



# Facilities Planning & Construction

UNIVERSITY *of* ALASKA ANCHORAGE

## INVITATION FOR BID

### **UAA NSB-EM2 Mechanical Systems Conversion/Upgrade Anchorage, Alaska**

## **VOLUME II TECHNICAL SPECIFICATIONS**

**PROJECT NO.: 16-0103  
BID NUMBER: 17-04**

**Building Name: Natural Science Building  
Building Number: AS122**

**ISSUED: March 16, 2017**

**FACILITIES PLANNING AND CONSTRUCTION  
3890 UNIVERSITY LAKE DRIVE, SUITE 110  
ANCHORAGE, AK 99508-4669  
(907) 786-4900**

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NSB EM-2 Mechanical Systems  
Conversion/Upgrades

Project # 16-0103

Issued for Construction

Specifications

February 17, 2017

UNIVERSITY OF ALASKA ANCHORAGE

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## SECTION 01 3545 - AIRBORNE CONTAMINANT CONTROL

## PART 1 - GENERAL

## 1.1 SUMMARY:

## A. Related sections:

1. Section 02 2600 Hazardous Materials Assessment
2. Section 02 4119 Selective Demolition
3. Section 02 8233 Removal and Disposal of Asbestos Containing Materials
4. Section 02 8333 Removal and Disposal of Materials Containing Lead
5. Section 02 8418 Removal and Disposal of Chemical Hazards

- B. Notification of Potential Hazards: Asbestos, lead and other potentially hazardous materials are present in the building that may impact the work of all trades. Regulated air contaminants, including asbestos and lead, are also present in settled and concealed dust in and on architectural, structural, mechanical and electrical components or systems throughout the building. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to Specification Divisions 0, 1 and 2 for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.

## 1.2 DEFINITIONS:

- A. "Airborne Contaminants" are those contaminants listed in 29 CFR 1926.55 and 8 AAC 61.1100 that have the potential to become airborne due to various work activities being performed by the Contractor. Additionally, airborne contaminants include those fumes and odors that may be objectionable to personnel in Occupied Areas of the facility even though they are not listed in the reference regulations. Airborne contaminants may be broadly categorized as Pre-Existing or Activity Generated. Contaminant producing activities include, but are not limited to:

1. Demolition, removal, installation and disposal of walls, floors, ceilings, steel, and other architectural or structural materials.
2. Disturbance or removal of existing settled and concealed dusts.
3. Demolition, relocation, installation and disposal of plumbing, mechanical and electrical systems and equipment.
4. Finish operations such as sanding, preparation, painting, and application of special surface coatings.
5. Any construction activity, which can generate aerosols, dust, smoke, or fumes.
6. Temporary heat sources.

7. Other on-site work operations not described above.
- B. "Pre-Existing Contaminants" are those contaminants that are present in the facility prior to the start of any work. These contaminants, including asbestos and lead, are assumed to be also present in settled and concealed dust throughout the building in areas not subject to routine cleaning, including the roof and inside and on top of architectural, mechanical, electrical and structural elements. The dust generally contains several common components including, but not limited to asbestos, cellulose, cotton, fiberglass, lead, silica and other Particulates Not Otherwise Regulated. Representative dusts throughout the facility have been examined by an EPA Certified Building Inspector and determined not to be "asbestos debris" from adjacent "Asbestos-Containing Building Materials" (ACBM). Based on similar sampling from similar buildings, the inspector also determined that the dusts are unlikely to contain more than one percent (1%) asbestos by weight, and therefore are not an asbestos-containing material (ACM). Reference 40 CFR 763.83. Refer to Section 02 2600, Hazardous Materials Assessment. Dust and debris related to adjacent damaged asbestos containing materials are addressed in Section 02 8233, Removal and Disposal of Asbestos Containing Materials.
- C. "Activity Generated Contaminants" are those contaminants generated by the various demolition or construction related activities of the Contractor. Examples of typical Activity Generated Contaminants include wood dust (cellulose), cement dust (silica), gypsum dust (particulates not otherwise regulated), paint fumes, and welding fumes. A complete list of regulated air contaminants is available in 29 CFR 1926.55 and 8 AAC 61.1100.
- D. "Work Areas": Areas of demolition, renovation, construction, adjacent staging and storage areas, and passage areas for workers, supplies, and waste. This may include but is not limited to attic spaces, spaces above ceilings, crawl spaces, mechanical and electrical spaces, confined spaces and other spaces not normally accessed or occupied.
- E. "Occupied Areas": Areas as determined by Owner's Representative and as shown on contract drawings. Typically these include areas adjacent to Work Areas or containment areas, either occupied or used for passage, as well as areas connected to construction area by mechanical system air intake, exhaust, and ductwork. Contaminant control procedures may be relaxed during periods when the building is not occupied as allowed by the Contractor's approved work plan.
- F. "Critical Clean Areas": Areas inside or outside the Work Area with equipment or occupants that cannot tolerate airborne contamination, and are to be maintained under positive pressure by High-Efficiency, Particulate, Air (HEPA) filtered equipment relative to the surrounding air. These areas will be described or shown in contract documents or drawings.
- G. "Contractor" is defined to include all trades and all subcontractors performing work on the work site.
- H. "Negative Initial Determination" is a determination made either through air monitoring or other objective data that indicates worker exposure to regulated airborne contaminants are below or expected to be below the regulated limits.

### 1.3 AIRBORNE CONTAMINANT CONTROL

- A. There is no requirement to remove Pre-Existing Contaminants from the facility. The Contractor may remove Pre-Existing Contaminants from his work areas if he determines that to be a more cost effective means of completing the work.
- B. The Contractors shall establish and maintain control over the generation and containment of all potential airborne contaminants so that workers, facilities, students, staff, educational programs, equipment, and operations are not adversely affected, including adverse affects on air monitoring. Construction activities that disturb existing materials or create airborne contaminants must be conducted in Work Areas specifically constructed, ventilated, and/or equipped to prevent the movement of contaminants into Occupied or Critical Clean Areas.
- C. The Contractor shall establish and maintain control over Activity Generated Contaminants within the Work Area to prevent abnormally high levels of airborne contaminants from settling on architectural, mechanical, electrical or structural components within the work areas, or interference with monitoring conducted for other work. The Contractor shall be required to clean all surfaces within a work area where abnormally high levels of Activity Generated Contaminants are deposited.
- D. The Contractor shall ensure that all workers are aware of the Occupied and Critical Clean Areas, the potential air contaminants present and the means and methods established in the work plan to control those contaminants.
- E. The Contractor shall ensure workers have the proper protective equipment needed for the job being performed.

### 1.4 TRAINING

- A. The Contractor shall ensure that all workers/trades performing work on the project site are trained in accordance with OSHA standards for hazard communication (29 CFR 1910.1200) and proper protective equipment (29 CFR 1926), as well as engineering controls and work methods required to prevent exposure to regulated air contaminants that might be generated or encountered as a results of their work.

### 1.5 RESPONSIBILITY:

- A. Owner's Responsibilities
  - 1. The Owner shall identify in contract documents Occupied Areas and Critical Clean Areas prior to allowing the Contractor to begin work. The Contractor shall be notified of all changes to these areas as work progresses.
- B. Contractor's Responsibilities:
  - 1. Preparing proposed work plans and procedures for control of airborne contaminants during demolition and construction.
  - 2. Identifying and implementing specific means and methods of achieving and maintaining control of airborne contaminants.

3. Controlling the generation and spread of airborne contaminants from the Contractor's Work Areas.
4. Cleaning and decontaminating all areas contaminated as the result of their operation. The Owner has the right to review and approve of any and all clean-up and decontamination procedures, chemicals, and processes.
5. Notifying Owner's Representative a minimum of 48 hours prior to starting construction activities that might be expected to produce excess levels of airborne contaminants in Work Area so that precautions may be taken.

