’s instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish specified items acceptable to AHJ as suitable for intended use.

B. New, unless otherwise indicated, free from defects and the standard products of reputable manufacturers regularly engaged in production of such equipment.

C. Furnish similar items of equipment by same manufacturer.

D. Materials and Equipment: UL listed and labeled or other AHJ approved testing laboratory and in compliance with other industry standards as specified.

E. Remove rejected or damaged material from site.
F. Samples may be required for non-standard or substituted items before installation. Submit samples as required in specific specification sections.

G. Furnish required items necessary for installation and testing procedures.

2.2 POSTED INSTRUCTIONS

A. Posted Operating Instructions: Furnish simplified, consolidated equipment control and power diagrams. Graphically represent entire system and actual equipment installed. Include concise written instructions on how to start and stop systems. Show settings and conditions to be observed. Indicate what control adjustments are to be made or maintained by the operator.
   1. Include control diagrams and specific operating instructions.
   2. Indicate how to energize each major component of systems. Show what action must be taken in an emergency, how to restore power following an outage, and what precautions to be taken when maintenance is required.
   3. Include photographic or comparable non-fading reproductions, either framed under glass or encased in non-discoloring plastic.
   4. Include one-line diagrams of electric power distribution riser.

B. Copies of operating instructions shall be used with Operation and Maintenance Manuals as basis in training Owner’s employees in the operation and maintenance of systems and related installed equipment.

2.3 ENCLOSURES

A. NEMA Type 1 – Dry Interior locations unless otherwise noted on drawings or as specified below.

B. NEMA 3R Weather-proof/Rain-proof – Windblown rain, sleet, ice – Provide in all locations where exposed to moisture unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify installation conditions as satisfactory to receive work of the various sections. Do not install until unsatisfactory conditions are corrected.

3.2 INSPECTIONS

A. Confirm that installations have been inspected before enclosure within building features, buried, or otherwise hidden from view. Pay costs associated with uncovering or exposing installations and features not previously inspected and for repair to exposed surfaces.

3.3 PREPARATION

A. Protect surrounding areas and surfaces to prevent damage as work is installed.

B. Obtain equipment roughing-in dimensions from approved Shop Drawings or actual measurements.

C. Be familiar with the location of other trade’s equipment. Eliminate conflicts. Check door swings before installing switches. Locate switches on strike side of doors unless noted otherwise.
D. Layout electrical, telecommunications, and electronic safety and security work in advance of construction to eliminate unnecessary cutting, drilling, channeling, and similar activities. Where such cutting, drilling, channeling and similar activities become necessary for proper installation, perform with care using skilled mechanics of trades involved. Repair damage to building and equipment at no additional cost to the Owner.

E. Perform cutting work of other trades only with consent of that trade. Cutting structural members not permitted without consent of the A/E.

3.4 INSTALLATION

A. Install Work as specified and in accordance with the Drawings and manufacturer's instructions. Where these conflict, manufacturer's instructions govern.

B. Review Architectural, Mechanical and other applicable drawings and applicable Shop Drawings to prevent switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, and similar items, or from being located in whiteboards, tackboards, glass panels, and similar items. Relocate electrical devices and connections as directed by the A/E at no additional cost to the Owner if the work is not properly coordinated.

C. Where conduit, outlets, and apparatus are encased in concrete, locate and secure at point of installation. Check locations of electrical items before and after concrete and masonry installation and relocate displaced items.

D. Provide block-outs, sleeves, demolition work, and similar items required for installation of Work specified in this division.

3.5 WORKMANSHIP

A. Work and materials will be subject to observation at any time by the Owner and the A/E.

B. Install material and equipment in accordance with manufacturer's instructions. Provide calibrated torque wrenches and screwdrivers as required.

C. Cutting and Patching: Do not weld to, cut, or notch structural members or building surfaces without approval of the A/E. Restore surfaces neatly to original condition after cutting, channeling, chasing, and drilling of walls, partitions, ceilings, paving, and anchorage of conduit, raceways, and other electrical equipment.

3.6 WELDING, CUTTING, AND DRILLING

A. Perform in accordance with American Welding Society Standards.

3.7 CLEANING

A. Clean equipment, conduit, and fittings and remove packing cartons and other debris created by Divisions 26, 27, and 28 Work.

B. Before Substantial Completion, carefully clean equipment, fixtures, exposed raceways and similar items. Remove construction labels, dirt, cuttings, paint, plaster, mortar, concrete, and similar items. Clean fixtures, interiors and exteriors of equipment and raceways.
3.8 IDENTIFICATION
   A. Provide nameplates and decals required to identify equipment and components, comply with requirements in Section 260553.
   B. Mount operating instructions and diagrams near equipment or elsewhere as otherwise designated by the Owner.

3.9 PROTECTION
   A. Protect equipment during and after electrical hookup, painting, and final testing.

3.10 REMOVAL AND REPLACEMENT OF EXISTING ACCESSIBLE CEILING PANELS
   A. General: Remove and reinstall necessary panels in existing accessible ceilings to install electrical work in areas where no architectural work is being performed. Where existing ceiling panels are damaged, replace with new to match existing. After ceiling removal and reinstallation is complete, ceiling system appearance shall match adjacent similar ceilings that have not been removed.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes final electrical connection to equipment having electrical requirements. Contractor shall make final connections for Owner furnished equipment including switches, receptacles, and similar items. See other applicable specification sections for building temperature control wiring requirements specified in Divisions 21, 22, and 23.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

C. Connection to Equipment Specified in Divisions 21, 22, and 23 as Follows unless Specified Otherwise in Divisions 21, 22, and 23:

1. For motorized only equipment with built-in controllers (packaged equipment), Connect power and provide an external disconnect at equipment. Division 23 will provide control wiring.

2. For motorized only equipment with external controller (non-packaged equipment), provide external motor controller, disconnect switch, and make power wiring complete to equipment. Division 23 will provide control wiring.

3. For electric duct heaters with built-in controllers (packaged type equipment), connect power complete and provide external disconnect switch at equipment. Division 23 will provide control wiring.

4. For electric duct heaters with remote controllers (non-packaged type equipment), provide external controller, disconnect switch, and make power wiring to equipment. Division 23 will provide control wiring.

5. For combination motorized and electric heating packaged units specified with built in controllers and specified with "single point electrical connection" under Division 23, connect power and provide external disconnect switch. Division 23 will provide control wiring.

6. For equipment requiring a full voltage non-reversing starter, include as a combination disconnect unit.

D. Refer to Division 23 sections for control system wiring.

E. Refer to sections of other divisions for specific individual equipment power requirements.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.

C. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements and to applicable Division 26 sections.

D. UL Labels: Provide electrical connection products and materials which have been UL listed and labeled.
PART 2 - PRODUCTS

2.1 ELECTRICAL CONNECTIONS MATERIALS

A. For each electrical connection indicated, include complete assembly of materials, including but not limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories to complete splices, terminations, and connections.

B. Comply with requirements in Section 260519 for wires and cables, Section 260533 for raceway systems, and Section 262726 for wiring devices.

C. Include Final Connections for Equipment Consistent with the Following:
   1. Permanently Installed Fixed Equipment: Flexible seal-tite conduit from branch circuit terminal equipment, and raceway to equipment, control cabinet, terminal junction box, and wiring terminals. Totally enclose wiring in raceway.
   2. Movable and/or Portable Equipment: Wiring device, cord cap, and multi-conductor cord suitable for equipment and in accordance with NEC requirements.
   3. Other methods as required by NEC and as required by special equipment and field conditions.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.

B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.

C. Coordinate installation of electrical connections for equipment with installed equipment.

D. Verify electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit ampacity, and similar characteristics) for equipment furnished under other divisions, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report variances from electrical characteristics noted on electrical drawings to the A/E before proceeding with rough-work.

E. Obtain and review equipment submittals and shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.

F. Comply with requirements in Section 260553 for identification of electrical power supply conductor terminations.

3.2 STARTERS (CONTROLLERS)

A. Install non-packaged starters and wiring devices near motors or as indicated on the Drawings. Securely support and anchor in accordance with manufacturer's installation instructions. Locate for proper operational access, including visibility for safety.
### 3.3 PROVISIONS FOR MECHANICAL CONTROLS

A. Provide 120 Volt, 20 Amp circuit at locations required and described in Section 230900. Coordinate exact locations prior to installation.

B. Install power metering equipment at panelboards and switchboards furnished by control system subcontractor at locations required and described in Section 230900.

### 3.4 EQUIPMENT SHORT CIRCUIT CURRENT RATING

A. All mechanical equipment, packaged systems, control panels, motor starters, motor controllers, variable frequency drives and similar equipment shall carry a Short Circuit Current Rating (SCCR) equal to or greater than the available fault current delivered from the electrical system. Coordinate final available fault currents with the contractors providing this equipment.

### 3.5 MECHANICAL – ELECTRICAL INTERFACE SCHEDULE

A. Establishing the separation of work between trades and subcontractors is not within scope of these Contract Documents. The following schedule is proposed for assistance in bidding only.

B. Unless otherwise indicated in the Contract Documents, mechanical equipment and controls are suggested to be furnished, installed, and wired in accordance with the following schedule. Coordinate work with Division 22 and 23 sections.

<table>
<thead>
<tr>
<th>Item</th>
<th>Furnished By:</th>
<th>Installed By:</th>
<th>Power Wiring By:</th>
<th>Control Wiring By:</th>
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<td>9b. Relays and Ancillary Devices Associated with HVAC Unit Shutdown by Duct Smoke Detectors:</td>
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<td>10. Electric Heat Trace:</td>
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<td>11. Variable Frequency Drives:</td>
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<td>12. Section 230900 Control Panels:</td>
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</tbody>
</table>

M = Division 22 and 23, Plumbing and HVAC  
E = Division 26, Electrical  
For purposes of the above table, responsibility of power and control wiring includes raceways, connections and other components as required for complete installation of wiring system.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes selective demolition of existing electrical work as indicated in the Contract Documents.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Dust Control: Provide protective measures to minimize transfer of noise, dust, dirt, and refuse to adjacent areas of building. Such measure may include dusttight barriers, temporary walls, portable exhaust fans, vacuum systems, and temporary partitioning.

B. Extent: Keep areas of demolition as clean and orderly as physically possible. Do not allow demolition debris to accumulate. Gather debris and dispose daily. Broom or vacuum-clean work areas on daily basis.

C. Protection: Protect existing equipment, furnishing, and systems with protective coverings. Protect finished surfaces including floors, ceilings, and walls.

3.2 DAMAGES

A. Repairs: Promptly repair damage to existing surfaces, equipment, finishes, or adjacent facilities at no cost to the Owner and to the satisfaction of the A/E and the Owner.

3.3 DEMOLITION

A. General: Provide demolition work required in existing building for removal of existing electrical equipment, raceways, and conductors and for installation of new electrical equipment, raceways, and conductors. Relocate and modify existing electrical equipment, raceways and conductors as required by general construction alterations and by installation of new electrical equipment, raceways, and conductors in existing building to achieve a complete and functioning installation as defined in the Contract Documents.

B. Extent: Remove and dispose of existing materials indicated in the Contract Documents to be removed.

C. Reuse: Do not reuse existing products unless indicated on the Drawings.
D. Materials to Owner: Deliver items to the Owner’s Representative as indicated in the Contract Documents.

E. Materials to Contractor: Materials other than those reserved by the Owner.

F. Existing Conditions: Comply with requirements in Division 01. Verify specific demolition work and operating conditions to be encountered from on-site review and coordination with the Owner. Maintain service to existing equipment and devices during new construction work as required by construction sequencing/scheduling provisions. In areas adjacent to new construction work, provide temporary services as necessary to meet these conditions. Protect active conductors encountered. Notify the A/E of utilities encountered whose services are not known.

G. Repair of Damages to Underground Utilities: Exact location of existing underground utilities is not definitely known. Should any underground utilities be damaged in excavations, restore such utilities without additional cost to the Owner.

H. Drilling of Concrete: Drill openings through existing concrete with diamond tipped rotary core-drilling equipment or carbide tipped drills. In existing post tensioned slabs, locate and mark post tensioned strand locations with subsurface interface radar type locating equipment prior to drilling, cutting, and sawing operations.

I. Saw-Cutting of Concrete: Saw cut through existing concrete with diamond tipped or carbide tipped saw blade. In existing post tensioned slabs, locate and mark post tensioned strand locations with subsurface interface radar type locating equipment prior to drilling, cutting, and sawing operations.

3.4 DISPOSAL OF DEMOLISHED MATERIALS

A. Disposal: Remove debris, rubbish, and other materials resulting from demolition operations from building site unless reinstalled or delivered to the Owner as indicated in the Contract Documents. Transport and legally dispose of material off site.

B. Burning: Burning of removed materials is not permitted on project site.

3.5 CLEAN-UP AND REPAIR

A. Clean-Up: Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protection and leave interior areas clean.

B. Repair: Repair demolition performed in excess of that required at no additional cost to Owner. Return structures and surfaces to conditions existing prior to commencement of demolition work or as directed by the Owner.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Description: Work includes wire, cable, splices, and terminations for systems 600 Volts and less and associated appurtenances.
B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE
A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
B. Codes and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. UL 83, Thermoplastic-Insulated Wires and Cables.
   3. UL 62275, Cable Ties for Electrical Installations
C. Comply with NEC as applicable to construction and installation of electrical wire and cable. Electrical wire and cable UL listed and labeled.
D. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of wire and cable.
E. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of wire and cable.

1.3 SUBMITTALS
A. Comply with requirements in Division 01 and Section 260500.
B. Product Data: Submit manufacturer’s technical product data for each type of wire, cable, and appurtenance.
C. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 POWER AND LIGHTING CIRCUITS
A. Factory-fabricated conductors of sizes, ratings, materials and types indicated on the Drawings for each service. Where not indicated, select to comply with project’s installation requirements and NEC standards. Comply with the following:
   1. UL 83.
   2. Copper Conductor. No. 12 AWG and No. 10 AWG wire and cable to be solid. Wire and cable larger than No. 10 AWG stranded.
   3. Insulation type THHN/THWN-2 dual rated, 600 Volt for circuits from 115 to 600 Volts.
4. Use only 90°C insulated conductors based on 75°C ampacity tables of the NEC.

2.2 CONTROL AND SIGNAL CIRCUITS

A. Class 1:
   1. UL 83.
   2. Stranded copper conductor.
   3. Insulation type THHN, or THWN, 600 Volt for circuits from 115 to 600 Volts.

B. Class 2 and 3:
   1. Copper conductor, 300 Volt insulation, rated 75°C in dry locations and 60°C in wet locations. Individual conductors twisted together and covered with non-metallic jacket unless otherwise noted on the Drawings.
   2. UL listed for use in air handling ducts and hollow spaces used as ducts and plenums.
   3. Category UTP cabling for electrical control systems:
      a. Cable type per system manufacturer and shop drawings.
      b. Cables shall meet the most current technical characteristics of TIA-568-C standard.
      c. Cables shall be NFPA 262 CMP (plenum) rated, unless otherwise noted.

2.3 PLASTIC CABLE TIES

A. Teflon or nylon, locking type

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 WIRING AND CABLE INSTALLATION, GENERAL

A. Install electric conductors and cables as indicated on the Contract Drawings, in compliance with manufacturer’s written instructions, applicable requirements of NEC and NECA’s “Standards of Installation,” and in accordance with recognized industry practices.

B. Coordinate installation work with electrical raceway and equipment installation work for proper interface.
C. Pull cables by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device made through approved swivel connection. Non-metallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop to which pull wire can be attached. Remove insulation from conductors before forming loop. Larger sizes of cable may be pulled by using basket weave pulling grip, if pulling force does not exceed limits recommended by manufacturer. If pulling more than one cable, bind them together with friction tape before applying grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.

D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to conductors limited to 0.008 lbs. per circular mil of conductor cross-section area.

E. Pull in cable from end having the sharpest bend (bend closest to reel). Keep pulling tension to minimum by liberal use of lubricant, turning of reel, and slack feeding of cable into duct entrance. Employ not less than one person at reel and one in vault during this operation.

F. For training of cables: provide 12 times cable diameter minimum bend radius to inner surface of cable.

G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50 percent greater than specified above for training.

H. Apply wire and cable pulling compound recommended by specific cable manufacturer.

I. Seal cable ends unless splicing is done immediately.

J. Support cables in vaults, concrete trenches, and similar locations by cable racks. Secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator.

K. Follow manufacturer's instructions for splicing and cable terminations.

L. Provide separate neutral conductor for each circuit serving single phase loads, unless indicated otherwise on the Contract Drawings. Where shared neutrals are indicated for multi-wire branch circuits, provide circuit breaker handle ties per Section 262813.