#### 1.6 SUBMITTALS:

- A. Submittals Required: Submit the following documentation to the Owner for approval. The submittal shall be coordinated with all the Contractor's subcontractors and trades and be submitted as one submittal for all work covered by this section. **WORK SHALL NOT PROCEED UNTIL THE SUBMITTAL PACKAGE IS APPROVED, AND THE PRE-CONSTRUCTION MEETING HAS BEEN HELD.**
  1. Shop Drawings: Make all shop drawings accurately and to a scale sufficiently large to show all pertinent features of the work. Shop Drawings shall show:
    - a. Boundaries of each Work Area, Occupied Areas and Critical Clean Areas.
    - b. Location of barriers, negative pressure areas, positive pressure areas, and exhaust fan units (if required).
    - c. Locations of windows, louvers, ducts and other penetrations into Occupied Areas and/or Critical Clean Areas that need to be protected from airborne contamination
    - d. Disposal Routes.
    - e. Locations of contaminant producing operations like painting or sanding which could be moved away from Occupied Areas.
  2. Work Plan: The Work Plan shall be prepared for this specific job in the form of checklists and shall include:
    - a. Work area set-up and protection procedures during occupied times.
    - b. Work area set-up and protection procedures during periods of limited occupancy (vacation and holidays).
    - c. Work procedures to minimize generation of airborne contaminants.
    - d. Worker protection procedures.
    - e. Daily cleanup procedures and activities.
    - f. Procedures to follow if air contaminants enter Occupied or Critical Clean Areas.
    - g. Exposure assessment procedures if a "negative initial determination" has not been completed. A record of "negative initial determinations" shall be maintained by the Contractor and be available on the job site for review by the Owner or regulatory agencies.
  3. Safety Data Sheets (SDSs): The Contractor shall maintain on the job site, at a location approved by the owner, SDSs for each encapsulant, surfactant, solvent, detergent, and other material proposed to be used.

- B. Monitoring Results: The Contractor shall submit copies of all air monitoring and testing results to the Owner within 24 hours of receipt of results.

#### 1.7 WORKER PROTECTION:

- A. The Contractor shall review the SDS's for the substances that will be used, data provided by these specifications, proposed means and methods, manufacturers data and other available data to determine the potential for worker exposure.
- B. Conduct air monitoring of worker exposures as necessary to show that workers are not being exposed above the permissible exposure limits established by 29 CFR 1926 and 8 AAC 61.1100 (negative initial determination). Not all contaminants or substances will require exposure monitoring.
- C. In lieu of worker exposure monitoring, the Contractor may rely on objective data from recognized trade groups, manufacturer or previous exposure monitoring data that establish that worker exposure above the permissible exposure limits is not probable under conditions "closely resembling" the processes, types of materials, control methods, work practices and environmental conditions in the current job.

#### PART 2 - PRODUCTS

Not Used

#### PART 3 - EXECUTION

##### 3.1 WORK PRACTICES:

- A. General: All construction/demolition work shall be isolated, either by enclosures, and/or work practices and equipment to prevent worker exposures above the permissible exposure limit(s), and prevent the migration of contaminants (dust, fumes, smoke, etc.) into Occupied Areas and Critical Clean Areas of the facility. Exposures to occupants shall be maintained at least 10 times lower than the permissible exposure limit(s) for airborne contaminants. If the Contractor's work practices are not effective in controlling airborne contaminants, as evidenced by dust, fumes, smoke, odors, dust, etc. in Occupied or Critical Clean Areas, the Contractor shall provide a sealed barrier at the perimeter of the work area and exhaust the work area to maintain a negative pressure and/or provide a filtered positive pressure to Critical Clean and Occupied areas to keep airborne contaminants out. Maintain a positive pressure of 0.05 inches of water column relative to the air outside the Critical Clean Areas, with a minimum 100 feet per minute velocity through cracks, openings, etc.
- B. Direct exhaust from fume or smoke producing equipment away from building air intakes, windows and other penetrations into Occupied and Critical Clean Areas.
- C. The Contractor shall provide "walk-off" mats, at all connections between Work Areas and Occupied Areas, vacuumed or changed daily when there is traffic between the Work Area and the Occupied Areas.

- D. Enclosures, where used, shall be dust tight and withstand air pressure.
- E. Prohibited Materials: The use or application of the following materials is prohibited:
  - 1. All cleaners and aerosol products not submitted and approved by the Owner.
  - 2. All flammable or chlorinated hydrocarbon solvents, unless approved by the Owner.
- F. Any dust or debris tracked outside of Work Areas into Occupied Areas shall be cleaned up immediately. Contractor shall have the necessary manpower and equipment (dust and wet mops, HEPA vacuums, buckets and clean wiping rags) to keep adjacent Occupied Areas clean at all times.
- G. Dry Sweeping is prohibited. All vacuums used for cleaning shall be equipped with HEPA filters.
- H. Traffic between Work Areas and Occupied Areas shall be kept to a minimum. Keep doors between such areas closed at all times. Transport refuse through Occupied Areas in covered containers.
- I. Notify the Owner's Representative immediately of any release of airborne contaminants into Occupied Areas.

### 3.2 ENFORCEMENT:

- A. The Contractor shall periodically inspect Occupied Areas at the perimeter of the work area and Critical Clean Areas to verify that airborne contaminants have not spread into those areas.
- B. Failure to properly maintain airborne contaminant control in Work Areas, Occupied or Critical Clean Areas will result in issuance of a written warning. If the problem is not corrected immediately, the Owner will have cause to stop work.
- C. Failure of the Contractor to correct deficiencies in controlling airborne contaminants will result in corrective action taken by the Owner and deduction of all costs from the Contract.

### 3.3 WORK STOPPAGE:

- A. The Contractor shall stop work and notify the Owner whenever his work has caused visible dust, smoke, fumes or objectionable odors in Occupied or Critical Clean Areas.
- B. When such work stoppage occurs, the area shall be restored to its original condition by the Contractor at no expense to the Owner. The Contractor is responsible for removing dust, fumes and debris that were generated as a result of his work.

## 3.4 WORK COMPLETION:

- A. Provide thorough cleaning of finished surfaces that become exposed to dust or other airborne contaminants. Cleaning of Pre-Existing contaminants is not required.
- B. Removal of construction barriers and airborne contaminant control equipment shall be performed in a manner to minimize disturbance of airborne contaminants into occupied spaces. HEPA vacuum and clean all finished surfaces free of dust after the removal of barriers and equipment.

END OF SECTION 01 3545

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## SECTION 02 2600 – HAZARDOUS MATERIALS ASSESSMENT

## PART 1 - GENERAL

## 1.1 SECTION INCLUDES

- A. The Hazardous Materials Assessment for the proposed construction is included with these Contract Documents.

## 1.2 USE OF INFORMATION

- A. The Hazardous Materials Assessment is provided for the Contractor's information and use in the planning and performance of work in areas containing hazardous or potentially hazardous materials as outlined in Paragraph 1.3.
  - 1. The information provided in the Hazardous Materials Assessment is based on samples collected in various locations of the building. Thus, the Owner and/or its Representative cannot guarantee or warrant that actual conditions encountered might not vary from the information presented in these reports.
  - 2. The data reported in the Hazardous Materials Assessment is accurate to the best of the Owner's and its Representative's knowledge. The requirements contained in these specifications and in the relevant state and federal regulations pertaining to the performance of work in areas containing hazardous or potentially hazardous materials provide guidance for the contractor for performance of work in these areas. The Owner and its Representative disclaim all responsibility for the Contractor's erroneous conclusions regarding the information presented in these reports; the requirements contained in these specifications; and the requirements of applicable state and federal regulations pertaining to performance of work in these areas.
  - 3. The Contractor shall be responsible for obtaining additional information if Contractor deems it necessary to carry out the work.
- B. It is highly recommended that the contractor visit the site to acquaint themselves with existing conditions.
- C. Attached Hazardous Materials Assessment

## 1.3 HAZARDOUS MATERIALS NOTIFICATION:

- A. Notification of Potential Hazards: Asbestos, lead and other potentially hazardous materials are present in the building that may impact the work of all trades. Regulated air contaminants, including asbestos and lead, are also present in settled and concealed dust in and on architectural, structural, mechanical and electrical components or systems throughout the building. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to Specification Divisions 0, 1 and 2 for specific information concerning disturbing,

removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.

**PART 2 - PRODUCTS**

Not Used

**PART 3 - EXECUTION**

Not Used

# HAZARDOUS MATERIALS ASSESSMENT

## NSB EM-2 MECHANICAL SYSTEMS CONVERSION/UPGRADES

### ANCHORAGE, ALASKA

**Surveyed**  
**January 9, 2009**  
**March 5, 2009**  
**May 21, 2010**  
**June 25, 2010**

**Report Date**  
**February 22, 2017**

EHS ALASKA, INC.  
ENGINEERING, HEALTH & SAFETY CONSULTANTS  
11901 BUSINESS BLVD., SUITE 208  
EAGLE RIVER, ALASKA 99577-7701

**HAZARDOUS MATERIALS ASSESSMENT  
NSB EM-2 MECHANICAL SYSTEMS CONVERSION/UPGRADES****ANCHORAGE, ALASKA****TABLE OF CONTENTS**

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**HAZARDOUS MATERIALS ASSESSMENT  
NSB EM-2 MECHANICAL SYSTEMS CONVERSION/UPGRADES****ANCHORAGE, ALASKA****OVERVIEW**

The UAA Natural Sciences Building, located in Anchorage, Alaska, was previously surveyed for the presence of asbestos-containing materials (ACM), and other potentially hazardous materials as a part of the design services for the NSB EM-2 Mechanical Systems Conversion/Upgrades Project at the building for the University of Alaska Anchorage. The contractor is required to provide a "good faith" inspection for hazardous materials that may be disturbed during the construction. The proposed work includes the disturbance, demolition, removal and disposal of lead-containing paints and/or lead-containing materials that is incidental to the renovation and remodeling project. Mr. Jonathan Lotton and Mr. Stephen Littlejohn of EHS-Alaska, Inc. (EHS-Alaska) conducted the inspections in January 2009. Mr. Robert French, P.E. of EHS-Alaska conducted the inspection in March 2010, and Mr. Stephen Littlejohn of EHS-Alaska conducted the inspection in May 2010. It will be the contractor's responsibility to take this baseline data, and to conduct hazardous materials removal in compliance with all regulatory requirements.

**A. GENERALIZED REQUIREMENTS FOR HAZARDOUS MATERIALS**

Potentially hazardous materials have been identified in The UAA Natural Sciences Building that will be affected by the proposed renovations. Those materials include asbestos, lead, polychlorinated bi-phenyls (PCBs), mercury, and radioactive materials. Not all materials were tested for potentially hazardous components, other potentially hazardous materials, including those exterior to the building, such as contamination from underground fuel tanks may be present, but are not part of this report.

Buildings or portions of buildings that were constructed prior to 1978 which are residences, or contain day care facilities, kindergarten classes or other activities frequently visited by children under 6 years of age are classified as *child occupied facilities*. All work classified as "renovations" or disturbing more than 6 square feet of lead-based painted surfaces per room for interior activities or more than 20 square feet for exterior activities in child occupied facilities must comply with the requirements of 40 CFR 745. This building is not classified as a *child occupied facility* and therefore the requirements of 40 CFR 745 are not applicable.

Only the materials that will be directly affected by this project are required to be removed. The quantities and types of materials are incorporated into the design documents for this renovation. The removal and disposal of potentially hazardous materials are highly regulated, and it is anticipated that removal and disposal of asbestos, lead and chemical hazards will be conducted by a subcontractor to the general contractor who is qualified for such removal. It is anticipated that the general contractor and other trades will be able to conduct their work using engineering controls and work practices to control worker exposure and to keep airborne contaminants out of occupied areas of the building. Refer to Section 01 3545, Airborne Contaminant Control.

Settled and concealed dusts in areas not subject to routine cleaning are present throughout the building, including the roof, and inside and on top of architectural, mechanical, electrical, and structural elements, and those dusts have been identified to contain regulated air contaminants. This should not be read to imply that there is an existing hazard to building occupants (normal occupants of the building as opposed to construction workers working in the affected areas). However, depending on the specific work items involved and on the means and methods employed when working in the affected areas, construction workers could be exposed to regulated air contaminants from those dusts in excess of the OSHA Permissible Exposure Limits (PELs).

The settled and concealed dusts were examined by an EPA Certified Building Inspector who previously sampled and this report identifies the locations, sampling data and test results. The inspector determined that the dusts are not "asbestos debris" from an asbestos-containing building material (ACBM). The inspector also determined that the dusts do not contain more than one percent (1%) asbestos by weight, and therefore are not an asbestos-containing material (ACM). Reference 40 CFR 763.83.

"Awareness training" (typically 2 hours) and possibly respiratory protection will be required for all Contractor Personnel who will be disturbing the dusts. The extent of the training and protective measures will depend upon the airborne concentrations measured during air monitoring of the contractors work force, which depends on the means and methods employed to control the dusts. The air monitoring may be discontinued following a "negative exposure assessment" showing that worker exposures are below the OSHA permissible exposure limits for the type of work and means and methods employed. Previous air monitoring from similar jobs with similar conditions may be used as historical data to establish a "negative exposure assessment".

## **B. BUILDING DESCRIPTION**

UAA Science Building was originally constructed in 1977 with various upgrades and repairs through the years. The interior partitions were primarily framed construction. The interior classroom and office walls were typically of finished gypsum wallboard with asbestos containing joint compound or gypsum wall board panels.

The exterior walls were prefabricated insulated metal panels with asbestos containing sealants. The roof was typically of steel beams and open web steel joists supporting a concrete floor deck, or metal roof deck and of the Inverted membrane roof assembly type (IRMA).

Corridor and classroom ceilings in the original construction were typically of 2' x 4' acoustic ceiling tiles. Toilets, and storerooms, etc., had gypsum wallboard ceilings with asbestos-containing joint compound.

Floor finishes were mainly of sheet vinyl or carpet over concrete on the 1<sup>st</sup> and 2<sup>nd</sup> floors. The flooring in the interstitial space was metal grating.

The building was heated with a hydronic system which was supplied from an energy module.

## **C. SAMPLING AND ANALYSIS**

### **1. Asbestos-Containing Materials**

No specific survey was done for this project. This information comes from a previous survey which included sampling of suspect ACM materials. This information has relied heavily on previous sampling conducted in other areas of the building. Testing of materials pertinent to the project, including asbestos and lead in dust samples was conducted and is included in this report.

The bulk samples were analyzed for the presence of asbestos by polarized light microscopy (PLM), the method of analysis recommended by the U.S. Environmental Protection Agency (EPA) to determine the composition of suspected asbestos-containing materials (EPA method 600/M4-82-020). Only materials containing more than 1% total asbestos were classified as "asbestos-containing" based on EPA and the Occupational Safety and Health Administration (OSHA) criteria. Samples that were analyzed to have less than 10% asbestos were "point-counted" by the laboratory for more accuracy. Samples that are listed as having a "Trace by Point Count" had asbestos fibers found in the material, but the fibers were not present at the counting grids. Table 1 in Part D below contains a summary list of the asbestos bulk samples and the applicable results.