M. Branch circuit wiring shall be grouped in separate raceways as indicated on the Contract Drawings. Where branch circuit raceways are not indicated on Contract Drawings, a maximum of three circuits may be installed in the same raceway if each circuit originates from the same panelboard.

3.5 WIRING METHODS, GENERAL

A. Install wiring in raceways unless indicated otherwise on the Contract Drawings or authorized by the A/E.

B. Install Wire After:
   1. Interior of building is protected from weather.
   2. Mechanical work likely to injure conductors is completed.
   3. Conduits have been cleaned and moisture removed.

C. Neatly train and lace wiring inside boxes, equipment, and panel boards.
D. Clean raceway system before installing conductors.

E. Use half-lapped synthetic tape if taping is utilized for insulation purposes.

F. Provide conductor support devices as required by NEC in vertical conduit runs.

G. Torque conductor connections and terminations to manufacturer's recommended values.

H. Maintain minimum 12-inch clearance between open cabling and heat sources such as flues, steam pipes, and heating appliances.

3.6 MINIMUM SIZES

A. Minimum No. 12 AWG for power and lighting circuits.

B. Minimum No. 14 AWG for control wiring.

C. Power and lighting circuits with home run lengths greater than 100 feet.  No. 10 AWG minimum.

D. Power and lighting circuits with home run lengths greater than 150 feet.  No. 8 AWG minimum

3.7 CLASS 2 AND 3 CABLE INSTALLATION

A. Class 2 and 3 Cable: Install in conduit.

3.8 WIRING SPLICES AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Splices and Taps:
   1. Use compression-set pressure connectors with insulating covers or screw-on pressure (wire nuts) for sizes No. 10 AWG and smaller.
   2. Use compression-set pressure connectors with insulating covers for wire splices and taps sizes No. 8 AWG and larger.  Split bolt splices and connectors not acceptable.

C. Terminations:  Eye-type compression lug when termination is to a bolt or screw terminal.
   1. 250 kcmil and larger, two-hole long barrel compression lugs.

D. Tape un-insulated portions of conductor and connectors with electrical tape to 150 percent of conductor insulation value.

E. Clean wires before installing lugs and connectors.

F. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.

G. Leave minimum 8 inches of pigtail at outlet boxes for connection to fixtures and devices. Where wiring is continued to other outlets, splice connection wire in a tap.  In no case will continuity through double terminal of device be allowed for either hot or neutral leg of circuit.

H. Insulate ends of spare conductors with electrical tape or wire nut.
I. Terminate control circuit conductors at terminal blocks only.

J. Utilize eye or forked tongue type compression set terminator for conductors No. 12 AWG and smaller when termination is to a bolted or screw set type terminal block or terminal cabinet.

K. Make below grade splices in handholes and vaults watertight with epoxy resin type splicing kits similar to Scotchcast.

3.9 FIELD QUALITY CONTROL

A. Test for Wires and Cables in accordance with Section 260810.

B. Test Category 5e UTP cabling as follows:
   1. Horizontal cabling shall be certified to meet or exceed the permanent link performance specifications for Category 5e horizontal cabling tested with a frequency range from 1 MHz to 100 MHz as defined in TIA-568-C.
   2. Certifications shall include the following parameters for each pair of each cable installed:
      a. Building System
      b. Cable identification between system devices
      c. Date of test
      d. Test equipment manufacturer and model number
      e. Wire map
         1) Continuity to the remote end.
         2) Shorts between any two or more conductors
         3) Reversed pairs
         4) Split pairs
         5) Transposed pairs
         6) Any other miswiring
      f. Length
      g. Near-end crosstalk (NEXT)
      h. Power sum-near-end crosstalk (PS-NEXT)
      i. Return loss (RL)
      j. Propagation delay (PD)
      k. Delay skew (DS)
   3. Horizontal cabling shall be tested using a Permanent Link configuration as defined in TIA-568-C.
   4. Test reports with an asterisk (*) or fails, shall be documented identifying the reason for the test failure and a corrective action plan developed.
   5. After corrective action has been completed, the permanent link shall be retested.
   6. Ensure 100 percent of the horizontal cabling system links pass all tests.

C. Test results shall be organized by building system type and cable identification number. The test results shall contain the date and time of when each test was saved in the memory of the tester. The test results shall be recorded in both PDF and manufacturer software formats and provided in the O&M manuals.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes grounding and bonding systems, equipment, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   3. IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding
   4. NFPA 70, National Electrical Code (NEC).
   5. NFPA 780, Standard for the Installation of Lightning Protection Systems
   6. UL 467, Standard for Grounding and Bonding Equipment.
   7. UL486A-486B, Wire Connectors
   8. ANSI C119.4, Electric connectors - connectors to use between Aluminum-to-aluminum or aluminum-to-copper conductors

C. Comply with NEC and IEEE requirements as applicable to electrical grounding and ground fault protection systems.

D. Products UL listed and labeled.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data for each item and appurtenance.

C. Shop Drawings: Plans showing dimensioned location of grounding system features, including ground rods, ground rings, test wells, grounding electrode system connections, and routing of grounding electrode conductors.

D. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.
PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 GROUNDING ELECTRODES AND CONDUCTORS

A. Bare Ground Conductors: Soft drawn copper. Stranded unless indicated otherwise. Tinned where indicated. Solid for No. 8AWG and smaller. Stranded conductors for No. 6 AWG and larger.

B. Insulated Ground Conductors: Copper with 600 Volt insulation in accordance with Section 260519.

2.3 GROUND CONNECTORS

A. Listed and labeled for applications and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connections: Exothermic-welding kits of type recommended by kit manufacturer for materials being joined and installation conditions. Manufacturer: Cadweld, Thermoweld, Thomas & Betts, or approved.

C. Compression Ground Connectors: Conform to IEEE 837 and UL 467.
   1. Cable-to-Cable Connections: Copper or copper alloy. Approved for direct burial or in concrete applications. Manufacturer: Thomas & Betts EZ-Ground® or approved.
   2. Cable-to-Busbar Connections: Two-hole long barrel compression lug, unless indicated otherwise on Contract Drawings.
   3. Cable-to-Cable Tray Connections: Two-hole long barrel compression lug.

D. Mechanical Ground Connectors: Conform to IEEE 837 and UL 467.
   2. Split-Bolt Connectors: Not acceptable.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.
C. Preparation of Surfaces: Clean contacting surfaces of ground connections to bright metal before connecting.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. System ground not to exceed maximum 5 ohms meggered resistance.

C. Ground each separately-derived system neutral to nearest building steel.

D. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, underground metal water piping systems, and gas piping systems.

3.4 GROUNDING ELECTRODE AND CONDUCTOR INSTALLATION

A. Equipment Ground Conductor: Install separate, insulated equipment ground conductor in each feeder and branch circuit. Terminate each end on grounding lug, bus, and bushing and to intermediate metallic enclosures.

B. Connect grounding conductors to motors in accordance with NEC. Remove paint, dirt, and other surface coverings at grounding conductor connection points so that good metal-to-metal contact is made.

C. Size main grounding system per NEC. Provide conduit to protect ground wire from damage to an area 6 feet above floor.

D. Conductor to Conductors, Conductor to Steel, and Conductor to Ground Rod: Exothermic-welded type connectors. Cadweld, Thermoweld, Thomas & Betts, or approved.

E. When making bolted connection to aluminum and galvanized structures, apply corrosion-inhibitor to contact surfaces between cable, connector, and surface of structure. Penetrox A or approved.

3.5 GROUND CONNECTORS

A. Welded Connections:
   1. Provide for underground connections.
   2. Provide for connections to structural steel.
   3. Provide for connections to ground bars where indicated.
   4. Provide full weld between coupling and ground rod at joint.
   5. Connect grounding conductors to ground rods at upper end of rod with end of rod and connection point below finished grade, except provide bolted connections at test wells and as otherwise indicated.
   6. When making connections, wire brush or file point of contact to bare metal surface. Use welding cartridges and molds in accordance with manufacturer’s recommendations. After welds have been made and cooled, brush slag from the weld area and clean joint. Use connectors of specified size for conductors and ground rods. Notify A/E before backfilling ground connections.
B. Ground shields of shielded power and control cable at each splice and termination as recommended by manufacturer.

C. Ground metal sheathing and exposed vertical metal structural elements of building. Ground metal fences enclosing electrical equipment. Bond metal equipment platforms which support electrical equipment to equipment ground. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, raceways, and similar items carrying circuits to these devices.

3.6 FIELD QUALITY CONTROL

A. Comply with requirements in Section 260810.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Include field test reports of grounding system in the Operation and Maintenance Manual.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes conduit and equipment supports, fastening hardware, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data, rated capacities and accessories for each item and appurtenance.

PART 2 - PRODUCTS

2.1 MATERIAL

A. General: Built-up framing for electrical raceway and equipment supporting systems, including but not limited to channel, rod, clamps, and hardware. Comply with requirements in Section 260548 for seismic restraints. Unless design is shown on the Drawings, size for 400 percent of calculated load.

B. Channel: 12 gauge galvanized formed metal with or without pre-drilled holes, Pre-galvanized. Cooper B-Line, Unistrut, Powerstrut, or approved.

C. Beam Clamps, in Pairs, at each Supporting (Structural) Beam: B-line B441-22 and B441-22A; Superstrut U-501 and U-502; Unistrut P2785, P2786, and P1379S, or approved. Submit other manufacturers for approval with evidence proving clamp complies with IBC and ASCE 7-05 for seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.

D. Beam Clamps for Use with Rods: B-Line B751-J4, B751-J6, B751-J9, and B751-J12; Superstrut U-569; Unistrut P2824-6, P2824-9, and P2824-12, or approved. Submit other manufacturers for approval with evidence proving clamp complies with seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.


F. Connectors for Bracing: Unistrut P6186, P7097, P7098, P7100, P7101, P7108, P7109, P7110, P6546, or approved.
G. Hardware, including Nuts (Locking Type), Bolts, and Set Screws: Corrosion resistant, designed for intended use.

H. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

I. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

J. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58

K. Hanger Rods: Threaded steel

L. Spring Steel Conduit Clips: Erico K series or approved.

M. Circular Cable Retainer:
   1. Cable retainers shall be of plastic material with rounded edges, plenum rated, utilizing an easy-lock closure and an attachment base. Cable retainers shall be screwed into structure and only be utilized in spaces that are extremely tight and J-hooks do not have sufficient space to be mounted.
      a. Manufacturer: Erico Caddy, Part No. CAT CR50

N. Outlet Box Support:
   1. Where more than one outlet box is shown on the Contract Drawings, and indicated to be at same elevation, align them exactly on center lines horizontally with wall mounting bracket.
      a. Manufacturer: Cooper B-Line Series BB8 or approved:

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.
3.4 SUPPORTING DEVICES INSTALLATION

A. Comply with requirements in Section 260548 for seismic restraints.
   1. Install diagonal bracing for trapeze support systems at 2 right angle planes to brace
      against:
      a. Horizontal and torsional movement lateral seismic forces.
      b. Vertical (uplift) movement caused by vertical seismic forces.
      c. Horizontal distortions in conduit system caused by wire pulling.

B. Unless otherwise shown on the Contract Drawings, attach connectors to vertical framing
   members with 2 bolts

C. Install toggle bolts or hollow wall fasteners in hollow masonry, plaster, and gypsum board
   partitions and walls. Install expansion anchors or preset inserts in solid masonry walls, self-
   drilling anchors, and expansion anchors on concrete surfaces. Comply with requirements in
   Section 260548 for seismic anchors.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten
   electrical items and their supports to building structural elements by the following methods
   unless otherwise indicated:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor
      fasteners on solid masonry units.
      a. To Existing Concrete: Expansion anchor fasteners.
      b. To Steel: Beam clamps MSS SP-58, Type 19 or 23, complying with MSS SP-69.
      c. To Light Steel: Sheet metal screws.
   4. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets,
      panelboards, disconnect switches, control enclosures, pull and junction boxes,
      transformers, and other devices on slotted-channel racks attached to substrate by means
      that comply with seismic-restraint strength and anchorage requirements

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a
   neat appearance. Use hexagon head bolts with spring lock washers under nuts.

F. Free Standing Electrical Equipment: Bolt to concrete base with leveling channels. Comply
   with requirements in Section 260510 for concrete base and Section 260548 for seismic
   restraints.

G. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards
   in stud walls.

H. Transformer Support: Comply with requirements in Section 262200.

I. Lighting Fixture Supports: Fixture support wires for recessed ceilings, match ceiling support
   requirements. All fixture supports to comply with requirements in Section 265100 and
   Section 260548.

J. Open Cabling Support Installation
   1. Provide hanger supports and cable supports for cabling specified in Division 26. All
      support structures shall adhere to the requirements in the National Electrical Code.
   2. Space cabling supports no further than 4'-0" apart.
   3. Install cabling supports on their own dedicated support system.
K. Raceways:
   1. Single raceway runs: Spacing to comply with requirements of Section 260533
      a. Suspended: support by threaded rod with spring steel conduit clips. Spring-steel
         clamps designed for supporting single conduits without bolts may be used for 1-inch
         and smaller raceways serving branch circuits and communication systems above
         suspended ceilings
      b. Mounted to building structure: single hole pipe straps.
   2. Two or more parallel runs of raceway: Install trapeze support systems with 25 percent
      space (6 inches minimum) for future conduit runs. Refer to Section 260533 for spacing
      requirements.
   3. Welding conduit and conduit fittings to structure not acceptable.
   4. Spacing: Space so that fittings are accessible to accommodate pulling or splicing.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes conduit, electrical metallic tubing, wireway, surface metal raceway, and associated appurtenances within building perimeter.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

C. Refer to Section 260543 underground electrical work beyond building perimeter.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county and state codes and ordinances. Comply with local Utility requirements and standards.

B. Codes and Standards:
   1. UL 1, Standard for Flexible Metal Conduit.
   2. UL 5, Standard for Surface Metal Raceways and Fittings.
   3. UL 6, Standard for Rigid Metal Conduit.
   4. UL 360, Standard for Liquid-Tight Flexible Metal Conduit.
   5. UL 514B, Standard for Conduit, Tubing, and Cable Fittings.
   6. UL 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
   7. UL 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
   8. UL 797, Standard for Metallic Tubing – Steel.
   9. UL 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
   10. UL 1242, Standard for Intermediate Metal Conduit – Steel.
   11. UL 2420, Standard for RTRC Conduit and Fittings for underground – Fiberglass
   12. UL 2515, Standard for RTRC Conduit and Fittings for above ground - Fiberglass

C. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.

D. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements of raceway systems.

E. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes specified and whose products have been in satisfactory use in similar service for not less than 3 years.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data for each type of raceway system and appurtenance.
PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC) AND FITTINGS
   A. Ferrous Metal Conduit: Steel, UL 6, hot-dip galvanized.
   B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS
   A. Ferrous Metal Conduit: Steel, UL 1242, hot-dip galvanized.
   B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.3 TELE-POWER POLES
   A. Provide Tele-Power Poles to extend branch circuit wiring and telecommunication cabling to
      locations shown on the drawings. The Tele-Power Poles shall consist of the Tele-Power Pole
      Assembly, appropriate fittings and accessories to complete the installation per the electrical
      and communication drawings.
      1. Wiremold 30TP-4V.
   B. The Tele-Power Pole: Steel channel, 10'-5" long with a cross section of 3" x 2.75" with two
      separate compartments and an ivory-baked enamel finish.
   C. One compartment factory wired with the number of devices indicated on the drawings. Provide
      ivory color to match the pole finish. The harness is to be single circuit (2 conductor plus
      ground), factory assembled to the receptacles. 6" conductor leads are to be furnished for
      termination to the overhead wiring system. The second compartment for field installation of
      telecommunications horizontal cabling.
   D. A full complement of fittings for the Tele-Power Pole shall be available including, but not limited
      to, entrance end fitting for top of the electrical channel, ceiling trim plate, pole-mounting
      bracket, Velcro carpet gripper pad, and adhesive pad. (If for air handling spaces, an entrance
      end fitting must be furnished for the communications channel.)

2.4 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS
   A. Ferrous Metal Conduit: Steel, UL 797, hot-dip galvanized.
   B. Fittings: UL 514B, galvanized steel, insulated throat, rain tight compression ring type through
      1-1/4 inch, set screw type for 1-1/2 inch and larger. Drive-on type and cast fittings not
      acceptable.