Limited sampling of dust was also conducted during the survey which included 4 "microvac" samples of dust taken in the building according to the American Society for Testing and Materials (ASTM) Standard D5756 protocol. ASTM Standard D5756 is used to determine the percentage of asbestos by weight. The

“microvacuum” technique collected the dust samples, by pulling air through a 2 mm “tygon” tube into a 25 mm, 0.45m mixed cellulose ester filter cassette by means of a battery operated vacuum pump operating at 2 liters of air per minute. Dust was collected from a surface that measured 100 square centimeters ( $\text{cm}^2$ ). The dust in the filter cassette was then analyzed at the laboratory. The D5756 samples had the asbestos content reported as both a weight percentage and as the number of asbestos structures per unit area of sampled surface ( $\text{St./cm}^2$ ). Table 2 in Part D below contains a summary of the mass concentration asbestos dust samples and the applicable results.

The Mass Concentration dust samples were analyzed for asbestos content by International Asbestos Testing Laboratories (IATL), Mt. Laurel, New Jersey a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

The Bulk Asbestos samples were also analyzed for asbestos content by International Asbestos Testing Laboratories (IATL).

Field survey data sheets and laboratory reports of the bulk samples are included in Appendix A. Field survey data sheets and laboratory reports of the dust sampling for asbestos are included in Appendix B. Drawings showing sample locations are included as Appendix D.

EPA regulations under 40 CFR 763 requires the use of Polarized Light Microscopy (PLM) to determine whether or not a material contains asbestos. While PLM analysis does a good job for most materials, it does have some limitations, both in the size of the fibers that are visible under a standard optical microscope, and because the organic matrix that the fibers are bound within can obscure the fibers. At the discretion of the building inspector and the client, some types of samples may be analyzed or re-analyzed by what is called TEM NOB, or Transmission Electron Microscopy for Non-Friable Organically Bound materials. TEM NOB is the definitive method for determining if asbestos is present, but TEM NOB use is not required by the EPA. TEM NOB analysis was not done for this project.

Field survey data sheets and laboratory reports of the bulk samples are included in Appendix A. Field survey data sheets and laboratory reports of the dust sampling for asbestos are included in Appendix B. Drawings showing sample locations are included as Appendix D.

## **2. Lead-Containing Materials**

Nearly all surfaces in the building were coated with paint and most surfaces had been repainted. EHS-Alaska tested paint throughout the affected areas of the building using a NITON XLi303AW X-Ray Fluorescence (XRF) lead paint analyzer (Serial # 14311 with software version 5.1CDual). Refer to the Lead Paint Screening Table in Appendix C that identifies the surfaces tested, and the results. The Paint Test Locations are shown in Appendix D.

EPA and the Department of Housing and Urban Development (HUD) have defined lead-based paint as any paint or other surface coating that contains lead equal to or in excess of 1.0 milligram per square centimeter ( $\text{mg/cm}^2$ ) or 0.5 percent by weight. XRF results are classified as positive (lead is present at  $1.0 \text{ mg/cm}^2$  or greater), negative (less than  $1.0 \text{ mg/cm}^2$  of lead was present) or inconclusive (the XRF could not make a conclusive positive or negative determination). Tests that were invalid due to operator error are shown as void tests.

A Performance Characteristic Sheet (PCS) for the NITON XLi303AW is available upon request. This PCS data provides supplemental information to be used in conjunction with Chapter 7 of the “HUD Guidelines”. Performance parameters provided in the PCS are applicable when operating the instrument using the manufacturer’s instructions and the procedures described in Chapter 7 of the “HUD Guidelines”. The instrument was operated in accordance with manufacturer’s instructions and Chapter 7 of the HUD Guidelines. No substrate correction is required for this instrument. There is no inconclusive classification for this instrument when using the  $1.0 \text{ mg/cm}^2$  threshold.

**D. SURVEY RESULTS****1. Asbestos-Containing Materials**

Asbestos field survey data sheets and laboratory reports are included as Appendix A. Refer to Appendix D for sample locations. The following TABLE 1A lists the samples taken in January 2009 in the Science Building, and the results of the laboratory analysis. Note, some of these materials may have been removed by the previous project, but are included here to illustrate similar materials from the eras of construction.

**TABLE 1A**

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A01	Cream cove base mastic	NE entrance next to room 119 door	None Detected = ND
UAA109-A02	White with red and gray chip pattern sheet vinyl, (SV-1) with yellow mastic	NE entrance next to room 119 door 1/07/2009 100_2936	None Detected
UAA109-A03	White corner guard mastic	NE entrance next to stairwell entrance 01/07/2009 100_2931	None Detected
<b>UAA109-A04</b>	<b>Off white gypsum board</b>	<b>NE entrance next to stairwell entrance</b>	<b>Gypsum – ND JC – 0.5% Chrys.</b>
UAA109-A05	Black caulk	Room 119 center work bench, top of PVC utility enclosure 01/07/2009 100_2952	None Detected
UAA109-A06	Off white joint compound	Room 119 above center work bench near top of PVC utility enclosure 01/07/2009 100_2952	None Detected
UAA109-A07	Off white gypsum board	Room 119 above center work bench near top of PVC utility enclosure 01/07/2009 100_2952	None Detected
UAA109-A08	White caulk	Room 119 center work bench near PVC utility enclosure	None Detected
UAA109-A09	2"x4" lay in ceiling tile, 1/8"-1/4" fissures and holes (LCT-1)	Room 119 above center work bench near top of PVC utility enclosure 01/07/2009 100_2950	None Detected
UAA109-A10	Black lab bench top	Room 119 NE corner of north work bench 01/07/2009 100_2940	None Detected
UAA109-A11	White with red and gray chip pattern sheet vinyl, (SV-1) with yellow mastic	Room 119 near NW door	SV – ND Mastic - ND
UAA109-A12	White caulk with black paint	Room 119 at NE door	None Detected
UAA109-A13	Yellow mastic with fiberglass	Room 100U2 west wall under fiberglass	Insulation – ND Mastic - ND
UAA109-A14	Yellow mastic with fiberglass	Room 100U2 north wall under fiberglass	None Detected
UAA109-A15	Dark yellow flooring mastic	Hallway 100C1 at NE corner	None Detected



<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A16	Tan sawdust pattern sheet vinyl (SV-2) with brown mastic	Hallway 100C1 at north wall 01/07/2009 100_2980	SV – ND Mastic - ND
UAA109-A17	Brown cove base mastic	Hallway 100C1 at NE corner near elevator	None Detected
UAA109-A18	Brown cove base	Hallway 100C1 at NE corner near elevator	None Detected
<b>UAA109-A19</b>	<b>Off white joint compound with tape</b>	<b>Hallway 100C1 at south wall</b>	<b>Wht. JC – 1.3% Chrysotile</b> Tan JC - ND
UAA109-A20	Off white gypsum board	Hallway 100C1 at south wall	None Detected
UAA109-A21	1/8"-1/4" fissure and hole 2'x4' lay in ceiling tile (LCT-2)	Hallway 100C1 at south wall , 1 07 13:04	None Detected
UAA109-A22	1/4"-3/4" fissure and hole lay in ceiling tile (LCT-2)	Hallway 100C1 at south wall	None Detected
UAA109-A23	Black window seal	Hallway 100C1 at north wall at windows	None Detected
<b>UAA109-A24</b>	<b>Tan cove base with yellow and brown mastic 1 07 13:28</b>	<b>Hallway 100C2 next to door to room 124</b>	<b>CB – ND</b> <b>Yel. Mastic – ND</b> <b>Brn mastic-1.2% Chrysotile</b>
UAA109-A25	White gypsum board	Hallway 100C2 next to door to room 124	None Detected
UAA109-A26	Black sink top	Room 124 at sink	None Detected
UAA109-A27	Gypsum board panel	Room 124 east wall	None Detected
UAA109-A28	12"x12" white and gray streak floor tile with cream mastic	Room 124 next to east wall	FT – None Detected Mastic - ND
UAA109-A29	Deep 3/8" fissure random and holes 2"x4" lay in ceiling tile (LCT-3)	Room 124 ceiling near center of room 01/08/2009 100_3079	None Detected
UAA109-A30	1" wormy pattern 2"x4" lay in ceiling tile (LCT-4)	Room 124 near west wall 01/08/2009 100_3081	None Detected
UAA109-A31	Tan sand stone pattern sheet vinyl (SV-3) with cream mastic	Room 124 near west wall 01/07/2009 100_2983	SV – None Detected Mastic - ND
UAA109-A32	1/4"-1/2" few fissures with several holes 2"x4" lay in ceiling tile (LCT-5)	Hallway 100C2 at north door to room 121 01/08/2009 100_3080	None Detected
UAA109-A33	Black cove base	Room 100J1 on east wall	None Detected
UAA109-A34	White tile grout with tan mastic	Room 100J1 on south wall	Grout – ND Mastic - ND
UAA109-A35	Tan sawdust pattern sheet vinyl (SV-2)	Hallway 100C2 at south door to room 121	None Detected

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A36	2"x2" ceramic tile with white grout and tan mastic	Room 100M1, men's room, near doorway	Tile – ND Mastic – ND Grout - ND
UAA109-A37	Black lab bench top	Room 121 2nd work bench from north end	None Detected
UAA109-A38	Tan sawdust pattern sheet vinyl (SV-2)	Room 121 3rd work bench from north end	None Detected
UAA109-A39	Tan cove base	Room 121 3rd work bench from north end	None Detected
UAA109-A40	Off white gypsum board	Room 121 south wall	None Detected
UAA109-A41	Black 4" cove base	Room 123 near center of room at north end of work bench	None Detected
UAA109-A41a	Gray cement board from fume hood	Room 123 at hood 01/08/2009 100_3027	None Detected
UAA109-A42	White with red and gray chip pattern sheet vinyl, (SV-1) with yellow mastic	Room 123 near center of room at north end of work bench	None Detected
UAA109-A43	Gray duct seam sealant	Room 123 top of hood	None Detected
UAA109-A44	Black hood bench top	Room 125 at hood	None Detected
UAA109-A44a	Gray cement board from fume hood	Room 125 at hood	None Detected
UAA109-A45	Green hood duct seam sealant	Room 127 at east hood	None Detected
UAA109-A46	Tan sawdust pattern sheet vinyl (SV-2)	Room 122 north wall	SV – None Detected Mastic - ND
UAA109-A47	Gypsum board panel	Room 122 next to north door	None Detected
UAA109-A48	Off white joint compound	Room 122A at SW corner	None Detected
UAA109-A49	White gypsum board	Room 122A near door	None Detected
UAA109-A50	Tan sand stone sheet vinyl (SV-3) with fillet cove base and cream mastic	Room 122C near center wall	SV – ND CB – ND Mastic - ND
UAA109-A51	Tan, white, gray, brown chip pattern sheet vinyl (SV-4) with tan mastic	Room 122C near center wall	SV – None Detected Mastic - ND
UAA109-A52	White joint compound	Room 128F west wall	None Detected
UAA109-A53	Dark yellow carpet mastic	Entryway carpet in 100V2	None Detected
UAA109-A54	Off white gypsum board	Room 200U2 at south wall	None Detected
<b>UAA109-A55</b>	<b>Off white joint compound</b>	<b>Room 200U2 at NE corner</b>	<b>1.5% Chrysotile</b>
UAA109-A56	Off white joint compound panel	Room 213 next to NE door	None Detected
UAA109-A57	Brown cove base mastic	Room 213 next to NE door	None Detected
UAA109-A58	Black lab bench top	Room 213 east work bench near SE corner	None Detected

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A59	White joint compound with tape	Room 213 near SE corner	None Detected
UAA109-A60	White gypsum board	Room 213 near SE corner	None Detected
UAA109-A61	White joint compound	Room 215 near center of room	None Detected
UAA109-A62	Brown carpet mastic	Room 216 NE corner 01/08/2009 100_3048	None Detected
UAA109-A63	Brown carpet mastic	Room 223 near center of room	None Detected
UAA109-A64	Large and small hole pattern 2'x4'lay in ceiling tile (LCT-6)	Room 225 near center of room 01/08/2009 100_3064	None Detected
UAA109-A65	Gray duct seam sealant	Room 225 near center of room 01/08/2009 100_3066	None Detected
UAA109-A66	Tan sand stone sheet vinyl (SV-3)	Room 225 NW corner	None Detected
UAA109-A67	Black rubber window seal	Room 226 at east wall	None Detected
UAA109-A68	Black rubber window seal	Room 228 at east wall	None Detected
UAA109-A69	Off white joint compound	Room 228 at east wall below windows	None Detected
UAA109-A70	Dark brown cove base mastic	Room 228 at east wall below windows	None Detected
UAA109-A71	White gypsum board	Room 228 at east wall below windows	None Detected
UAA109-A72	Tan sand stone sheet vinyl (SV-3)	Room 232 near center of room	None Detected
UAA109-A73	Tan sawdust pattern sheet vinyl (SV-2)	Room 232 near center of room	None Detected
UAA109-A74	Tan, white, gray, brown chip pattern sheet vinyl (SV-4)	Room 232 near center of room	None Detected
UAA109-A75	White gypsum board panel	Room 232 east wall near door	None Detected
UAA109-A76	Dark yellow carpet mastic	Room 234 south wall near door	None Detected
UAA109-A77	Cream cove base mastic with black cove base	Room 234 south wall near door	CB – ND Mastic - ND
UAA109-A78	Brown cove base mastic	Room 235 at doorway	None Detected
UAA109-A79	Tan sawdust pattern sheet vinyl (SV-2)	Room 235 at doorway	SV – ND Mastic - ND
<b>UAA109-A80</b>	<b>White door insulation, wooden door with small window</b>	<b>2nd level door to stairwell 200S3 01/09/2009 100_3177</b>	<b>3.8% chrysotile 10% Amosite</b>
<b>UAA109-A81</b>	<b>White door insulation, wooden door with small window</b>	<b>2nd level door to stairwell 200S2</b>	<b>2.2% chrysotile 10% Amosite</b>
UAA109-A82	Black rubber window seal	Room 248 east wall	None Detected
UAA109-A82a	Black sink top	Room 248 center work bench north end at sink	None Detected
UAA109-A83	Gray cement patch at floor penetration	Room 200U5 west wall	None Detected

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A84	Off white gypsum board	Room 200U5 west wall near door	None Detected
<b>UAA109-A85</b>	<b>Off white joint compound</b>	<b>Room 200U5 west wall near door</b>	<b>1.4% chrysotile</b>
UAA109-A86	White joint compound	Room 241 west wall	None Detected
UAA109-A87	Gray fume hood cement board	Room 240 at hood on west wall	None Detected
UAA109-A88	White gypsum board	Room 240 at hood on south wall	None Detected
UAA109-A89	White with red and gray chip pattern sheet vinyl, (SV-1) with black fillet cove base and cream mastic	Room 240 at doorway	None Detect – All Layers
UAA109-A90	White fabric hood duct seam tape	Room 240 above hood	None Detected
UAA109-A91	Gray hood duct seam sealant	Room 240 above hood	None Detected
UAA109-A92	White fabric duct seam tape	Room 237 in overhead on older looking duct	None Detected
UAA109-A93	Gray duct seam sealant with duct tape	Room 237 in overhead on older looking duct	Sealant – ND Tape - ND
UAA109-A94	Brown remnant flooring mastic	Room 237 next to south wall 01/08/2009 100_3118	None Detected
UAA109-A95	Brown remnant flooring mastic	Room 237 near center of room 01/08/2009 100_3118	None Detected
UAA109-A96	White joint compound	Room 237 near SE corner near top of wall	None Detected
UAA109-A97	White gypsum board	Room 237 near SE corner near top of wall	None Detected
UAA109-A98	Cream with tan streaks sheet vinyl (SV-5)	Room 214 next to east wall 01/08/2009 100_3130	None Detected
UAA109-A99	Cream with tan streaks sheet vinyl (SV-5) with brown mastic and off white caulk	Room 214 at column near center of west wall	SV – ND Mastic – ND Caulk - ND
UAA109-A100	Black sink top	Room 214 south workbench at SE corner	None Detected
UAA109-A101	Brown cove base mastic	Hallway 200C2 west wall outside room 214 near south entrance	None Detected
UAA109-A102	Tan cove base	Hallway 200C2 west wall outside room 214 near south entrance	None Detected
UAA109-A103	White tile grout with tan mastic	Room 200M1 next to door	Grout – ND Mastic - ND
UAA109-A104	White tile grout with tan mastic	Room 200W1 north wall across from door	Grout – ND Tan mastic – ND Yel. Mastic - ND