2.5 FLEXIBLE METAL CONDUIT AND FITTINGS
   A. Ferrous Metal Conduit: Steel, UL 1, galvanized. UL listed for grounding as available.
      Aluminum and flexible metallic tubing not acceptable.
   B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.
2.6 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Ferrous Metal Conduit: Galvanized with PVC weatherproof cover, UL 360 listed for grounding as available.

B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.

2.7 RIGID NON-METALLIC CONDUIT

A. PVC Conduit: Schedule 40, UL 651, rigid type unless noted otherwise. UL 651A Type A permitted for underground concrete duct banks.

B. Fittings: UL 651, UL 651A, UL 2420 and UL 2515.
   1. For electric (power) duct, 90 degree elbows with minimum 48 inch radius, factory manufactured rigid steel or Fiberglass (RTRC) with minimum 48 inch radius
   2. For telecommunications service provider ducts, 90 degree elbows with minimum 48 inch radius, factory manufactured rigid steel or Fiberglass (RTRC)
   3. For telecommunications on-site distribution ducts, 90 degree elbows with minimum 36 inch radius factory manufactured rigid steel (RMC)

2.8 SURFACE METAL RACEWAY

A. UL 5, sheet metal channel with fitted cover. Type and size as shown on the Drawings.

B. Finish: Enamel. Field paint to match wall color.

C. Fittings, Boxes, and Extension Rings: Designed for use with raceway systems.

D. All raceway and fittings to be supplied by one manufacturer.

E. Manufacturers: Mono-Systems, Wiremold, or approved.

2.9 CONDUIT BODIES

A. Conduit bodies cast malleable iron, zinc or cadmium plated with threaded connections. Covers gasketed, blank steel, or cast malleable iron, zinc or cadmium plated, and of same manufacturer as conduit body. Where conduit bodies are used as junction or splice boxes, comply with NEC.

B. Conduit bodies (Smart LB) for telecommunications cables shall be die cast aluminum, gray powder coat paint finish, threaded connections with internal built-in radius. Covers gasketed, die cast aluminum, and of same manufacturer as conduit body. Madison Electric or approved equal.
   1. 1-1/4” Smart LB, Madison Electric, KLB120
   2. 2-1/2” Smart LB, Madison Electric, KLB 250
   3. 4” Smart LB, Madison Electric, KLB400

2.10 WIREWAY AND AUXILIARY GUTTER

A. UL 870, lay-in type, with hinged cover but without knockouts.

B. Size: As shown on the Drawings, 4 by 4 inch minimum.
C. Finish: Rust-inhibiting primer coat with manufacturer’s standard enamel finish.

2.11 EXPANSION FITTINGS

A. Malleable iron, hot-dip galvanized allowing 4 inches (plus or minus 2 inches) conduit movement.
   1. RGC and IMC Raceway: OZ/Gedney Type AX series, Thomas and Betts Type EJG series or approved
   2. EMT Raceway: OZ/Gedney Type TX series, Thomas and Betts Type XJG series or approved.

2.12 SEALING FITTINGS

A. Wall Sealing Fittings: At each wall sealing fitting, include conduit seal fitting, OZ/Gedney FSK Series or approved.
B. Raceway Stubups and Stubouts: Conduit seals together with wall sealing fittings. OZ/Gedney CSB Series or approved.
C. For Exterior Wall Penetrations below Grade: Include sealing bushing at interior end of penetrating raceway. Only threaded fittings are permitted in entering raceways ahead of sealing bushing. OZ/Gedney Type CSB or approved.

2.13 CONDUIT SUPPORTS

A. Conduit Clamps, Straps, and Supports: Steel or malleable iron. Comply with requirements in Section 260529.

2.14 FIRE RATED SEALING COMPOUND

A. Dow Corning 3-548 Silicone RTV Foam or approved.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.
3.4 RACEWAY SIZING, ARRANGEMENT, AND SUPPORT

A. Unless otherwise shown on the Drawings, size conduit for conductor type installed. Minimum size 3/4 inch.

B. Install conduit to maintain headroom and present neat appearance in unfinished spaces. Install a minimum of 9'-6" above finished floor in spaces unless otherwise indicated on the Contract Drawings.

C. Install conduit concealed in walls, below floors, and above ceiling in spaces, except conduit may be exposed in mechanical rooms, electrical rooms, and similar unfinished spaces. Horizontal conduit installation is not allowed in floor slab unless specifically noted on electrical and structural drawings.

D. Route conduit parallel and perpendicular to building planes.

E. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, heating and hot water pipes, and heating appliances.

F. Brace conduit or conduit supports to prevent distortion of alignment by wire-pulling operations.

G. Where conduit is run in parallel, group on formed channel supports. Comply with requirements in Section 260529.

H. Do not fasten or support with wire or perforated pipe straps. Remove temporary conduit supports used during construction before conductors are pulled.

I. Raceway to be routed around structural members. Structural Engineer to approve proposed modifications of structural elements prior to commencement of work.

3.5 RACEWAY INSTALLATION

A. Cut conduit square using a saw or pipe cutter. Deburr cut ends.

B. Bring conduit to shoulder of fittings and couplings and tighten securely.

C. Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Do not use conduit bodies to make sharp changes in direction unless shown on the Drawings.

E. Use hydraulic one-shot conduit bender or factory elbows for bends in 2 inch conduit and larger.

F. Provide plastic bushings on conduit stubs used for transition from conduit to open cable runs.

G. During construction, use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

H. Distance Between Supports:
   1. Threaded Rigid Metal Raceways: Maximum ten foot centers and within 18 inches of each outlet, junction box, and bend.
   2. Electrical Metallic Tubing: Maximum ten foot centers at each bend and within 12 inches of each outlet, junction box, and coupling.
3. Surface Metal Raceway, Auxiliary Gutter, and Wireway: Maximum 5 foot centers or in accordance with manufacturer’s instruction, whichever is less, unless otherwise shown on the Drawings.

I. Provide polyester mule tape with printed footage indicators secured at each end of each empty conduit, except sleeves and nipples. Identify with tags at each end indicating origin and destination of empty conduit. Minimum tensile strength of 1250 pounds for conduits 2-inch and smaller and 2500 pounds for conduits larger than 2-inch.

J. Route conduit through roof inside openings for ductwork where possible. Otherwise, install through roof jack and seal weather tight.

K. Install no more than equivalent or four 90 degree bends between boxes.

L. Avoid moisture traps where possible. Where unavoidable, install junction box with drain fitting at conduit low point.

M. Raceway Installation below Slab on Grade:
   1. Installed a minimum of 2 inches below bottom of slab.
   2. Arrange and slope raceway to drain away from building.
   3. Install insulated grounding bushings at conduits stubbed up or out from underground unless capped for future (spare).
   4. Wipe PVC conduit clean and dry before jointing. Apply full even coat of cement to entire area to be inserted into fitting. Let joint cure for minimum 20 minutes.
   5. Install conduit that stub up through floor at such depth that exposed conduit is vertical and no curved section of elbow is visible.

N. Sealing of Conduit Penetrations:
   1. Exterior Wall Surfaces Above Grade: Seal around penetrations with caulking approved by the A/E. For concrete construction above ground level, cast conduit in wall or core drill wall and hard pack with mixture of equal parts of sand and cement.
   2. Exterior Wall Surfaces Below Grade: Cast conduit into wall (and floor) or use manufactured seal assembly cast in place.
   4. Fire Rated Construction: Seal penetrations with fire rated sealing compound to maintain fire rating of construction penetrated.

O. Sealing of Raceways: Seal interior of raceways that pass through building roof and through outside walls of building, above or below grade. Seal on end inside building. Use raceway sealing fittings manufactured for purpose sealed with non-hardening, compound-type mastic, specially designed for such service. Pack around wires in raceways.

P. Raceways on exterior surface of building: install only when shown on the Drawings and as approved by the A/E.

Q. Where flexible metal or liquid tight flexible metal conduit is installed, install bonding conductor to insure electrical continuity of raceway. Route bonding jumper inside conduit and terminate at grounding bushing or grounding locknut installed on inside of junction boxes at each side of flexible section. In instances where this method is not feasible (such as when cast boxes with hubs are used or where required by the NEC, route bonding jumper on outside of flexible conduit and terminate in accordance with methods acceptable to the AHJ.
R. Raceway shall not penetrate sheet metal ducts.

S. Branch circuits: install overhead, except circuits serving floorboxes, outdoor circuits or unless indicated otherwise on the Contract Documents.

T. Support raceways below roof decking: provide minimum 1-1/2” separation from raceway surface to nearest surface of metal roof decking.

U. In finished areas with exposed structure, subject to the approval of the A/E, raceways may be installed exposed. Install raceways as high as possible, provide minimum 1-1/2” separation from raceway surface to nearest surface of metal roof decking, and neatly arranged. Submit shop drawing indicating routing of proposed surface raceways and boxes in finished areas.

3.6 SURFACE METAL RACEWAY INSTALLATION

A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.

B. Install insulating bushings and inserts at connections to outlets and corner fittings.

C. Maintain grounding continuity between raceway components for continuous grounding path.

D. Fastener Option: Use manufacturer’s standard clips and straps for installed purpose.

3.7 AUXILIARY GUTTER INSTALLATION

A. Bolt auxiliary gutter to steel channels fastened to wall or in self-supporting structure. Install level.

B. Gasket each joint in oil-tight gutter.

C. Mount rain tight gutter in horizontal position only.

3.8 RACEWAY SCHEDULE

A. Rigid Metal Conduit:
   1. Acceptable in all locations except as modified in this section.
   2. Where in contact with earth or concrete, install protective coating consisting of spirally wrapped 20 mil PVC tape with 1/2 inch minimum overlap – 3M Scotchrap Tape 51 or approved - or utilize PVC Coated Rigid Metal Conduit. Completely wrap and tape field joints.
   3. Required for exposed raceways in areas subject to physical damage.

B. PVC Coated Rigid Metal Conduit:
   1. Required in corrosive environments or where indicated on the Contract Drawings.

C. Intermediate Metal Conduit:
   1. May be used in lieu of rigid metal conduit unless otherwise prohibited by code or indicated on the Contract Drawings.
   2. Not acceptable for circuits over 600 Volts.

D. Electrical Metallic Tubing:
   1. Acceptable for dry interior locations where not exposed to moisture or physical damage.
   2. Not acceptable for circuits over 600 Volts.
E. Rigid Non-Metallic Conduit:
   1. Acceptable below concrete slab on grade installed a minimum of 2 inches below bottom of slab.
   2. Not acceptable for exposed raceways extending through floor slab; utilize Rigid Metal Conduit.
   3. Not acceptable for bends 45 degrees and greater unless concrete encased; utilize Rigid Metal Conduit as specified herein, PVC Coated Rigid Metal Conduit or Fiberglass (RTRC). Field bends not acceptable.
   4. Concrete encased where indicated on Contract Drawings or where required by Code or Utility.

F. Flexible Steel Conduit:
   1. For connections to recessed light fixtures and devices installed in suspended ceilings, maximum six foot length.
   2. For connections to motors, transformers and other equipment subject to vibration. Minimum of three foot and maximum of six foot length with 90 degree loop.

G. Liquid-Tight Flexible Metal Conduit.
   1. For pump motors and equipment subject to vibration in damp and wet locations, in areas subject to being washed down, and for machinery where cutting oil is used. Minimum of three foot and maximum of six foot length with 90 degree loop.

H. Surface Metal and Multi-Outlet Raceway: Install where indicated on the Contract Drawings.

I. Auxiliary Gutters and Wireways: Install where indicated on the Contract Drawings and as required in unfinished spaces. Elsewhere as approved by the A/E.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes outlet, junction, and pull boxes and associated appurtenances required to enclose devices, permit pulling conductors, and for wire splices and branches.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NFPA 70, National Electrical Code (NEC).
   3. UL 514A, Metallic Outlet Boxes.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data for each type of outlet box and appurtenance.

PART 2 - PRODUCTS

2.1 OUTLET BOXES FOR INTERIOR WIRING

A. General: Outlet and pull boxes pressed steel, zinc coated with plaster ring where applicable, minimum 4 inch size.

B. Telecommunications and Audio Visual: Outlet and pull boxes galvanized steel, with plaster ring where applicable, minimum 4-11/16 inch, 3-1/4-inches deep.

C. Surface Metal Raceway: Boxes of same manufacturer and to match raceway. Boxes shall accommodate standard devices and device plates.

D. Concrete and Masonry: Boxes for casting in concrete and mounting in masonry walls of type specifically designed for that purpose.

E. Ceiling Outlet Boxes: Galvanized octagonal 4 inch, 1-1/2 inches deep (without fixture stud) and 2-1/8 inch deep (with fixture stud).

F. Sheet Metal Boxes Larger than 12 Inches in any Dimension: Include hinged enclosure.

2.2 OUTLET BOXES FOR EXTERIOR WIRING

A. General: Weather resistant and rain tight, with appropriate covers, gaskets, and screws.
B. Above Grade: Outlet and junction boxes cast or malleable iron or cast of corrosion resistant alloy compatible with raceway to which they are connected. Pull boxes fabricated of hot dipped galvanized heavy gage steel. Boxes with gasketed covers.

C. Below Grade: Provide underground vaults as specified in Section 260543.

2.3 OUTLET BOXES CONTAINING MULTIPLE DEVICES

A. Outlet Boxes Containing Emergency and Normal Devices: Permitted only with steel barriers manufactured especially for purpose of dividing outlet box into 2 completely separate compartments.

B. Outlet Boxes Containing Multiple Devices and Wiring Rated over 150 Volts to Ground and Over 300 Volts Between Conductors: Permitted only with steel barrier manufactured especially for purpose of dividing outlet box into separate compartments for each device having exposed live parts.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 COORDINATION OF OUTLET BOX LOCATIONS

A. Locate as shown on the Drawings and as required to facilitate pulling. Limit number of bends per NEC.

B. Electrical box locations shown on the Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets before roughing in.

C. Locate outlet boxes to allow access. If inaccessible, furnish, arrange, and pay for installation of access doors.

D. Coordinate Work of this section with the Work of other sections and trades to avoid conflicts. Check and verify door swings and locations of built-in cabinets, plumbing, heating, and ventilating equipment.
E. Install outlet boxes of sizes and at locations necessary to serve equipment furnished under this or other divisions of the specifications. Make final connections thereto. Outlet boxes required if equipment is furnished with pigtail for external connection, does not have space to accommodate branch circuit wiring, or requires wire with insulation rating different from branch circuit wiring. Review equipment Shop Drawings for required outlet locations.

F. Where more than one outlet box is shown on the Drawings, and indicated to be at same elevation or one above the other, align them exactly on center lines horizontally or vertically. Relocate outlet boxes which are not so installed (including lighting, receptacle, power, signal, and temperature control outlets) at no additional cost to the Owner.

G. Centered on Built-In Work: In the case of doors, cabinets, recessed or similar features, or where outlet boxes are centered between such features, such as between door jamb and cabinet, make these outlet box locations exact. Relocate outlet boxes which are not centered.

H. Flush mount boxes with front edge of box or plaster ring even with finished surface of wall and ceiling, except those mounted above accessible ceilings and where surface mounting is permitted.

I. Locate to maintain headroom and to present a neat appearance.

J. Route conduit from switch and receptacle boxes in walls vertically to space above ceiling. Install junction box before horizontal run.

K. Offset outlet boxes minimum of one stud horizontal separation between flush boxes mounted on opposite sides of acoustic rated common wall.

L. Install outlet boxes with minimum 6 inch horizontal separation between closest edges of flush boxes mounted on opposite sides of common wall.

M. Ceiling Locations: Locate outlet either at corner joint or in center of a panel, whichever is closer to normal spacing. Locate outlet boxes in same room in same panel locations.

N. Conceal outlet boxes for electric water coolers behind cooler unit housing.

3.5 OUTLET BOX INSTALLATION

A. Anchor boxes so they will not shift or rock when devices are operated (including insertion and removal of cord caps).

B. Firmly anchor flush outlet boxes directly or with concealed bracing to studs and joists.

C. Close unused openings.

D. Support boxes independently of conduit except for cast outlet boxes that are connected to 2 rigid metal conduits, both supported within 12 inches of outlet box.

E. Use multiple-gang outlet boxes where 2 or more devices are mounted together. Do not use sectional boxes.

F. Install blank covers or plates over outlet boxes that do not contain devices.

G. In inaccessible ceiling areas, install outlet and junction boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling openings.
H. Install recessed outlet boxes in finished areas. Secure outlet boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall and adjustable steel channel fasteners for flush ceiling outlet boxes.