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A105	White door insulation, wooden door with small window	Hallway 200C1 at double door to hallway 200C2	None Detected
<b>UAA109- A106</b>	<b>Black roofing patch tar</b>	<b>Roof, smear on the side of square vent east side of roof 01/09/2009 100_3146</b>	<b>1.5% chrysotile</b>
<b>UAA109- A107</b>	<b>Black roofing patch tar with added granules</b>	<b>Roof, square vent east side of roof 01/09/2009 100_3146</b>	<b>2.1% chrysotile</b>
UAA109-A108	Black roofing patch tar	Roof, square vent east side of roof 01/09/2009 100_3146	None Detected
UAA109-A109	Gray parapet wall cap seal	Roof east wall near vents 01/09/2009 100_3147	None Detected
<b>UAA109- A110</b>	<b>Black roofing patch tar on vent</b>	<b>Roof, round vent east side of roof 01/09/2009 100_3148</b>	<b>2.2% chrysotile</b>
UAA109-A111	Black roofing sealant tar from roof drain	Roof drain near center of roof 01/09/2009 100_3152	None Detected
UAA109-A112	Gray putty like penetration sealant	Roof, round vent near south end 01/09/2009 100_3155	None Detected
<b>UAA109- A113</b>	<b>Black roofing patch tar at fan motor</b>	<b>Roof at big fan motor near south end 01/09/2009 100_3156</b>	<b>10% chrysotile</b>
UAA109-A114	Black roofing material with black patch tar	Roof around the base of hatch	None Detected
<b>UAA109- A115</b>	<b>Black roofing tar with granules debris</b>	<b>At flutes of roof deck inside hatch to roof. 01/09/2009 100_3158</b>	<b>0.25% chrysotile</b>
UAA109-A116	Thin gray duct sealant	Interstitial space near SE corner south side on duct	None Detected
<b>UAA109- A117</b>	<b>Gray green duct sealant</b>	<b>Interstitial space near SE corner east side on duct</b>	<b>2.4% chrysotile</b>
UAA109-A118	White fabric duct seam tape	Interstitial space near SE corner east side on duct	None Detected
<b>UAA109- A119</b>	<b>Gray green duct seam sealant</b>	<b>Interstitial space near SE corner east side on duct</b>	<b>5.7% chrysotile</b>
UAA109-A120	White fabric duct seam tape	Interstitial space north end, east side duct above walkway	None Detected
<b>UAA109- A121</b>	<b>Gray green duct seam sealant</b>	<b>Interstitial space north end, east side duct above walkway 01/09/2009 100_3160</b>	<b>6.3% chrysotile</b>
<b>UAA109- A122</b>	<b>Gray green duct seam sealant</b>	<b>Interstitial space near center of west wall 01/09/2009 100_3160</b>	<b>6.8% chrysotile</b>
UAA109-A123	White fabric duct seam tape	Interstitial space near center of west wall 01/09/2009 100_3160	None Detected
UAA109-A124	White floor penetration hole filler	Interstitial space north end, east side at pipe penetration through ceiling 01/09/2009 100_3172	None Detected

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA109-A125	Off white joint compound	Interstitial space north end, east side at raised unpainted gypsum board box 01/092009 100_3161	None Detected
UAA109-A126	Off white gypsum board	Interstitial space north end, east side at raised unpainted gypsum board box	None Detected
UAA109-A127	Off white joint compound	Interstitial space top of 1st floor wall below walkway NE area of space	None Detected
UAA109-A128	White floor penetration hole filler	Interstitial space near NE area at pipe penetration through ceiling	None Detected
UAA109-A129	Gray wall to floor sealant	Stairwell 200S2 base of gypsum wall at concrete floor	None Detected
UAA109-A130	Gray wall to floor sealant	Stairwell 200S3 base of gypsum wall at concrete floor	None Detected
<b>UAA109-A131</b>	<b>Gray exterior wall panel putty like sealant</b>	<b>Exterior wall outside of entrance 100V1</b>	<b>2.1% chrysotile</b>
UAA109-A132	Tan exterior wall panel to concrete sealant	Exterior wall north end of building near entrance door	None Detected
<b>UAA109-A133</b>	<b>Gray exterior wall sealant at window</b>	<b>Exterior wall north end of building near entrance door at windows</b>	<b>3.3% chrysotile</b>
UAA109-A134	Light gray sealant at door, exterior	Exterior wall north end at NW door	None Detected
UAA109-A135	Gray wall sealant at water faucet penetration	Exterior wall near NW corner of building	None Detected
UAA109-A136	White exterior wall pipe penetration sealant	Exterior wall near NW corner of building	None Detected
<b>UAA109-A137</b>	<b>Gray exterior wall sealant at window</b>	<b>Exterior wall west side near north end</b>	<b>4.0% chrysotile</b>
UAA109-A138	Gray wall sealant at water faucet penetration	Exterior wall near door at south end of building	None Detected
The testing method used (polarized light microscopy [PLM]) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Before this material can be considered or treated as non-asbestos containing, confirmation should be made by quantitative transmission electron microscopy (TEM).			

The following TABLE 1B lists the samples taken in March 2010 in the Science Building, and the results of the laboratory analysis. Note, some of these materials may have been removed by the previous project, but are included here to illustrate similar materials from the eras of construction.

**TABLE 1B**

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
<b>UAA310-A1</b>	<b>Dirty Gray, Putty-like sealant (Note: pre-fab cooler removed in Ph 1)</b>	<b>At penetration of refrigerant piping through "roof" of pre-fab cooler. Interstitial space, 5-21:23</b>	<b>15% chrysotile</b>

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
The testing method used (polarized light microscopy [PLM]) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Before this material can be considered or treated as non-asbestos containing, confirmation should be made by quantitative transmission electron microscopy (TEM).			

The following TABLE 1C lists the samples taken in May 2010 in the Science Building, and the results of the laboratory analysis. Refer to Appendix D for sample locations. Note, some of these materials may have been removed by the previous project, but are included here to illustrate similar materials from the eras of construction.

**TABLE 1C**

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA510-A01	Black fascia mastic and white caulking.	Room 119, cabinet on window wall.	None Detect – All Layers
<b>UAA510-A02</b>	<b>Black fascia mastic.</b>	<b>Room 119, cabinet on window wall.</b>	<b>4.7% chrysotile</b>
UAA510-A03	Black counter top material.	Room 121, front of room at sink.	None Detected
UAA510-A04	Black counter top material.	Fume hood counter top.	None Detected
UAA510-A05	Brown coving mastic.	Room 121, front wall.	None Detected, Both Layers
UAA510-A06	Black cove base material.	Room 121, under self cove sheet vinyl.	None Detected
UAA510-A07a	Brown cove base mastic.	Room 121, at work bench.	None Detected
UAA510-A07b	Black countertop material.	Room 121, work bench counter top.	None Detected
UAA510-A08	Black countertop material.	Room 121, sink countertop at end of work bench.	None Detected
UAA510-A09	Beige cove base with off white mastic.	Room 121, see sample location drawing.	None Detected, Both Layers
UAA510-A10	Gray sealant compound.	Exterior at louvers, see sample location drawing.	None Detected
UAA510-A11	White sealant compound.	Exterior at wall penetration, see sample location drawing.	None Detected
UAA510-A12	White joint compound.	Mechanical room, see sample location drawing.	None Detected
UAA510-A13	White gypsum wallboard.	Mechanical room, see sample location drawing.	None Detected
UAA510-A14	Green gasket material.	Mechanical room, hot water service pipe, see sample location drawing.	None Detected
UAA510-A15	Brown gasket material.	Mechanical room, cold water service pipe, see sample location drawing.	None Detected
UAA510-A16	Green gasket material. (lab also found yellow mastic)	Mechanical room at pipe flange, see sample location drawing.	None Detected, Both Layers
UAA510-A17	Gray sealant compound.	Mechanical room at exterior of air handler panel.	None Detected

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA510-A18	Clear rubbery patch sealant compound.	Mechanical room at exterior of air handler panel.	None Detected
UAA510-A19	Brown gasket material.	Mechanical room, flange at cold water return.	None Detected
UAA510-A20	Gray sealant compound.	Mechanical room at base of air handler exterior.	None Detected
UAA510-A21	Gray sealant compound.	Mechanical room, inside air handler at hatch.	None Detected
UAA510-A22	White sealant compound.	Mechanical room air handler panel at wall connection.	None Detected
UAA510-A23a	Gray mortar compound.	Mechanical room, around door frame at second level.	None Detected
UAA510-A23b	Yellow mastic compound.	Mechanical room, at east wall under fiberglass.	None Detected
UAA510-A24	Gray sealant compound.	Mechanical room, top of air handler at roof penetration.	None Detected
<b>UAA510-A25</b>	<b>White joint compound.</b>	<b>Mechanical room, west wall.</b>	<b>1.1% chrysotile</b>
UAA510-A26	Fibrous duct cloth with adhered paper and foil backing.	Mechanical room, large interface duct.	None Detected
UAA510-A27	Black penetration insulation material.	Mechanical room glycol pipe at wall penetration.	None Detected
<b>UAA510-A28</b>	<b>Gray sealant compound.</b>	<b>Inside perimeter air handler unit, see sample location drawing.</b>	<b>1.2% chrysotile</b>
<b>UAA510-A29</b>	<b>Gray sealant compound.</b>	<b>Inside perimeter air handler unit, see sample location drawing.</b>	<b>1.4% chrysotile</b>
<b>UAA510-A30</b>	<b>Gray sealant compound.</b>	<b>Inside perimeter air handler unit, see sample location drawing.</b>	<b>1.3% chrysotile</b>
The testing method used (polarized light microscopy [PLM]) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Before this material can be considered or treated as non-asbestos containing, confirmation should be made by quantitative transmission electron microscopy (TEM).			

The following TABLE 1D lists the samples taken in June 2010 on the roof of the Science Building, and the results of the laboratory analysis. Refer to Appendix D for sample locations. Note, some of these materials may have been removed by the previous project, but are included here to illustrate similar materials from the eras of construction.

**TABLE 1D**

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA0610-A01	Roof felt layer	Layer 2 under paver, NE corner of roof at hole cut by roofers Photo #8	None Detected



<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>ASBESTOS CONTENT</b>
UAA0610-A02	Asphalt roofing with roofing tar with brown fiber board	Layer 3 under felt layer, NE corner of roof at hole cut by roofers Photo #10	None Detected
UAA0610-A03	Brown fiber board with black tar/adhesive to insulation board	Layer 4 under asphalt layer, NE corner of roof at hole cut by roofers Photo #11	None Detected both layers
UAA0610-A04	Black roofing tar	Layer 6 under Styrofoam insulation board, NE corner of roof at hole cut by roofers Photo #12	None Detected
UAA0610-A05	Tar paper and roofing tar layers	Layer 7 under tar layer and above wood layer, NE corner of roof at hole cut by roofers Photo #12	None Detected
UAA0610-A06	Tan gypsum board	Layer 8 next to wood above metal roof deck, NE corner of roof at hole cut by roofers Photo #12	None Detected
UAA0610-A07	Roof felt layer	Layer 2 under paver, NE corner of roof at hole cut by roofers Photo #14	None Detected
UAA0610-A08	Asphalt roofing with roofing tar	Layer 3 under felt layer, NE corner of roof at hole cut by roofers Photo #14	None Detected
UAA0610-A09	Brown fiber board with black tar/adhesive to insulation board	Layer 4 under asphalt layer, NE corner of roof at hole cut by roofers Photo #14	None Detected both layers
UAA0610-A10	Black roofing tar, tar paper and roofing tar layers	Layers under insulation board and above gypsum board, NE corner of roof at hole cut by roofers Photo #14	None Detected
UAA0610-A11	Tan gypsum board	Bottom layer above metal roof deck, NE corner of roof at hole cut by roofers Photo #14	None Detected
UAA0610-A12	Black/gray roof sealant at drain bowl	North end of roof	None Detected
UAA0610-A13	Black/gray roof sealant at drain bowl	South end of roof	None Detected
The testing method used (polarized light microscopy [PLM]) is not consistently reliable in detecting asbestos in floor coverings and similar non-friable organically bound materials. Before this material can be considered or treated as non-asbestos containing, confirmation should be made by quantitative transmission electron microscopy (TEM).			

The following materials have been found to contain asbestos in the previous surveys, or were assumed to contain asbestos.

1. Gray sealants of the exterior metal “insulated sandwich panels”.
2. Cement asbestos “stiffeners” at the interlocking joints of the exterior metal “insulated sandwich panels” (assumed ACM).
3. Exterior tarry dampproofing at foundation (assumed ACM).
4. Flange gaskets and valve packing on piping (to be inspected), refer to discussion below.
5. Buried “transite” piping (assumed ACM).
6. Joint compound in original gypsum wall board systems on the ceilings and walls (not found at modular vinyl finished partition system walls). The previous project removed the original finishes in the renovation area.
7. Older cove base mastic at original wall locations. The previous project removed the original finishes in the renovation area.
8. Various colors of ventilation system duct sealants. The previous project removed a majority of the asbestos-containing duct sealants in the renovation area.
9. Hard and chalky insulation at concealed pipe valves and fittings (assumed ACM) not likely to be affected by this project.
10. High temperature wiring insulation at autoclaves and incubator ovens (assumed ACM).
11. Remnants of asbestos-containing Patching Tars at older Roof mounted Exhaust fans.
12. Original fire door insulation. The previous project removed most of the original fire doors, including all of the doors in the renovation area.
13. Remnants of concealed asbestos-containing flooring mastics (assumed ACM).

The following materials have been found to be asbestos-free in this or previous surveys.

- All 2' x 4' Ceiling tiles.
- Various color and patterns of sheet vinyl and associated adhesives.

The affects of the above asbestos-containing materials on the proposed renovation are discussed below.

#### **Gray Sealants Of The Exterior Metal “Insulated Sandwich Panels”**

A gray sealant found between the joints of the insulated metal wall panels (and assumed to be present around the windows and doors), was found to be asbestos-containing. Penetrations through the wall panels, (including incidental penetrations for mechanical, electrical, structural and architectural work) are scheduled to be created by this project, which will disturb the asbestos-containing sealants.

#### **Cement Asbestos “Stiffeners” At Exterior Metal “Insulated Sandwich Panels”**

Cement asbestos “stiffeners” are assumed to be present at the interlocking joints of the exterior metal “insulated sandwich panels”. Those interlocking joints are scheduled to be disturbed in order to install new air louvers for the mechanical system.

#### **Exterior Foundation Wall Damp-proofing Sealant**

The foundation water-proofing is assumed to contain asbestos. The sealants are assumed to be not friable and in good condition. The tarry sealants may require minor disturbance by this project.