I. Install outlet boxes in walls without damaging wall insulation.

J. Seal conduit boxes, telephone boxes, and similar items air tight with acoustical caulk where located in acoustical rated walls that are not fire rated.

K. Install outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use outlet boxes with sufficient depth to permit conduit hubs to be located in masonry void space.

L. Install pull boxes to be accessible after completion of building construction.

3.6 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK, AND CASEWORK

A. Install as shown on the Drawings. Furnish templates to other trades for drilling and cutting to ensure accurate location of electrical fixtures (outlets and devices) as verified with the A/E. Install wiring, devices, plates, and connections required by said fixtures.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes isolation pads, spring isolators, restrained spring isolators, restraint cables, hanger rod stiffeners, anchorage bushings and washers, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel".

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data:
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation and seismic restraint device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the AHJ.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

C. Delegated-Design Submittal: For vibration isolation and seismic restraint details indicate to comply with performance requirements and design criteria, including analysis data signed and sealed by professional engineer responsible for their preparation.
   1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
      a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors.
      b. Comply with requirements in other Division 26 sections for equipment mounted outdoors.
   2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
   3. Field fabricated supports.
   4. Seismic Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By agency acceptable to AHJ, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

D. Welding Certificates.

E. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.4 PERFORMANCE REQUIREMENTS

A. General: A single supplier shall furnish isolation mounts, pads, seismic restraints, sway braces, related hardware, and fabricate isolation bases for the project unless otherwise specified.

B. Responsibility: This supplier shall be responsible for selection and installation supervision of vibration isolators. Prepare engineering drawings and details and submit to the A/E. Perform installation supervision and provide adjustment instructions.

C. Seismic Restraints:
   1. Design and select restraint devices for ducts, pipes, and equipment to meet seismic requirements in IBC and ASCE 7-05. Retain a structural engineer to determine the following coefficients as listed in IBC and ASCE 7-05 as they pertain to this project. Pay structural engineering service fees.
      a. Seismic Design Category.
      b. Component Importance Factor, IP.
      c. Occupancy Category.
      d. Design Spectral Response Acceleration at Short Periods, SDS.
      e. In-Structure Component Amplification Factor, AP.
      f. Component Response Modification Factor, RP.
      g. Mapped Spectral Acceleration for Short Periods, SS.
      h. Site Coefficient, FA.
      i. Site Class.
   2. Retain an engineer, specialty consultant, or seismic restraint device manufacturer to design and develop seismic restraint systems and perform calculations based on actual equipment data.
   3. Engineer, specialty consultant, or seismic restraint device manufacturer shall coordinate attachments to structure to verify that attachment points on equipment and structure can accept seismic, weight, and other loads imposed. Pay any additional structural engineering services fee.
   4. Shop Drawings, details, and calculations shall be stamped and signed by a professional engineer licensed in engineering in the state in which the Work is performed.
PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINT DEVICES

A. Manufacturers: Amber/Booth, California Dynamics Corporation, Cooper B-Line, Hilti, Mason Industries, TOLCO, Unistrut, or approved.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements as defined in reports by an agency acceptable to AHJ.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components minimum 4 times maximum seismic forces to which they will be subjected.

C. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service. Include minimum 2 clamping bolts for cable engagement.

D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene with a flat washer face.

H. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of 8 times diameter.

I. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.
3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to the AHJ.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces. Welding stiffeners to rods not acceptable.

C. Strength of Support and Seismic Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.5 SEISMIC RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
   1. Install restrained isolators on electrical equipment.
   2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   3. Install seismic restraint devices using methods approved by agency acceptable to AHJ providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall mounted equipment, arranged to provide resilient media where equipment or equipment mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated on the Drawings, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, and at concrete members.

D. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the A/E if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, and grout has achieved full design strength.
   3. Mechanical Anchors: Protect threads from damage during anchor installation. Install sleeve anchors with sleeve fully engaged in structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from bottom of hole and progressing toward surface in such a manner as to avoid introduction of air pockets in adhesive.
   5. Set anchors to manufacturer’s recommended torque using a torque wrench.
3.6  ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections and branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.7  FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Obtain the A/E’s approval before transmitting test loads to structure. Install temporary load-spreading members.
   2. Test at least 4 of each type and size of installed anchors and fasteners selected by the A/E.
   3. Test to 90 percent of rated proof load of device.
   4. Measure isolator restraint clearance.
   5. Measure isolator deflection.
   6. Verify snubber minimum clearances.
   7. If a device fails test, modify installations of same type and retest until satisfactory results are achieved.

B. Remove and replace malfunctioning units, provide new, and retest as specified above.

C. Prepare test and inspection reports. Include copy of reports in the Operation and Maintenance Manual.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES
   A. Description: Work includes nameplates, wire and cable markers, conduit color coding, buried duct marking tape, and associated appurtenances.
   B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE
   A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
   B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

1.3 SUBMITTALS
   A. Comply with requirements in Division 01 and Section 260500.
   B. Product Data: Nameplate schedule.

PART 2 - PRODUCTS

2.1 IDENTIFICATION MATERIAL
   A. Nameplates:
      1. Engraved three-layer laminated plastic.
         b. NEC 700 System - Emergency Power: White letters on orange background.
         c. NEC 702 System – Optional Standby Power: White letters on green background.
      2. Control Panels and Equipment (Lighting and Receptacle Control): 1/2 inch high letters to identify equipment designation. 1/4 inch high letters to identify source, control panel name and space and zone controlled as designated on the Drawings.
      3. Digital Control Switches: 1/4 inch engraved letters on push button or cover to identify control zone.
   B. Adhesive Printed Labels:
      1. Laminated tape – Brother TZe Series 12 mm width tape or equivalent with adhesive back suitable for exterior locations.
         b. NEC 700 System Emergency Power: Orange letters on white background.
         c. NEC 702 System Emergency Power: Green letters on white background.
      2. Switches: 1/4 inch letters to identify load controlled.
      3. Receptacles: 1/4 inch letters to identify panelboard, circuit number and where identified as Dedicated, identify equipment designation as shown on panel schedule
      4. Lighting control devices: 1/4 inch letters to identify lighting control device designation as shown on shop drawings and lighting control program
   C. Outlet boxes, junction boxes and pull boxes for emergency system devices and circuits orange in color, both inside and outside.
D. Outlet boxes, junction boxes and pull boxes for fire alarm system devices and conductors: red in color, both inside and outside.

E. Permanent felt marker for junction and pull box.
   2. Lighting controls: Black letters indicating "Lighting Control Device" and relays

F. Wire and Cable Markers:
   1. Split sleeve or tubing type. Vinyl impregnated cloth, vinyl, and mylar self-adhesive types not acceptable.
   2. Color code wire in accordance with the coding shown in Decal Detail below. Conductors of power systems in this building (plant) are identified as follows:

<table>
<thead>
<tr>
<th>Conductor</th>
<th>208Y/120 Volt</th>
<th>480/277 Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Phase (Left Bus In Panel):</td>
<td>Black</td>
<td>Brown</td>
</tr>
<tr>
<td>B Phase (Center Bus In Panel):</td>
<td>Red</td>
<td>Orange</td>
</tr>
<tr>
<td>C Phase (Right Bus In Panel):</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>A Phase (Isolated Ground Circuit):</td>
<td>Black with yellow stripe</td>
<td>N/A</td>
</tr>
<tr>
<td>B Phase (Isolated Ground Circuit):</td>
<td>Red with yellow stripe</td>
<td>N/A</td>
</tr>
<tr>
<td>C Phase (Isolated Ground Circuit):</td>
<td>Blue with yellow stripe</td>
<td>N/A</td>
</tr>
<tr>
<td>Neutral:</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>Equipment Ground:</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Isolated Ground:</td>
<td>Green with yellow stripe</td>
<td>N/A</td>
</tr>
</tbody>
</table>

3. Where dedicated neutral conductors are provided for single phase circuits, neutral conductor shall have a colored stripe to match the color of the corresponding phase conductor.

G. Phase Identification: Vinyl colored electrical tape.

H. Directory Cards: Directory cards shall consist of heavy cardstock, metallic mounting frames and plastic covers. Mounting frames attached to the back side of panelboard or lighting control panel doors. Directories shall contain typewritten text indicating the circuit breaker or control relay number, type of load served and room number in which each load is located. Unused circuit breakers or control relays designated with "SPARE" written in pencil. Spaces for future circuit breakers left blank. Circuit designations on directory cards shall match the installed conditions with respect to loads and physical arrangement within panelboards.

I. Wiring Color Code Schedules: Prepared using a color printer and laminated between two layers of clear plastic. Schedules shall show color designation for each phase, neutral and ground of each system voltage. Schedule size, 130 mm by 180 mm (5" by 7").

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.
3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. Description: Install, apply, erect, and perform work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, more stringent requirements govern.

B. Nameplates:
   1. Degrease and clean surfaces to receive nameplates.
   2. Install nameplates parallel to equipment lines.
   3. Secure nameplates to equipment fronts using screws or rivets. Adhesives not acceptable.

C. Wire Identification:
   1. Install wire markers on conductors in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer’s shop drawings for control wiring.
   2. Install solid colored jackets for wire sizes smaller than number 8 AWG. Wire sizes larger than number 10 AWG may be taped at both ends and at pull and junction boxes with appropriate colored tape. Color coding tape to completely encircle conductor at least 3 inches wide.

D. Felt Marker Identification: Apply on front of cover in non-finished areas, such as mechanical/electrical rooms, above ceilings, and similar locations, and on back of cover in finished areas.

3.4 INSTALLATION

A. General:
   1. Provide identification for electrical equipment as specified herein.
   2. Attach identification in durable manner, suitable to each respective type of identification. Securely fasten nameplates to equipment with two (2) rivets. Wiring color code schedules fastened to equipment with permanent adhesive.

B. Panelboards: Provide the following schedules
   1. Directory cards: Provide in each panelboard. Update room numbers and descriptions to match final owner approved room name/number. Place directory card in holder behind plastic cover.
   2. Provide a reduced copy of each panel schedule contained in the Contract Documents, showing actual configuration. Provided panel schedules in addition to the typewritten panelboard directories. Place schedules in directory frame.
   3. Provide a wiring color code schedule attached to each panelboard. Install schedules on the inside of panelboard doors.
C. Control Panels/Equipment:
   1. Nameplate: attach to the outside, front of enclosure for each relay panel, control units and control equipment. Nameplate text shall include the relay panel name or space and zone controlled as designated on the Drawings.

D. Relays and Time Switches:
   1. Provide a nameplate on the outside front of each relay and time switch enclosure. Nameplate text shall include the name of the load controlled as designated on the Drawings.

E. Contactors:
   1. Provide a nameplate on the outside front of each contactor enclosure. Nameplate text shall include the contactor name as designated on the Drawings and the name of the load controlled.

F. Control Switches:
   1. Provide a nameplate for each equipment control switch with a device plate as specified in Section 262726. Nameplate text shall include the name of the load controlled as designated on the Drawings.
   2. Provide a nameplate or printed label on each control switch that does not have a device plate as specified in Section 262726. Verify type with Architect’s Consultant. Text shall include the name of the load controlled as designated on the Drawings.

G. Wiring Devices:
   1. Receptacle Labels:
      a. Indicate panelboard and circuit number.
      b. Where noted with subscript “D” indicating dedicated receptacle, provide label indicating equipment to be connected as noted in panel schedule e.g., refrigerator, microwave, copier, printer, etc.
      c. Where noted with equipment description on plan drawing, provide label indicating equipment to be connected as spelled out in panel schedule e.g., refrigerator, microwave, copier, printer, etc.
   2. Provide an engraved printed label for each switch that controls luminaires not within sight of the switch or that controls receptacles. Engraved printed label text shall include the type and location of the load controlled.

H. Junction Boxes and Pull Boxes:
   1. Provide nameplates on the outside of the front cover of junction boxes and pull boxes in finished areas and of junction boxes and pull boxes that are larger than 150 mm by 150 mm (6" by 6"). Nameplate text shall designate the system for which wiring is to be enclosed in the box. In the case of power system junction boxes or pull boxes, the nameplate text shall also include the panelboard name and circuit number.
   2. Junction boxes and pull boxes 150 mm by 150 mm (6" by 6") or smaller in unfinished areas and above accessible ceilings must be color coded by spray painting the outside edges of the box and spray painting the cover with the following colors:

   - 208Y/120 VAC Power: Unpainted
   - 480Y/277 VAC Power: Tan
   - Fire Alarm & Detection: Red
   - Security and Video Surveillance: Purple
   - Telecommunications: Blue
   - Intercom/Paging & Clock: White
   - Television: Black
Audio-video: Gold
High Voltage – 600V and higher: Yellow
NEC 700 Emergency System: Orange
NEC 702 Optional Standby System: Green

3. After painting, mark the covers of power system junction boxes and pull boxes with the panelboard name and circuit numbers. Marking must be done with a wide-tip, permanent-ink black marker.

I. Outlet Boxes:
   1. Outlet boxes for emergency power and fire alarm circuits must be color coded by spray painting the box inside and outside with the following colors:

   Fire Alarm & Detection: Red
   NEC 700 Emergency System: Orange
   NEC 702 Optional Standby System: Green

J. Raceway systems:
   1. NEC 700 Emergency Power: Provide adhesive label at intervals not exceeding 25 feet. Orange with black letters, “EMERGENCY SERVICE” Brady #44328 or approved. Where outlet boxes or enclosures are encountered within 25 feet, label not required.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes testing requirements for individual components, equipment, systems, and integration to ensure intended facility operation. Test equipment per manufacturer guidelines and industry standards. Test modes of operation and interlocks and alarm functions. This section presents a guideline of system testing. Provide complete, comprehensive testing in addition to minimum requirements specified in individual sections and in this section.

B. Training: Include comprehensive Owner operation and maintenance training of individual components, equipment, and systems. Training includes normal operation and alternate modes of operations.

C. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   4. NFPA 70, National Electrical Code (NEC).

C. Testing Agency: Testing shall be accomplished by an approved testing agency. Retain services of a NETA certified firm or approved. Testing agency shall not be associated with manufacturer of equipment or systems under test.

D. Perform testing and inspections with the assistance of a factory-authorized service representative, where indicated in individual specification sections.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Qualifications: Testing agency qualifications.

C. Testing Plan and Schedule: Detailed plan and schedule of testing, and training for acceptance by the Owner and the A/E prior to initiation of work.

D. Test Procedures: Test procedures and sample test forms.
E. Test Reports: Submit detailed report of testing functions with associated results. Include date of testing and corresponding line item for system tested and individual components. Include testing checklists for each system and device tested. Record for each line item test results that comply with requirements. Record for each line item test results that do not comply with requirements, corrective actions taken to achieve compliance with requirements and retest date and confirmation.

F. Settings of Adjustable Devices: Record as-left set points of all adjustable devices.

G. Include copy of reports in the Operation and Maintenance Manual.

H. Certification: Certification that tests have been completed.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 GENERAL

A. Perform acceptance tests in accordance with manufacturer’s recommendations, NFPA 70 and ANSI/NETA ATS.

B. Report any system, material, or workmanship which is found defective on basis of electrical inspections and tests to the A/E.

C. If test reveals a fault or problem, remove and replace malfunctioning units. Repeat entire test until problem is corrected. Submit additional written test reports.

D. Maintain written record of tests. Upon completion of project, assemble and certify final test report and include in the Operation and Maintenance Manual. Compile field test reports signed by individuals performing the tests.
3.5 GENERAL COMPONENT AND EQUIPMENT TESTING REQUIREMENTS

A. Grounding:
   1. Test each ground electrode system. Comply with requirements in Sections 260526 and 260527.

B. Overcurrent Protective Device Calibration: Perform necessary field settings and adjustments to conform to the coordination study specified in Section 260573.

C. Overcurrent Protective Device Factory Tests: Submit documentation of factory testing of distribution circuit breakers as specified in Section 262813.

D. Receptacles: Test for open ground, reversed polarity, open hot, open neutral, hot and ground reversed, and hot on neutral.

3.6 LIGHTING CONTROLS TESTING

A. Test lighting controls, components and systems in accordance with local codes, manufacturer recommendations.

B. Test each device to confirm operation per manufacturer recommendations and design requirements.

C. Document each component, device and system tested and include “as-left” settings for all adjustable settings. Include a matrix which identifies device, type and location at a minimum.

3.7 REPORTS

A. Prepare test reports for each system, equipment and device tested. Include copy of each test report in the Operation and Maintenance Manual. Utilize test forms for systems and equipment tested. Use manufacturer’s standard or other appropriate test forms commensurate with test performed. Test reports shall include the following.
   1. Summary of project.
   2. Description of equipment tested.
   3. Description of test.
   4. Test results including retesting results.
   5. Test dates.
   6. Tester’s name.
   7. Witnesses (when required).
   8. Corrective work.
   9. Acceptance criteria.
   10. Conclusions and recommendations.
   11. Appendix including appropriate test forms.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes design, furnish, and install of lighting control system(s) required to form complete coordinated system(s) ready for operation. Contract Documents indicate minimum scope and performance criteria. It is the responsibility of the lighting controls manufacturer/vendor/contractor to provide a complete system.

B. Digital lighting controls: Stand-alone, energy saving intelligent lighting control system including lighting control panels, network interface modules, emergency lighting transfer devices, as well as digital wall switches, occupancy sensors, daylighting controls, and associated appurtenances.

C. Analog lighting controls: Energy saving lighting control devices including wall switches, occupancy sensors with power supplies, emergency lighting transfer devices, daylighting controls, contactors and associated appurtenances.

D. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   1. NEMA 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts.
   2. NFPA 70, National Electrical Code (NEC).
   3. UL 508, Standard for Industrial Control Panels.
   5. UL 917, Standard for Clock Operated Switches.

C. Comply with NEC, NEMA, and FCC emission requirements for Class A applications.

D. UL Approvals: Relay panels and accessory devices UL listed and labeled under UL 916. Custom relay panels UL listed and labeled under UL 508. Automatic load control relays UL listed and labeled under UL 924. Branch Circuit Emergency Lighting Transfer Switch UL listed and labeled under UL 1008.

E. Certification: Manufacturer shall certify that products will meet product specifications and local energy codes. If any additional equipment is required to meet coverage patterns and local energy codes, provide additional equipment at no additional cost to the Owner.

1.3 DESIGN/PERFORMANCE REQUIREMENTS

A. Design, furnish, and install complete operable lighting control system(s) in accordance with the latest adopted editions of energy code and Owner requirements.
B. Drawings reflect minimum Owner requirements. The Contractor’s scope of work shall include but not limited to the following:
   1. Complete lighting control system based on the available architectural, civil, structural, mechanical and electrical drawings.
   2. Wiring systems associated with lighting controls.
   3. Providing additional occupancy sensors, photo sensors, daylight sensors, low voltage switches, relays, dimming modules, UL 924 control devices, control panels, and power supplies associated with lighting controls system.

C. Stand-Alone digital lighting controls shall accommodate the square-footage coverage requirements for each space controlled as indicated on the lighting zone control plans. Provide relays, control modules, dimming modules, occupancy sensors, switches, daylighting sensors, contactors and accessories that suit the required lighting and electrical system parameters.

1.4 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of lighting control system and components. Include digital cable, analog cable, termination types, wire connectors, manufacturer specific back boxes/supporting equipment.

C. Shop Drawings:
   1. Floor plans showing wall occupancy sensors, light switches, relays, contactors, power supplies, dimming modules, and locations. Include typical installation and mounting diagrams for dimming and occupancy control devices. Above ceiling devices to be shown on the floor plans.
   2. Reflected ceiling plans showing occupancy sensors, daylighting sensor. Include typical installation and mounting diagrams for occupancy and daylighting control devices.
   3. Detailed point to point wiring diagrams.
   4. System one-line diagram showing panels, number and types of switches and sensors, and building energy management system interface.
   5. Request for engraved switch verbiage
   6. Drawings for each panel showing hardware configuration and numbering.
   7. Panel wiring schedules.
   8. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

D. Commissioning/Test Reports:
   1. Field Test Reports.
   2. Commissioning Plan with Test Procedures.

E. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      a. Include approved Shop Drawings and Product Data.
      b. Engraved switch identification.
      c. Include Sequence of Operation, identifying operation for each room/ space and accent lights.
      d. Include manufacturer's maintenance information.
e. Operation and Maintenance Data: Include detailed information on device programming and setup.
f. Include startup and test reports.

1.5 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.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.6 WARRANTY

A. Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Digital Lighting Control: Match existing. Wattstopper DLM.

B. Analog Lighting Control: Match existing. Wattstopper.

2.2 SYSTEM DESCRIPTION

A. Space Control System: Electrically operated, electrically supervised, lighting control system as described herein. Include control units, power supplies, relays, dimming output control devices, input control devices including occupancy sensors, photo sensors and control switches, wiring, cabling, conduit, fittings, and accessories required for a complete operating system.

B. System Types (indicated in the contract documents):
   1. Digital control: Digital controllers for lighting zones, fixtures. Provide controllers to match the lighting control requirements. System, control, and features include:
      a. Stand-alone digital control system: Digital control within a single space to bind room loads to the connected control devices in the space. Control functions are limited to the devices connected to the stand alone digital control system.
         1) Self-configuring digital controller(s) with all digital parameter data programmed into non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
      b. Digitally addressable control devices:
         1) On/Off control relays.
         2) Dimming control devices: 0-10V, phase dimming.
         3) Plug load control relays.
         4) Tunable control devices.
      c. Digital inputs:
         1) Occupancy sensors.
         2) Photo sensors.
3) On/Off/Scene and dimming control switches.
4) Partition sensors.

d. Configuration tools: Allows complete configuration and reconfiguration of the Space. Must be able to tune system without the use of ladders.

2. Analog control: Single function analog devices to control lighting fixture and/or plug loads. Provide devices to match the lighting and plug load control requirements indicated in contract documents.

a. Analog control devices:
   1) Line voltage control devices receive input from analog low voltage control devices and include the following:
      a) On/Off universal voltage power pack.
      b) Plug load control on/off universal voltage power pack.
   2) Low voltage control devices provide inputs to line voltage control devices or directly to light fixtures and include:
      a) Occupancy sensors.
      b) Photo sensors.
      c) Momentary contact On/Off Switches.
      d) Occupancy sensor control switches W/ 0-10V dimming control where indicated.

C. Comply with requirements in Section 260533 for raceways, Section 260519 for conductors and wiring, Section 260534 for outlet boxes, and Section 260529 for supports. System cabling requirements shall meet manufacturer standards.

D. Enclose entire lighting control system wiring in raceways.

E. Control: The system shall have control devices to perform automatic and/or manual control functions indicated on the drawings and defined below. The control devices shall be capable of being controlled by any system input device type.

1. Occupancy Sensor Control: Provide occupancy sensors for on/off control with manual dimming of light fixtures in as indicated on drawings. Control shall function as vacancy sensors with Manual-ON functionality or occupancy sensors with Automatic–ON functionality.

2. Dimming Control Requirements: Provide automatic dimming for each light fixture in daylight areas and manual dimming zones as indicated on lighting zone control drawings.

3. Manual On/Off Control: Provide control devices to turn on/off all light fixtures within manual control zones as indicated in the drawings.

4. Daylighting Control Requirements: Provide daylight-responsive automatic control in all spaces where daylight contribution is available as defined by relevant local building energy code. See lighting control zone drawings for additional information:
   a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylighting zones.
   b. Daytime set points for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with drawings and specifications.
   c. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system shall be designed to turn off electric lighting when daylight is at or above required lighting levels. Daylighting control system shall turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

5. Egress Lighting Control: Provide dedicated control devices for all egress lights within each control zone indicated in the drawings. Egress light fixtures shall be on anytime the building is occupied. Control of egress light fixture shall be with occupancy sensor.
2.3 SYSTEM OPERATION

A. Digital Control System shall include the following features:

1. Occupancy Sensors: Digital wall/ceiling device or digital wall switch.
   a. Calibration and configuration for the following variables:
      1) Sensitivity: 0-100 percent in 10 percent increments.
      2) Time delay: 1-30 minutes in 1 minute increments.
      3) Test mode: Five second time delay.
      4) Detection technology: PIR, Dual Technology activation and/or re-activation.
      5) Walk-through mode.
   b. Programmable control functionality including:
      1) Each sensor may be programmed to control specific loads within a local
         network.
      2) Adjustable retrigger time period for manual-on loads. Load will retrigger (turn
         on) automatically during the configurable period of time (default 10 seconds)
         after turning off.
      3) On dual technology sensors, independently configurable trigger modes are
         available for both Normal (NH) and After Hours (AH) time periods. The
         retrigger mode can be programmed to use one of both technologies.
         Technologies include:
            a) Ultrasonic or Microphonic.
            b) Passive Infrared.
      c. Independently configurable sensitivity settings for passive infrared and ultrasonic
         technologies (on dual technology sensors) for both Normal Hours (NH) and After
         Hours (AH) time periods.
      d. Cable or wiring connections as required by the lighting controls systems.
      e. Device Status LEDs including:
         1) PIR detection.
         2) Ultrasonic or Microphonic detection.
         3) Configuration mode.
      f. Assignment of any occupancy sensor to a specific load within the room without
         wiring or special tools.
      g. Manual override of controlled loads.

2. Dimming Control:
   a. Each load shall have an independently configurable preset on level for Normal Hours
      and After Hours events to allow different dimmed levels to be established at the start
      of both Normal Hours and After Hours events.
   b. The following dimming attributes may be changed or selected using a network
      interface or wireless configuration tool:
      1) Establish preset level for each load from 0-100 percent.
      2) Set high and low trim for each load.
      3) Normalize dimming curve for main ambient light fixtures of each space so they
         dim at the same rate.
   c. Override button(s) for each load provides the following functions:
      1) Press and hold for dimming control (Dim Up).
      2) Press and hold for dimming control (Dim Down).
   d. Each dimming output channel shall have an independently configurable minimum
      and maximum calibration trim level to set the dimming range to match the true
      dynamic range of the connected ballast or driver. LED level indicators on bound
      dimming switches shall utilize this new maximum and minimum trim.
3. Daylight sensors:
   a. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
      1) Closed loop sensors measure the ambient light in the space and control a single lighting zone.
      2) Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
      3) Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

4. Digital Push Button Switches:
   a. Programmable control functionality including:
      1) Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.
      2) Individual button function may be configured to Toggle, On only or Off only.
      3) Individual scenes may be locked to prevent unauthorized change.
      4) Ramp rate may be adjusted for each dimmer switch.
      5) Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
      6) Button priority may be configured to any priority level corresponding to system operation allowing local actions to utilize life safety priority.
      7) Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

5. Device Status LEDs to indicate:
   a. Data transmission.
   b. Device has power.
   c. Status for each load.
   d. Configuration status.

6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
   a. Turn on to 100 percent.
   b. Turn off.
   c. Turn on to last level.

7. Each load be configurable to operate in the following sequences based on occupancy:
   a. Auto-on/Auto-off.

B. Analog Control Devices shall include the following features:
   1. Wall Occupancy Switch:
      b. Dimmable push buttons with 0-10V dimming where indicated.
      c. The following sequence:
         1) Time delay: 1-30 minutes in 1 minute increments.
         2) Test mode: Five second time delay.
         3) Detection technology: PIR, Dual Technology activation and/or re-activation.
   2. Wall Switch with ceiling occupancy sensor and power packs:
      c. Dimmable push buttons with 0-10V dimming where indicated.
d. Sensors capable of operating normally with electronic ballasts/drivers, PL lamp systems, and rated motor loads.

e. Sensors dual technology which use passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound not acceptable.

f. Coverage of sensors remains constant after sensitivity control has been set. Automatic reduction shall not occur in coverage due to cycling of air conditioner or heating fans.

g. Sensors readily accessible with user adjustable settings for time delay and sensitivity.

h. Include bypass manual override on each sensor in event of failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to wall switch until sensor is replaced. Control recessed to prevent tampering.

i. Include LED as continuous visual means of indication to verify that motion is being detected during both testing and normal operation.

j. Include internal additional isolated relay with NORMALLY OPEN, NORMALLY CLOSED, and COMMON outputs for use with HVAC control, data logging, and other control options.

k. The following sequence:
   1) Time delay: 1-30 minutes in 1 minute increments.
   2) Test mode: Five second time delay.
   3) Detection technology: PIR, Dual Technology activation and/or re-activation.

l. Control wiring between sensors and control units shall be Class 2, No. 18 through No. 20 AWG, stranded, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

2.4 POWER REQUIREMENTS

A. Include 277 VAC power for each controller and power supply.

2.5 EQUIPMENT

A. Control Panels: Include power supply, relays, network equipment, dry contact inputs, dry contact outputs, 0-10V dimming modules pre-wired in a single NEMA 1 enclosure. If multiple control panels/devices or pieces of equipment are located in a single space/room, provide custom enclosure with voltage barriers to enclose all of the devices and equipment.

B. Room Controllers (controls 8 or fewer outputs in a single enclosure): Include power supply, relays, dry contact inputs, dry contact outputs, 0-10V dimming modules pre-wired in a single NEMA 1 enclosure. If multiple controllers/devices or pieces of equipment are located in a single space/room, provide custom enclosure with voltage barriers to enclose all of the devices and equipment.

C. On/Off Control Relays: Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load mounted in lighting control panel.

D. 0-10V Dimming Controller: The 0-10 V output controller compatible with 0-10V dimming driver/ballast and mounted in lighting control panel. 0-10V output shall automatically open upon loss of power to the Controller to assure full light output from the controlled lighting.

E. On/Off/0-10V Dimming Control Module: On/Off and dimming to control one output or load.
   1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load.
   2. Dual Voltage (120/277 VAC, 60 Hz) capable rated for 3A total load used for single light fixture control.
F. Phase Dimming Controllers: Forward phase 120V dimming modules with network communication functionality.

G. Ceiling/Wall Occupancy Sensors: Features include the following:
   1. Finish White. Provide compatible wall plates with decorator opening.
   2. Sensors capable of operating normally with electronic ballasts/drivers, PL lamp systems, and rated motor loads.
   3. Detection technology: Dual Technology activation and/or re-activation.
   4. Time delay: 1-30 minutes in 1 minute increments.
   5. Test mode: Five second time delay.
   6. Coverage of sensors remain constant after sensitivity control has been set. Automatic reduction shall not occur in coverage due to cycling of air conditioner or heating fans.
   7. Sensors readily accessible with user adjustable settings for time delay and sensitivity.
   8. Include bypass manual override on each sensor in event of failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to wall switch until sensor is replaced. Control recessed to prevent tampering.
   9. Include LED as continuous visual means of indication to verify that motion is being detected during both testing and normal operation.
   10. Include internal additional isolated relay with NORMALLY OPEN, NORMALLY CLOSED, and COMMON outputs for use with HVAC control, data logging, and other control options.
   11. Provide additional detection devices as required for the space.
   12. Provide sensors that can function at the same mounting height as the light fixtures including but not limited to the following areas:
        a. Ceiling heights less than 12 feet.
        b. Open ceiling areas of two or more stories.
   13. Analog Devices with Power Packs shall use power packs capable of automatic on or manual on.

H. Wall Switch Occupancy Sensors:
   1. Finish White. Provide compatible wall plates with decorator opening.
   2. Capable of operating normally with electronic ballasts/drivers, PL lamp systems, and rated motor loads.
   3. Detection technology: Dual Technology activation and/or re-activation.
   4. Time delay: 1-30 minutes in 1 minute increments.
   5. Test mode: Five second time delay.
   6. Coverage of sensors remains constant after sensitivity control has been set. Automatic reduction shall not occur in coverage due to cycling of air conditioner or heating fans.
   7. On/Off push button.
   8. Dim up/Dim down push button with 0-10V Dimming.

I. Photo Sensors:
   1. Finish: White. Provide compatible wall plates or ceiling plates with decorator opening.
   2. Sensor's internal photodiode shall only measure light waves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers. Sensor light level range shall be from 1-6,553 foot-candles (fc).
   3. Open loop digital photo sensors shall include the following additional features:
      a. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
b. Automatically establishes application-specific set points following manual calibration using a wireless configuration tool or a PC with appropriate software. For dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.

J. Digital Control Switches:
1. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration.

K. Contactors:
1. Manufacturer: Square D 8903 Series or equivalent by ASCO, Eaton/Cutler Hammer, GE, Siemens or approved.
2. Description: Electrically operated and mechanically held type of types, sizes, and ratings as indicated in the Contract Drawings, 30 Amp, 6-pole minimum. Include auxiliary devices and contacts as indicated on the Contract Drawings, two normally-open contacts minimum. Appropriate enclosure listed for installation.
3. Short Circuit Withstand (SCCR) Rating: Equal to or exceeding the available fault current at the upstream panelboard.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, A/E, Commissioning Agent, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Review interface with Division 23 Controls including list of BACnet integration points, schedules and responsibilities.
5. Discuss requirements for integration with other trades.

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3.3 PRE-INSTALLATION TRAINING

A. Prior to installation, post submittal, the manufacturer shall provide an on-site training session for the contractor. This is a mandatory meeting for the installing contractor to attend and is to be scheduled by the contractor. Notify A/E two weeks prior to meeting date. Manufacturer to provide agenda and Contractor to provide meeting minutes and attendance list.

3.4 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.5 INSTALLATION

A. Install system in accordance with the drawings, this section, Sections 260511, 260519, 260553, 262726, applicable codes and manufacturer's recommendations. Install wiring in compliance with NEC for power and non-power limited signaling circuits. Upon completion, certify in writing to the Owner and general contractor that system has been installed in compliance with NEC.

B. Lighting Control Equipment:

1. Room Controllers/Control Panels: Install where indicated on the plans. Provide 277V power supply and circuit as indicated on the plans, if no circuit is indicated circuit with load on relay 1.

2. Emergency Control Equipment: Install equipment next to normal power lighting controls for the space or the following.
   a. Control panel with barrier separating emergency loads from non-emergency loads.
   b. Ceiling space above controlled light fixtures.
   c. Electrical room/closet.

3. On/Off/0-10V Control Modules:
   a. Remote Modules: Install remote mounted control modules in accessible location. Where possible mount to junction box connected to first light fixture in the lighting control zone.
   b. Centrally located Control Modules: Two or more control modules mounted in a single location, install control units in a single enclosure with voltage barriers.

4. 0-10V Dimming Controllers: Install in room controllers/control panels where possible. Mount in NEMA 1 enclosure above entry doorway into space and in an accessible location where modules are providing control.

5. Phase Dimming Controllers: Install in electrical rooms.

6. Ceiling/Wall Occupancy Sensors: Install where indicated on the drawings and as required to provide complete coverage based on shop drawings layouts.
   a. Open to structure overhead sensors mount at same height as light fixtures.

7. Wall Switches: Mounting height to match switches in Section 260519.

8. Photo Sensors: Mount per manufacturer recommendations in locations indicated on shop drawings.
C. Digital devices: Connect together with manufacturer approved low voltage network wiring.
   1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
   2. Low voltage wiring topology must comply with manufacturer's specifications.
   3. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

D. Test conductors for ground conditions before making final wiring connections. Comply with requirements in Section 260526.

E. Maintain wiring color code throughout installation. Include color code identification in the Operation and Maintenance Manual.

F. Coordinate with appropriate subcontractors for installation of equipment and devices that pertain to other work in the contract.

G. Clean dirt and debris from inside and outside of the equipment after completion of installation.

H. All line voltage connections shall be tagged to indicate circuit and switched legs.

I. Test all devices to ensure proper communication.

J. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

K. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
   1. Sensor parameters, time delays, sensitivities, and daylighting set points.
   2. Sequence of operation, (e.g. manual ON, Auto OFF, etc.).
   3. Load Parameters (e.g. blink warning, etc.).
   4. Normalized dimming in lighting control system to match dimming curve of each space main ambient light fixtures.

L. Post Start-up Tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy.

M. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

N. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

O. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to controllers.

3.6 INTERIOR LIGHT LEVEL SET POINTS

A. Light Levels: Measurements shall be made in accordance with the methods set forth in Section 9.15 of the IES handbook, 10th Edition.
   1. Measure all spaces/areas identified with a light level set points.
   2. Set dimming level of light fixtures so the maximum light output matches the light level set point.
3. Photo sensors:
   a. Daylight Zones:
      1) Automatic dimming of light fixtures in primary/secondary daylight zones to
         maintain illumination levels indicated on Contract Drawings.
      2) Automatically turn off light fixtures when daylight illumination exceeds
         maintained illumination levels.
      3) Light fixture shall dim to driver/ballast lowest rated light output prior to switching
         off.
   b. Non-Daylight zones:
      1) Automatic dimming of light fixtures in control zones to maintain light level set
         point indicated on Contract Drawings.

3.7 OCCUPANCY SENSOR SETTINGS

   A. Ceiling and wall mount occupancy/vacancy sensor time delay settings of 20 minutes except
      spaces below or indicated otherwise in the drawings:
      1. Corridors – Shall be adjusted to 30 minutes.
      2. Offices/Conference Rooms – Shall be adjusted to 15 minutes.

3.8 IDENTIFICATION

   A. Identify components, power and control wiring according to Division 26 Section "Electrical
      Identification".
   B. Identify controlled circuits in Directory Cards.
   C. Provide engraved nameplate to identify time switches and contactors with a unique
      designation.
   D. Provide engraved push buttons on digital switches, confirm switch labels with owner.
   E. Provide printed labels on ceiling tiles or grid runners below all above ceiling mounted control
      devices.
   F. Provide printed labels on Control Relays and modules to indicate controlled loads.

3.9 CONTRACTOR COMMISSIONING

   A. Upon completion of initial contractor self-commissioning, the contractor shall coordinate
      system commissioning by the manufacturer’s factory authorized representative who shall verify
      the system is complete and fully functional.
   B. Provide computer generated documentation on the commissioning of the system with room by
      room description including:
      1. Sensor parameters, time delays, sensitivities, daylighting set points.
      2. Sequence of operations (e.g. Manual On, Auto OFF, etc.).
      3. Load Parameters (e.g. blink warning, etc.).
      4. Re-commissioning – After 30 days from occupancy, recalibrate occupancy/vacancy
         sensor time delay settings, occupancy/vacancy sensor sensitivity settings and photo
         sensor light level settings. Provide detailed report to A/E for review.
3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
   1. Verify Class I and II wiring connections are terminated properly by validating system performance.
   2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
   3. Verify/complete task programming for all switches, dimmers, time clocks, and sensors.
   4. Verify that the control of each space complies with the Sequence of Operation.
   5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
   1. Date of test or inspection.
   2. Loads per space, or Fixture Address identification.
   3. Quantity and Type of each device installed.
   4. Reports providing each device's settings.

3.11 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day (8 hour) Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instructions includes:
   1. Confirmation of entire system operation and communication to each device.
   2. Confirmation of operation of individual relays, switches, and sensors.
   3. Confirmation of system Programming, photocell settings, override settings, etc.
   4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

B. Provide additional one-day (8 hour) site visit for on additional training and site tuning 60-90 days after occupany.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes wall switches, receptacles, device plates, box covers, and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards:
   3. NEMA WD 1, General Color Requirements for Wiring Devices.
   4. NFPA 70, National Electrical Code (NEC).
   5. UL 498, Standard for Attachment Plugs and Receptacles.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data for each type of wiring device and appurtenance.

C. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers: Leviton, Bryant Electric, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.

B. Finish: White.

C. Wall Switches for Lighting Circuits: NEMA WD 1. General use snap switch with colored toggle handle rated 20 Amps and 120/277 Volts AC. Switch with back and side wired screw type terminals. Units specification grade.
2.2 LED WALL DIMMERS

A. Manufacturers: Leviton, Lutron, Bryant Electric, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.
   1. Architectural Slide Dimmers:
      a. Leviton Model IP710-LF

B. Finish: White.

C. Voltage: 277 Volts.

D. Power Rating: Match load shown on the Drawings. 1200 Watts @ 120V and 1500 Watts @ 277V minimum.

E. Accessory Wall Switch: Match dimmer appearance.

2.3 LOW VOLTAGE CONTROL

A. Manufacturer: General Electric, Square-D, Cutler Hammer, Siemens, or approved.
   1. Relays: General Electric Type RR-7.
   2. Switches: General Electric Type RTS-5.
   3. Transformers: General Electric Type RT1 and RT2.
   4. Rectifiers: General Electric Type RA16.
   5. Device Plates: As specified in Article “Device Plates”.

B. Wire: Copper conductor for low voltage control purpose furnished by supplier of low voltage relays and switches.

2.4 RECEPTACLES

A. Manufacturers: Leviton, Bryant Electric, Crouse Hinds, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.

B. Finish: White.

C. Convenience and Straight-Blade Receptacles: NEMA WD 1. Units specification grade.

D. Convenience Receptacle Configuration: (20A-125V NEMA 5-20R) straight blade with grounding type with, back and side wired screw type terminals.
   1. Duplex Receptacle: Leviton Model 5362.
   3. USB Charger/Duplex Receptacle: Leviton Model T5832.
   4. GFCI Receptacles: Duplex convenience receptacle with integral ground fault circuit interrupter. Units feed-through type for downstream device protection. Leviton Model GFNT2

E. Specific Receptacle Configuration: NEMA WD 1. Type as indicated on the Drawings, with black plastic face.
2.5 DEVICE PLATES

A. Manufacturers: Bryant Electric, Hubbell, Leviton, Pass and Seymour, or approved. Bryant Electric and Leviton model numbers are listed.

B. Plates in Finished Areas: Type 302 non-magnetic stainless steel except as noted below:
   1. Wall plates for isolated ground receptacles to be with 1/4 inch specially engraved black letters “COMPUTER ONLY”.
   2. Wall plates for emergency receptacles with 1/4 inch red letters “EMERGENCY”. Leviton 84003-E40.
   3. Wall plates for dedicated receptacles with 1/4 inch specially engraved black letters “DEDICATED”.
   4. Wall plates for receptacles protected by a GFCI circuit breaker or feed through GFCI receptacle with 1/4 inch specially engraved black letters “GFCI PROTECTED”. Leviton 84003-G40.
   5. Wall plates for receptacles other than NEMA 5-20R with 1/4 inch specially engraved black letters which show ampere rating, voltage, and phase.

C. Plates on Surface Mounted Boxes: Sized to fit box without extending over sides of box.

D. Cast Metal Plates: Cast metal box. Steel plates with steel boxes and copper-free aluminum with aluminum boxes. Stainless steel screws.

E. Raised Sheet Steel Plates: 1/2 inch high zinc or cad-plated covers with surface mounted sheet steel boxes.

F. Weather Resistant Cover Plate:
   1. While In-Use Cover: Cast metal with hinged gasketed device covers. Leviton IUM1V-GY unless otherwise noted.
   2. Not In-Use Cover: Cast metal with hinged gasketed device covers. Leviton WM1V-GY, only where noted on contract drawings.

G. Finish of Attachment Screws: Match that of its respective device plate.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.
3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE
   A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 WIRING DEVICE INSTALLATION
   A. Install wiring devices in clean electrical boxes, free from excess building materials, dirt, and debris.
   B. Install jumbo size plates for outlets in masonry walls.
   C. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
   D. Install devices and wall plates flush and level.
   E. Fasten each device to outlet box at wall surface to bring receptacle flush with plate or for switch handle the proper distance through plate.

3.5 ORIENTATION
   A. Install switches vertical with handle operating vertically, up position "ON". Install center at 44 inches above finished floor unless noted otherwise on the Drawings.
   B. Install receptacles vertical with ground slot up centered at 18 inches above finished floor and 6 inches above counters.
   C. Install exterior receptacles vertical with ground slot up centered at 18 inches above finished grade.

3.6 RECEPTACLE GROUNDING
   A. Install bare bonding wire between receptacle grounding terminal and box. Plaster ear screws connecting frame to box not acceptable for grounding.

3.7 HANDICAPPED ACCESS
   A. Comply with requirements of Washington State Handicapped Access Code.

3.8 FIELD QUALITY CONTROL
   A. Comply with requirements in Section 260810. Include copy of field test reports in the Operation and Maintenance Manual.
   B. Prior to energizing circuitry, test wiring devices for electrical continuity and polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes overcurrent protective devices for operation at 600 Volts and below, including circuit breakers and fuses as individual components in separate enclosures and for installation as integral components of switchboards and panelboards and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

C. Comply with NEMA and ANSI standards as applicable to construction and installation of overcurrent protective devices.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer's technical product data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.

C. Shop Drawings: Include layouts of circuit breakers with spatial relationships to proximate equipment.

D. Closeout Submittals:
   1. Written confirmation that all circuit breaker settings were adjusted to match the power studies final report.

E. Test Reports:
   1. Field test reports.
   2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.4 EXTRA MATERIALS

A. Fuses: For each type and rating, furnish additional fuses amounting to 1 unit for every 5 units installed, but not less than 2 units of each size and type.

B. Spare Fuse Cabinet: Provide one, sized to house spare fuses provided under this contract plus 25% additional space for future.

C. Electronic Trip Unit Test Set: Furnish one set, including associated software, capable of testing each circuit breaker type.
PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Circuit Breakers: Square D, Eaton/Cutler Hammer, General Electric, Siemens or approved. Circuit breaker manufacturer shall be same as panelboard and switchboard manufacturer when installed therein.


C. Fuses: Bussmann Mfg. Co. or Mersen Electrical Power. No substitutions. Fuses shall be by one manufacturer.

2.2 CIRCUIT BREAKERS

A. General:
   1. UL 489 fixed mounted molded case type with unless indicated otherwise.
   2. Overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication.
   3. Common trip for two and three pole circuit breakers. Handle ties, manufactured by circuit breaker manufacturer, permitted for multi-wire branch circuits on approval of samples.
   4. Trip ratings imprinted on handle or visible through deadfront cover.
   5. Constructed for mounting and operating in any physical position and calibrated for operation in ambient temperature up to 40°C.
   6. Mechanical screw type removable connector lugs, AL/CU rated, to accommodate conductors specified. Rated for 75°C conductors for 60 Amp and larger circuit breakers.
   7. Amperage and Voltage as indicated.
   8. Short circuit rating: RMS interrupting rating as indicated. Minimum 10,000 AIC rating at 120, 208 and 240 Volts. Minimum 14,000 AIC rating at 277 and 480 Volts.
   9. Ground Fault Interrupter (GFI) circuit breakers: Equipped with integral ground fault interrupter set to trip on ground fault of thirty milliamps or greater.
   10. Ground Fault Circuit Interrupter (GFCI) circuit breakers: Equipped with integral Class A ground fault circuit interrupter set to trip on ground fault of six milliamps or greater.
   11. Arc Fault Circuit Interrupter (AFCI) where indicated.
   12. Switching rated for 120 Volt and 277 Volt lighting branch circuits.
   13. HACR rating where serving air conditioning and refrigeration equipment.
   15. Tandem-mounted circuit breakers not acceptable.
   16. Minimum Frame Size: To match trip rating, unless indicated otherwise.
   17. Keyed Interlocks: Externally-mounted and arranged to prohibit interlocked circuit breaker operation, except in a specified sequence. Include mountings and hardware. Provide nameplates at each keyed interlock indicating interlocked circuit breaker and sequence of operation.
   18. Zone-Selective Interlocking: Integral with ground fault trip unit for interlocking ground fault protection function.
   19. Arc Energy Reduction: Provide energy-reducing maintenance switch with local status indicator for use as a temporary arc-flash incident energy-reduction device during maintenance activities. Provide for each circuit breaker with a frame size 1200 Amps and larger and as indicated.
      a. Provide a manual switch on the compartment door to switch the circuit-breaker short-time tripping characteristics to instantaneous with minimum pickup setting, to reduce the danger from potential arc-flash at downstream equipment.
b. Provide a lock feature for the switch so that it may be locked in either the off or on maintenance-mode position.

c. Provide a blue LED indicating light to indicate that the switch is in maintenance mode.

d. Provide dry relay contacts on each switch for annunciation of the switch position.

2.3 TRIP UNITS

A. General:
   1. Thermal magnetic unless indicated otherwise.

B. Thermal Magnetic Trip Unit: Adjustable magnetic trip setting for sizes 250 Amps and larger.

2.4 FUSES

A. General:
   1. Fuses of type, sizes, ratings, and electrical characteristics of single manufacturer.
   2. Fuses labeled UL Class L, UL Class R, current limiting, rated for up to 200,000 Amps.

B. Where fuses are shown on the Drawings feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing. Adjust fuse size and type to comply with manufacturer's recommendation.

C. Main Service, Feeder and Branch Circuit Fuses:
   1. For fuse ratings over 600 Amps: UL Class L (KRP-C or A4BY).
   3. Feeder or branch circuit directly feeding motors, transformers, and other inductive load: UL RK5 time delay (FRN-R, FRS-R or TR-R or TRS-R).

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.
3.4 CIRCUIT BREAKERS

A. Install in panelboards, switchboards and enclosures, in accordance with the manufacturer's recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards.

B. Install handle ties for multiwire branch circuits per Section 260519.

C. Device Settings: Adjust in accordance with the Electrical Power Studies report from Section 260573, including but not limited to the following:
   1. Circuit Breakers.
   2. Zone selective interlocking.

3.5 FUSES

A. Install fuses in switches, panelboards, switchboards and enclosures. Install fuses so current rating is visible from front when cover is open.

B. Do not install until equipment is ready to be energized.

C. Coordinate with equipment furnished by others for proper fuse type and size.

D. For motor and equipment circuits, fuse sizes shown on the Contract Drawings are for general guidance only. Size fuses in accordance with fuse manufacturer’s recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) for nuisance free tripping. Adjust fuse size for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

3.6 FIELD QUALITY CONTROL

A. Test circuit breakers as specified in Section 260810.

END OF SECTION
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Work includes interior and exterior luminaires, lamps, ballasts/drivers and associated appurtenances.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Sections 260500, and 260510 apply to Work in this section.

C. Comply with requirements in other specification sections for concrete used for embedding poles, pole foundations, and footings for exterior area luminaire poles, standards, and foundations. Pole bases included in this section.

D. Where conflict occurs, the Luminaire (Light Fixture) Schedule shall take precedence.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Codes and Standards: NFPA 70, National Electrical Code (NEC), including local amendments, as applicable.

C. Comply with NEC and NEMA for installation and construction of luminaires. Components, Devices and Accessories shall be listed and labeled for intended use as defined in NEC, by a qualified testing agency and acceptable to the AHJ. Luminaires shall be UL listed and be labeled.

D. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers’ laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

E. Each lamp type shall be of the same manufacturer.

F. Each ballast type shall be of the same manufacturer.

G. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

H. Luminaires in damp or wet locations shall be listed for such use and labeled as either “Suitable for Damp Locations” or “Suitable for Wet Locations”.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Product Data: Submit manufacturer’s technical product data and maintenance data for each type of luminaire and appurtenance.
   1. Submit product data for associated lamp, ballast (or driver) for each luminaire type.
   2. Create a matrix encompassing all luminaire types with ballast and lamp type, including manufacturer name and part number(s).
3. Submit copy of individual and/or tandem warranties for luminaire, lamp and ballast (or driver), as applicable.

4. For solid state lamps:
   b. Provide IES TM-21 report.
   c. Provide Bin Coding System Chart, with appropriate target CCT reference line, identifying which bin corresponds to the lamps supplied to each luminaire. For luminaires with multiple solid state lamps, identify which bins shall be included for color mixing.

C. Qualifications: Indicate manufacturer qualifications as identified in Part 2.

D. Shop Drawings:
   1. Submit dimensioned drawings of each type of luminaire. Submit in booklet form with separate sheet for each luminaire, assembled by luminaire “type” in alphabetical order with proposed luminaire and appurtenances clearly indicated on each sheet.
   2. Submit support and hanging details for luminaires weighing more than 56 pounds and pendant hung luminaires requiring support design approved by the AHJ.
   3. Submit copy of manufacturer installation instructions for each luminaire type.

E. Test Reports:
   1. Comply with commissioning requirements in Section 260810.
   2. Perform field test reports.

1.4 EXTRA MATERIALS

A. Turn over to the Owner and obtain signed receipt.

B. Include copy of transmittal(s) and receipt(s) in Operation and Maintenance Manual.

C. Lamps:
   1. Furnish five percent (but not less than one solid state lamp) of solid state lamps for each type used on the project that has replaceable components.

D. Drivers:
   1. Furnish two percent (but not less than one driver) of solid state drivers/power supplies for each type used on the project.

E. Exit Signs: Furnish and install ten percent (but not less than one exit sign) of each type used on the project. For each exit sign, include rough-in and fifty feet of branch circuit raceway and wiring connected to a local (non-emergency or emergency) circuit, as appropriate or indicated by AHJ. Location of spare exit signs as required/directed by AHJ.

1.5 DEFINITIONS

A. CU: Coefficient of utilization.

B. HID: High-intensity discharge.

C. HO: High output.
D.  IC: Insulation contact.

E. Lamp: The complete light source package, including all associated components (base, pins, filament, outer bulb, solid state components, etc.) that make up a single unit.

F. Light: Radiant energy sensed or seen.

G. Light Fixture: Luminaire.

H. Lumens: Measured light output of lamp (or luminaire if using solid state lamping).

I. Luminaire: A complete lighting unit consisting of a lamp, ballast (or driver) as required together with the parts designed to distribute the light and to position and protect the lamp, as well as the electrical parts required to generate the light. This may include the means to connect to a power supply.

J. Rated Lamp Life:
   1. Incandescent, Fluorescent and HID lamps: The time after which half of the tested sample of lamps have extinguished.
   2. Solid State lamps: L-70, the time after which 70% of the initial lumen output is maintained out of the respective luminaire.

1.6 COORDINATION

A. Review luminaire types with respective ceiling type prior to ordering. Initiate a meeting with the ceiling installer and issue meeting minutes to the A/E. Inform A/E where mounting method conflict occurs.

B. Review luminaire types with location of building insulation prior to ordering. Initiate a meeting with the insulation installer and issue meeting minutes to the A/E. Inform A/E where non-IC rated luminaires are in conflict with the building insulation.

C. Review luminaire types with final millwork shop drawings. Initiate a meeting with the casework installer and issue meeting minutes to the A/E. Verify luminaires will fit where specified in or adjacent millwork prior to rough-in.

D. Coordinate layout and installation of luminaires and associated support methods with all trades.

E. Facilitate coordination meetings once a month (throughout construction) with the general contractor, ceiling installer, sprinkler installer, HVAC installer, plumber, telecommunications installer and all other applicable trades. Shop drawings shall be adjusted accordingly and resubmitted for A/E review and approval. Log shall be kept on site with meeting dates and meeting minutes.

1.7 WARRANTY

A. Comply with requirements in Division 01 and Section 260500 – Warranty.

B. Warranty period as indicated in Section 260500 shall establish minimum requirement, unless otherwise noted.

C. Occupancy-Vacancy Sensors: 5 years.
D. Solid State Lamps and Drivers: 5 years.

PART 2 - PRODUCTS

2.1 LUMINAIRE

A. Housing: Metal parts shall be free from burrs, sharp corners and edges. Sheet metal components shall be formed and shall not warp or sag. Luminaires shall be free of light leaks while also providing the required ventilation so as not to degrade the rated photometric performance and rated life of lamps and/or ballasts. Adjustable luminaires shall utilize positive locking devices to set aiming angle; luminaire shall be able to be relamped without affecting aiming angle.

B. Lenses: Where utilized, acrylic plastic shall be 100% virgin acrylic, highly resistant to yellowing and other changes due to aging, exposure to heat and ultraviolet radiation. Minimum thickness of 0.125 inches.

C. Hardware: Finish ferrous mounting hardware and accessories to prevent corrosion and/or discoloration to any and all adjacent materials. Hardware for steel or aluminum luminaires shall be cadmium, or approved, plated. Hardware for stainless steel luminaires shall be stainless steel. Hardware for bronze luminaires shall be stainless steel or bronze.

D. Sockets: Linear fluorescent lamp sockets shall be 4-position positive stop lamp-lock style with knife-edge contacts. HID sockets shall be porcelain for mogul or medium base lamps, pulse rated as required; sockets shall be keyed for all position oriented lamps.

E. Reflecting Surfaces: The following minimum reflectance values shall be met:
   1. White Surfaces: 85%.
   2. Specular Surfaces: 90%.
   3. Anodized Aluminum Surfaces: 93%.

F. Latches: Latches for luminaire doors/louvers, where applicable, shall be spring type and shall operate freely and easily without excessive force.

G. Wiring
   1. Cords/cables between luminaire components shall have a minimum temperature rating of 105°C.
   2. Cords/cables shall be fitted with appropriate strain relief connectors and/or weathertight entries, where required by application.
   3. No internal wiring shall be visible from normal viewing angles.
   4. Cords/cables to pendant luminaires shall match color of respective canopy.
   5. Internal and/or factory wiring shall be a minimum size of 18 AWG.

H. Installed Where Subject to Damage: Where luminaires are installed subject to physical damage and contain metal halide lamping, the luminaires shall consist of means of protection where the lamp is completely enclosed by glass or plastic/acrylic. If the lamp breaks, the glass shards shall not escape the luminaire and the lamp shall not emit ultraviolet light outside the luminaire.

I. Solid State LED luminaires shall be on at least one of the following (or be pre-approved by the A/E):
   2. Designlights Consortium Qualified Products List (where applicable category exists) or Lighting Design Lab LED Qualified Luminaire and Tubular LED Lamp List.
2.2 LAMPS

A. Refer to Luminaire (Light Fixture) Schedule for additional information.

B. Notify and send A/E manufacturer’s recommendations for lamp/ballast combination if different from products specified.

C. Solid State:
   1. LED:
      a. Manufacturers:
         1) Minimum of 5 year history of producing and/or installing LEDs in North America.
         2) Philips/Lumileds, Osram/Sylvania, General Electric, Cree, Nichia, Samsung, or approved.
      c. Must be on the Lighting Design Lab’s LED Qualified Lamp List.
      d. Replaceable modules shall be designed to Zhaga Consortium standards.
      e. 3,500 K CCT, unless otherwise noted.
      f. Minimum CRI of 85.
      g. Lamps shall not use any energy when ‘off’.
      h. CCT throughout life of lamp shall be within +/- 200 K of respective specified value.
   2. Organic LED lamps are not allowed.

2.3 BALLASTS AND DRIVERS

A. Refer to Luminaire (Light Fixture) Schedule for additional information.

B. Notify and send A/E manufacturer’s recommendations for lamp/ballast combination if different from products specified.

C. Quantities: For continuous linear light fixtures provide quantity of ballasts/drivers required to support the circuiting and control shown on the contract documents.
   1. Daylight zones: Provide drivers for control within daylight zones for linear fixtures that are mounted in any portion of a daylight zone. If 50% or more of a control length is in a daylight zone it shall be controlled within that zone.
   2. For linear lengths that cross primary/secondary zones control with the more stringent daylight zone.
   3. Control Length: Maximum eight foot, minimum four foot.

D. Solid State Drivers/Power Supplies:
   1. Manufacturers:
      a. Minimum of 5-year history of producing and/or installing drivers in North America.
      b. Philips/Advance, Osram Sylvania, General Electric, Universal, Thomas Research, or approved.
   2. When not in the luminaire, the housing shall be plenum rated.
   3. Poke-in wire trap connectors or integral leads color coded per ANSI C82.11.
   4. Withstand +/- 10% voltage fluctuation with no compromise of performance or life cycle.
   5. +/- 5% output across published load range.
   6. 120-277 Volt rating.
   7. PF greater than 0.9, at specified voltage.
   8. Minimum efficiency of 70% at rated full load.
   9. Maximum case temperature rating of 70°C.
   10. THD less than 20%.
   11. Class A sound rating.
12. Minimum operating temperature of -20°F.
13. Shall tolerate sustained open circuit and short circuit output conditions without damage and without need for external overcurrent protection.
14. No PCB allowed.
16. Dimmable, as specified in the Luminaire (Light Fixture) Schedule.

2.4 EGRESS

A. UL 924 Listed.

B. Battery Packs (Emergency Ballasts) in General Luminaires:
   1. Manufacturers: Philips/Bodine, Iota Engineering, or approved.
      a. Solid State driver assemblies with integrated components are allowed.
   2. Must fit inside luminaire’s ballast compartment. In case of remote ballast installation, battery pack shall be installed adjacent ballast and marked accordingly on the record drawings (as-builts).
   3. Must initiate within 3-10 seconds of power failure and allow for 90 minutes of operation.
   4. Compatible with 1-lamp, 2-lamp, 3-lamp, 4-lamp and dimming ballasts.
   5. Minimum 1,100 lumens of output for linear fluorescent lamps and 750 lumens for compact fluorescent lamps.
   6. Allow for multi-lamp operation.
   7. 120/277 Volt rating.
   9. Damp listed.
   10. High temperature, maintenance-free nickel-cadmium sealed battery, minimum 7 years of operation.
   11. Self-testing, every 30 days, without horn. Indicator light shall flash if problem is detected.
   12. Must automatically switch back to normal power once available.
   13. Test switch, located inside the luminaire if possible; if not possible, notify A/E and locate switch and indicator light per A/E direction prior to rough-in.

C. Unit Equipment:
   2. Must initiate within 3-10 seconds of power failure and allow for 90 minutes of operation.
   3. Maintenance-free lead-calcium sealed battery, minimum 7 years of operation.
   4. Must contain visual indicator status of normal power.
   5. Automatic self-diagnostic monitoring and testing of unit operation. Self-test every 28 days.
      a. Must contain visual indicator status of service alerts for ‘battery fault’, ‘charger fault’, ‘transfer fault’ and ‘lamp fault’.
   6. Must automatically switch ‘off’ once normal power is available.
   7. Automatic low voltage disconnect battery protection.
   8. Automatic normal power lockout circuit.
PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory. Work that requires modification due to unsatisfactory conditions, deemed by the A/E, shall be corrected and completed to the satisfaction of the A/E at no additional cost to the contract.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

B. Temporary Lighting for Construction Use: Contractor shall provide lighting used during the construction period for construction tasks. Permanent luminaires that are part of the project may not be utilized for this use.

C. Temporary Lighting required as part of Project Phasing: As approved by A/E, permanent luminaires may be used for temporary lighting means. Install and energize the minimum number of luminaires necessary for the task. When construction is sufficiently complete, remove the temporarily installed luminaires in a neat and workmanlike manner, dissemble, clean thoroughly, replace lamp(s) and ballast(s) and install in permanent location per the contract documents. Permanently installed luminaires deemed by the A/E to be damaged shall be replaced at no additional cost.

D. Remote Mounting of Ballasts (where indicated on the drawings and/or approved by the A/E): Distance between the remote ballast and respective luminaire shall not exceed distance recommended by the ballast manufacturer. If recommended distance conflicts with the drawings, notify the A/E prior to rough-in.

3.4 INTERIOR LUMINAIRE INSTALLATION

A. Install luminaires at locations and heights as indicated on the Drawings, in accordance with luminaire manufacturer’s written instructions, applicable requirements of NEC, NESC, NECA’s “Standards of Installation”, NEMA standards, and recognized industry practices to ensure that luminaires fulfill requirements. Luminaires shall be installed exactly level, secure and plumb with respective building lines. Wall mount and ceiling mount luminaires shall be securely and tightly attached to their respective mounting surface. Lay-in luminaires shall sit flush with grid ceiling system, doors shall swing completely open in the designed direction.
B. Luminaire Supports:
   1. General: Comply with IBC and NEC (including all local amendments) as interpreted by AHJ for luminaires mounted in suspended ceilings. Lay-in and pendant luminaires shall not be supported by lay-in suspended grid ceiling system and must be attached to structure.
   2. Support Requirements:
      a. Include flexible ball joint hangers for pendant and stem hung luminaires at designated points of support.
      b. Equip hooks used to hang luminaires with safety latches. Include supports, brackets, clips, screws and miscellaneous items for mounting luminaires.
      c. Include locking catches, screws, safety chain(s) or safety cable(s) for detachable luminaire parts, luminous ceiling accessories, louvers, diffusers, lenses and reflectors.
   3. Seismic Restraints:
      a. For Luminaires Weighing Less than 10 Pounds: Install (1) slack No. 12 gauge hanger wire from luminaire to structure above.
      b. For Luminaires Weighing 10 to 56 Pounds: Install (2) independent slack No. 12 gauge hanger wires from opposite corners of luminaire to structure above.
      c. For Luminaires Weighing More than 56 Pounds: Support directly from the structure above by hangers approved by the AHJ. Comply with requirements in Section 260348 for seismic restraints.
      d. For Pendant Hung Luminaires: Support directly from structure with No. 9 gauge hanger wire or alternate support without using ceiling suspension system for direct support approved by the AHJ. Comply with requirements in Section 260348 for seismic restraints.

C. Fire Rated Assemblies: Provide gypsum board protection acceptable to the AHJ to ensure fire rating of ceiling or wall in which luminaires are installed. Maintain manufacturer’s recommended ventilation requirements.

D. Provide backing in wall cavity to reinforce support for wall mounted luminaires.

E. Luminaire Contact with Building Insulation: When building insulation is installed at a location where contact with luminaires is unavoidable, IC-Rated luminaires shall be utilized. Where insulation is present and an approved IC-Rated luminaire is not available, provide a gypsum board assembly around the luminaire, maintaining all recommended ventilation requirements, to separate luminaire from adjacent insulation.

F. Protect installed luminaires from damage during construction period through date of substantial completion. Damaged luminaires, including associated components, shall be replaced in their entirety.

G. Exit Signs: Verify color of lettering with AHJ prior to ordering.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of luminaires and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Repair malfunctioning units on site, then retest to demonstrate compliance. If not possible to repair on site, remove and provide new units and retest. Include copy of test reports in the Operation and Maintenance Manual.
B. Clean luminaires in their entirety of dirt and debris upon completion of installation, including but not limited to housing, lens(es), lamp(s) and louver(s) within (7) days of substantial completion.

C. At Substantial Completion, remove and provide new lamps in interior and exterior luminaires which are observed to be noticeably dimmed due to Contractor’s use and testing, as judged by the A/E.

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PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description: Design, furnish, install, and connect analog addressable, intelligent fire alarm and detection system required to form a complete coordinated system ready for operation. It shall include, but not be limited to, initiating devices, alarm notification appliances, control panels, annunciators, auxiliary control devices, power supplies, batteries, wiring and ancillary devices as shown on the Contract Drawings, as specified herein or as required to meet AHJ requirements. Contract Drawings and Specifications indicate minimum system requirements. This is a bidder-designed system and it is the responsibility of the fire alarm system vendor to provide an AHJ approved system and design.

B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 sections apply to Work in this section.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

B. Authorities Having Jurisdiction (AHJs):
   1. Seattle Fire Department.
   2. Seattle Department of Planning and Design.

C. Codes and Standards:
   1. NFPA 70, National Electrical Code (NEC).
   2. NFPA 72, National Fire Alarm Code.
   4. UL 864, Control Units and Accessories for Fire Alarm Systems.
   5. UL 217, Standard for Smoke Alarms.
   6. FM Global.
   7. DPD Director’s Rule 17-2005 (SFD Administrative Rule 9.08.05) Sprinkler Systems and Fire Alarms for Elevator Machinery Rooms, Hoistways and Pits.
   8. UL 2075, Standard for Gas and Vapor Detectors and Sensors.

D. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Components and systems UL listed and labeled for fire alarm systems and fire alarm and detection systems and accessories and FM approved. Comply with applicable State and local requirements.

E. Comply with applicable provisions of current NFPA 72, local building codes, and requirements of AHJs.

F. Permits and Fees:
   1. Arrange for inspections and pay for all required licenses, permits, inspections, plan review fees and any other fees.
G. Fire Alarm and Detection System Installer Requirements:
   1. The installer shall be an authorized manufacturer’s agent staffed with factory-trained and
certified sales and service technicians. The installer shall have been the designated
manufacturer’s representative in the local market for a minimum of five (5) years.
   2. The local office of the installer shall be UL listed under the UUJS or UUFX category as a
qualified fire alarm system provider.
   3. The fire alarm system installer shall coordinate the installation of the fire alarm system
including the preparation of shop drawings and submittals to the Authority Having
Jurisdiction.
   4. System design and preparation of shop drawings shall be by factory-trained personnel
with the following qualifications: NICET-certified fire-alarm technician, Level II minimum.
   5. System installation shall be by factory-trained personnel with the following qualifications:
NICET certified fire alarm technician, Level II minimum.
   6. System commissioning and testing shall be by factory-trained personnel with the
following qualifications: NICET certified fire alarm technician, Level II minimum.
   7. Contractor’s factory trained technical representative shall respond to job site within
24 hour period for emergencies relating to system.
   8. Emergency response is defined as having a technician actively troubleshoot and correct
problem at job site.

1.3 SUBMITTALS

A. Comply with requirements in Division 01 and Section 260500.

B. Installer Qualifications.

C. Existing Fire Alarm Programming: Prior to submitting design, download and print out existing
fire alarm system program and sequence of operations functionality. Utilize this information
for preparation of new system submittals. Submit a hard copy.

D. Sequence of Operation Matrix: Provide a sequence of operation matrix which includes all
trouble and alarm conditions monitored by the system. The matrix shall be included in the
shop drawing set. Provide written sequence of operation that describes the interlocks
between the Fire Alarm system and all other building systems (Fire sprinkler, HVAC, Access
Control, etc.).

E. Product Data: Submit manufacturer’s technical product data for fire alarm and detection
systems components including, but not limited to, roughing-in diagrams and instructions for
installation, operation, and maintenance, suitable for inclusion in the Maintenance and
Operation Manuals. Include riser and wiring diagrams for panel and system components.

F. Shop Drawings: Indicate equipment and device locations and connecting wiring of entire fire
alarm and detection system. Include layout wiring and riser diagrams, point-to-point diagrams,
and floor plans with indicating devices, raceways and wiring routing, including device
addresses and strobe candela ratings.

G. Details. CAD based schedules to include:
   1. Battery Calculations.
   5. Symbol Legend and Wiring Code (per manufacturer’s requirements).
7. I/O Point and Relay Schedules.
8. Typical Wiring Diagrams indicating connections between panel modules and field devices and auxiliary interfaces (i.e. elevator controls, fire doors, etc.).

H. Acceptance Test Procedure: Submit a written Acceptance Test Procedure (ATP), approved by the AHJ, to Engineer at least thirty days prior to scheduled testing. The ATP shall include step-by-step procedures for performance testing every fire alarm device and system output to demonstrate functionality in accordance with specification requirements.

I. Test Reports:
1. Field test reports.
2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

J. Obtain from each AHJ written certification that the permanent installation has been inspected and that it complies with AHJs’ published regulations and requirements. Submit prior to Substantial Completion.

K. Operation and Maintenance Data: Comply with requirements in Section 260500. In addition, include the following:
1. Prepare complete, simple, understandable, step-by-step, testing instructions with recommended and required testing frequency of equipment with methods for testing equipment. Include troubleshooting manual.
2. Prepare complete, easy-to-read, understandable maintenance instructions including the following information:
   a. Instruction on replacing components of system including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.
   b. List of equipment and components with address and phone number of both manufacturer and local supplier of each item.
3. Comply with the “Records” Section of the “Inspection, Testing and Maintenance” Chapter in NFPA 72.
4. Provide “Record of Completion Documents” according to NFPA 72 article “Permanent Records” in the “Records” Section of the “Inspection, Testing and Maintenance” Chapter.
5. Record copy of site-specific software.

1.4 SYSTEM DESIGN CRITERIA (BIDDER DESIGN)

A. Design, furnish, and install complete operable fire alarm and detection systems in accordance with the latest adopted editions of IBC, IFC, NFPA 72, and applicable city, county, and state laws, codes, and standards.

B. Drawings reflect minimum Owner requirements. The Contractor’s scope of work shall include but not limited to the following:
1. Complete fire alarm system based on the available architectural, civil, structural, mechanical and electrical drawings.
2. Wiring systems associated with fire alarm system.
3. Providing additional smoke detectors, heat detectors, manual alarm stations, horns, bells, visual evacuation alarm devices, door closers and holder controls, panels, power supplies, and control graphic annunciators associated with fire alarm system.
4. Providing auxiliary controls and switches including interposing control, monitor relays, and interconnection coordination for monitoring of fire sprinkler system tamper, flow and air pressure switches mechanical equipment shutdown and smoke and combination fire/smoke damper controls.

5. Field verify locations of existing fire alarm system/fire alarm device signal transmission/interface points and document where the wiring terminations connect to other building systems. Photos shall be included in shop drawings with descriptions of fire alarm system output/control information including alarm type, zone/area of coverage, and any other information pertaining to the existing fire alarm system sequence of operations. Remake all connections to maintain the existing building systems operations.

C. Maintain system operation during construction or provide complete fire watch as required by the local AHJ.

1.5 SEQUENCING AND SCHEDULING

A. Existing Fire Alarm Equipment: Perform functional test of existing fire alarm systems to verify the existing sequence of operations and signal transmission/interface points. Verify all existing systems that are part of the sequence of operations are in working condition. Submit documentation to show all systems, including elevator recall, elevator pressurization fans, HVAC shutdown, door release and fire smoke dampers are all functional before demolishing the existing system. If any items are not functioning the owner will review and provide direction.

B. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it “NOT IN SERVICE” until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment “NOT IN SERVICE” until removed from the building.

C. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.6 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1.7 EXTRA MATERIALS AND LABOR

A. General: Furnish and install additional devices as specified herein. For each device, include rough-in and fifty feet of raceway and wiring extended from local fire alarm circuit. Location of devices as required by authority having jurisdiction. Turn over any unused devices to the Owner and obtain signed receipt.

1. Wall mounted strobes: Quantity two.

2. Wall mounted horn/strobes: Quantity one.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fire Alarm and Detection System: Match existing, Simplex Grinnell, No substitutions.

2.2 FIRE ALARM AND DETECTION SYSTEMS

A. General: Electrically operated, electrically supervised, fire alarm and detection system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings, and accessories required for a complete operating system.

B. Comply with requirements in Section 260533 for raceways, Section 260519 for conductors, Section 260534 for outlet boxes, and Section 260529 for supports. Minimum wire size No. 16 AWG for initiating circuits and No. 14 AWG for indicating circuits.

C. Enclose entire fire alarm system wiring in raceways.

D. Notification Appliance and Signaling Line Circuits: NFPA 72, Class B.
   1. Install no more than 100 addressable devices on each signaling line circuit. Provide isolation modules on signaling line circuits: 1) on each floor where serving multiple floors, and 2) so no more than 50 addressable devices can be out of service due to a single wiring fault.
   2. Signaling Circuitry: An open circuit in any speaker or strobe circuit shall not prevent the balance of the notification appliance circuits from operating. The control equipment shall supervise the speaker and strobe circuits to detect wiring faults.
   3. Selective Signaling: The system shall be configured to allow selective signaling by alarm type as well as by zone, or building, or general alarm. It shall also be capable of providing alarm signal to all zones simultaneously.

2.3 EXISTING SYSTEM TYPE

A. Low voltage, point identification fire management system. Fire alarm and detection system shall monitor intelligent (analog) and addressable (digital) devices, traditional initiating devices, point identify alarm location, and transmit signals to monitoring agency.

B. Fire alarm control panel shall allow for loading or editing special instructions and operating sequences. System capable of on-site programming to accommodate and facilitate expansion, building parameter changes, and changes as required by AHJs. Software operations stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory.

2.4 EXISTING SYSTEM OPERATION

A. Alarm displayed on an 80 character alphanumeric display and on remote printer. Top line of characters shall be point label and second line shall be device type identifier. System alarm red LED shall flash on control panel and remote annunciator shall indicate specific device in alarm. Subsequent alarm received from another zone after being acknowledged shall flash system alarm LED on control panel and remote annunciator. LCD display and printer shall show new alarm information. Alarm tone shall occur within control panel and remote annunciator until acknowledged.
B. Alarm indicating devices silenced by entering locked control cabinet and operating alarm silence switch. Subsequent alarm condition shall reactivate signals.

C. Activation of any system smoke detector shall initiate an alarm. Alarm verification operation shall be programmed into the system for future use but not active until approved by AHJ. Alarm verification function: control panel shall reset activated detector and wait for second alarm activation. If, within 1 minute after resetting, second alarm is reported from same or any other smoke detector, system shall process alarm as described previously. Time period for alarm verification reset programmable from 0 to 60 seconds. If no second alarm occurs within alarm verification time window, system shall resume normal operation. Alarm verification shall operate only on smoke detector alarms. Other activated initiating devices process immediately. Alarm verification operation selectable by device, not just by zone. Control panel with capability to display number of times zone or detector has gone into verification mode. Information displayed on control panel and transmitted to remote printer and remote annunciator.

D. Alarm and trouble conditions displayed on control panel from alphanumeric display, at remote printer, and at remote annunciator. If more than one alarm or trouble is initiated, operator may scroll to display new alarms.

E. Control panel capable of supplying minimum 6 Amps at 24 VDC, filtered and regulated. Power supply expandable to total ampacity required by system. Initial system shall include a minimum of 25% spare capacity.

F. Functions of control panel field programmable.

2.5 EXISTING POWER REQUIREMENTS

A. Include 120 VAC power from dedicated circuit for control panel.

B. Include sufficient battery capacity to operate entire system upon loss of normal 120 VAC power in normal supervisory mode for a period of 24 hours with 15 minutes of alarm operation at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic.

C. Circuits requiring system operating power shall be 24 VDC. Include individual fuses at control panel.

2.6 PERIPHERAL DEVICES

A. Primary Notification Appliances: Provide flush mounted combination horn/strobe Audio/Visual signaling appliances where required. Specific audible and visual characteristics shall be as follows:
   1. Visual Signals Fire Alarm: Furnish and install xenon strobes, synchronized in accordance with NFPA 72 chapter 4 and rated to UL 1971 standards. Strobes shall have a fixed candela rating, as follows: provide 15 candela in corridors and other areas up to 20’ x 20’, 75 candela in areas up to 40’ x 40’, and 110 candela in areas up to 50’ x 50’.
   2. Audible Signals: Provide audible signal appliances designed to produce a minimum sound output of 85 dbA at 10’, or 15 dbA above ambient; whichever is greater.
   3. Power Supplies: The power supplies provided for the system shall be capable of powering all notification devices simultaneously with a minimum of 20% spare capacity. Provide power supplies in increments of 8 Amps. Supervision of power supplies shall be integral to the panel. The need for separate monitor modules to supervise power supplies are not acceptable.
4. Amplifiers: The amplifiers provided for the system shall be 24 Volt 40 watt max output. Amplifiers shall be integral to the panel or in a separate enclosure next to the FACP.

5. Provide color matched surface mounted back boxes for surface mounted devices.

B. Multiple strobes visible in a single room coordinated to flash simultaneously.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.

B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

A. General: Install, apply, erect, and perform the work in accordance with Article “Quality Assurance” provisions, specifications, and manufacturer’s installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 FIRE ALARM AND DETECTION SYSTEM INSTALLATION

A. Install system in accordance with the Drawings and this section, applicable codes and manufacturer’s recommendations. Install wiring in compliance with NEC for power and non-power limited fire protective signaling circuits. Upon completion, certify in writing to the Owner and general contractor that system has been installed in compliance with NEC.

B. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

C. Mounting Heights:
   3. Magnetic Door Holders: 78 inches to center line except as noted.

D. Wire:
   1. Per manufacturer’s recommendations and as per NEC. Comply with requirements in Section 260519.
   2. Where required, provide wiring in metallic conduit. Comply with requirements in Section 260533.

E. Make conduit and wiring connections to sprinkler flow switches, sprinkler valve tamper switches, and appropriate air handling equipment.
F. Label junction boxes for fire alarm with minimum 1/4 inch letters: “FIRE ALARM”.

G. Test conductors for ground conditions before making final wiring connections. Comply with requirements in Section 260526.

H. Maintain wiring color code throughout installation. Include color code identification in the Operation and Maintenance Manual.

I. Coordinate with appropriate subcontractors for installation of equipment and devices that pertain to other work in the contract.

J. Clean dirt and debris from inside and outside of the fire alarm equipment after completion of installation.

K. Label all conductors in fire alarm panels, terminal blocks, and large pull boxes. Each conductor shall have a unique and specific designation.

L. All wiring shall be terminated/connected to a device, terminal block, or fire alarm panel. T-Tapping and splicing will not be permitted.

M. Wiring installed in riser conduits shall have strain relief in j-boxes so that cable and connections are maintained and not damaged.

3.5 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section “Door Hardware”. Connect hardware and devices to fire-alarm system.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Smoke dampers in air ducts of designated air-conditioning duct systems.
   2. Alarm-initiating connection to elevator recall system and components.
   4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

C. Supervisory connections at elevator shunt trip breaker.

3.6 MANUFACTURER’S FIELD SERVICES

A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

B. Include operations and maintenance instructions for the Owner’s representative of devices including trouble shooting procedures.

3.7 FIELD QUALITY CONTROL

A. Check out of and final connections to fire alarm control panel by factory trained technicians in employ of factory authorized franchised dealer for products installed.
B. System, upon completion of installation, checked out, final connections made, and tested to initiating and indicating devices by factory trained technicians in employ of factory franchised dealer for products installed.

C. Test completed fire alarm and detection system in accordance with NFPA 72 in presence of the Owner’s representative and the AHJ. Upon completion of successful test, certify in writing to the Owner and general contractor that system has been successfully tested and accepted by the AHJ. Include field test results in the Operation and Maintenance Manual.

3.8 RECORD DRAWINGS

A. See Section 260500 for record drawing information. Accurately identify the final location, addresses and type of each device on drawings. Divisions 26, 27, and 28 Subcontractor shall keep a set of record drawings on site during construction and programming and shall mark-up changes made on these drawings. Transfer the mark-up information to an AutoCAD 2002-2014 format CAD file at the close of the project. Provide the Owner with the mark-up drawings, a CAD plot and CAD file on disk.

B. Provide a complete printout hard copy of the system program and an electronic backup copy or the site specific software for all future programming needs by authorized manufacturer/distributor per NFPA 72 4,5,2,3.(3).

END OF SECTION