#### **Flange Gaskets and Valve Packing**

Due to their age gaskets and valve packing on mechanical equipment throughout the building but mostly in mechanical and fan rooms are assumed to be asbestos-containing. These materials are difficult to sample without disassembly of equipment and consequently limited sampling was performed. The mechanical systems in the renovation area were installed in 2013, and are unlikely to contain asbestos, however, any gaskets and valve packings affected by the project should be inspected to determine if they are suspected of containing asbestos. These materials were in good condition but may become friable during removal for replacement. The gaskets and packings are likely to be disturbed by this project.

**Buried “Transite” Piping**

Buried asbestos-containing “transite” water and sewer piping is assumed to be present at the site. Portions of the buried water piping are scheduled for demolition and/or abandonment by this project. The “transite” piping is assumed to be in good condition and is not considered friable unless damaged. The contractor will need to field verify the presence or absence of this material during the work.

**Gypsum Board Joint Compound**

Joint compound to the original gypsum wall board in the building was found to be asbestos-containing. Portions of the original gypsum wall board walls and ceilings remain in areas outside of the renovation area. All original gypsum wall board in the renovation area was reported to have been removed by the previous 2013 project. Any incidental work that might disturb the original joint compound in other areas of the building is required to be done by trained asbestos workers. No joint compound was found on the modular vinyl finished partition system walls. Some of the walls scheduled to remain, may require incidental penetrations for mechanical, electrical, structural and architectural renovations.

**Older Cove Base Mastics**

A mastic behind the self-coving sheet vinyl flooring in the building was found to be asbestos-containing. The previous project removed the original finishes in the renovation area. Walls with the ACM cove base mastics are not scheduled for removal by this project.

**Duct Sealants**

Gray-Green Sealants at joints of the medium or high pressure ductwork was found to contain asbestos. The previous project removed the ductwork in the renovation area. The sealant was in good condition and was not friable and are not scheduled for removal by this project.

**Pipe Insulation**

All piping inspected in the project areas was insulated with fiberglass insulation. Although no asbestos was detected, piping was concealed above ceilings and walls in some areas. Due to the age of construction, some concealed asbestos-containing insulation may be uncovered during demolition. If any concealed piping is found to have hard and chalky or other insulation suspected of containing asbestos, those materials shall be sampled prior to disturbance.

**High Temperature Wiring Insulation**

Although no suspect wire insulation was found by this survey, high temperature wiring insulation is assumed have asbestos-containing insulation due to the age of the building. The wiring is assumed to be present at older incandescent light fixtures, at high temperature heating equipment, and at ovens and ranges. If any wiring is found to have waxy, fibrous or any other insulation suspected of containing asbestos, those materials shall be sampled prior to disturbance. Wiring insulation is typically not friable, and is not scheduled for removal by this project.

**Door Insulation**

Hallway doors leading into the stairwell areas were insulated with asbestos-containing insulation. Hallway doors in the project area with a Warnock Hersey fire rating were insulated with a non-asbestos containing white material. The asbestos containing fire doors are not scheduled for removal by this project.

**Remnants of Floor Tile and Sheet Vinyl Mastics**

All flooring materials (with the exception of older cove base mastics) that were sampled in the project building did not contain asbestos. Due to the age of the building, it is assumed that some remnants of asbestos-containing mastics may be present underneath the non-asbestos flooring materials left over from past renovations. The design assumes that approximately 20% of the floor area will have remnants of asbestos-containing mastics, actual quantities will be determined during the renovation. The floor and sheet vinyl mastics are not scheduled for removal by this project.

**2. Dust Sampling for Asbestos**

The following TABLE 2 lists the dust samples for asbestos taken in January 2009 throughout the building, and the results of the laboratory analysis using ASTM D5756. Dust sample field survey data sheets and laboratory reports are included as Appendix B. Refer to Appendix D for sample locations.

**TABLE 2A**

<b>SAMPLE NUMBER</b>	<b>DESCRIPTION</b>	<b>LOCATION</b>	<b>RESULTS ASBESTOS St./cm<sup>2</sup> *</b>	<b>RESULTS PERCENTAGE ASBESTOS</b>
UAA109-AD1	Dust on metal, 10cm x 10cm	Interstitial Space at midpoint of eastern outside wall	8,300 st/cm <sup>2</sup> chrysotile and amosite	0.00092%
UAA109-AD2	Dust on metal, 10cm x 10cm	Interstitial Space center of room on top of abandoned metal duct	9,300 st/cm <sup>2</sup> chrysotile	0.00096%
UAA109-AD3	Dust on LCT, 10cm x 10cm	2nd floor above ceiling in hallway above door to room 215	15,000 st/cm <sup>2</sup> chrysotile and actinolite	0.0012%
UAA109-AD4	Dust on LCT, 10cm x 10cm	2nd floor above ceiling in hallway 200C5 on ceiling light	620 st/cm <sup>2</sup> chrysotile and actinolite	0.000035%

\* The St./cm<sup>2</sup> results by ASTM D5755 and D5756 are not directly comparable due to differences in sample preparation. The D5756 results are primarily meant to determine the weight percentage. Refer to discussion in Part E below.

**3. Lead-Containing Materials****Paint**

EHS-Alaska tested paint throughout the affected areas of the building using a NITON XLi303AW X-Ray Fluorescence (XRF) lead paint analyzer (Serial # 14311 with software version 5.1CDual). Lead in paints tested varied from a trace amount to 3.1 mg/cm<sup>2</sup>. Refer to the Lead Paint Screening Table in Appendix C that identifies the surfaces tested, and the results. The Paint Test Locations are shown in the Drawings in Appendix D. There were varying lead contents found in the paints, based on what surfaces they are on, with most surfaces containing little lead (but are still classified as lead-containing materials by OSHA). The highest levels of lead were found on structural members and miscellaneous steel, with lower levels on walls and other painted surfaces, and lowest levels on pre-finished materials.

Lead based paints (paint containing more than 1.0 mg/cm<sup>2</sup> of lead) were identified in the project on steel components such stairs and other structural steel. It is anticipated that other miscellaneous metal items, such as door frames and white boards may be painted with lead-based paint, or lead-containing paints. Lead was detected at very low levels in most of the painted floor, wall and ceiling surfaces. Low levels of lead found by XRF testing does not mean that the paints are free of lead, the paints may contain lead. However, these paints should not present a hazard to occupants or workers performing renovation work if lead-safe work practices are followed.

The following TABLE 3A lists the paint chip samples taken in June 2010 in the interstitial and 1st floor of the Science Building, and the results of the laboratory analysis. Refer to Appendix D for sample locations.

**TABLE 3A**

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>LEAD CONTENT*</b>
UAA0610-LPC01	Brown paint chips with Ghost Wipe	NE Column in Interstitial space, Grid 6-D, ref. XRF-L6	Lead present

<b>SAMPLE NUMBER</b>	<b>MATERIAL</b>	<b>LOCATION</b>	<b>LEAD CONTENT*</b>
UAA0610-LPC02	Brown paint chips with Ghost Wipe	On joist near 2nd column S of NE corner, Grid 5-D, ref. XRF-L10, Photo #08	Lead present
UAA0610-LPC03	Brown paint chips with Ghost Wipe	2nd column S of most NE corner, Grid 5-D, ref. XRF-L12 Photo #11	Lead present
UAA0610-LPC04	Brown paint chips with Ghost Wipe	Tube steel Cross Brace, in Room 119, 1st. Floor, ref. XRF-L13, Photo #15	Lead present
* Reference the XRF test locations for side-by-side samples listed in Appendix C. The laboratory determined that there was insufficient weight of paint chips to conduct their full paint chip analysis and chose to treat the samples as lead-wipe samples instead of calculating the percent of lead by weight. Due to this confusion about the samples, the results are shown here as just containing lead, as all of these samples clearly contained lead.			

### **Metallic Lead in Batteries, Sash Weights, Pipe Solder and Flashing**

Metallic lead items identified in the building included vent piping on the roof, lead counter weights for fume hood sash, and lead acid batteries for emergency lighting, building security and fire system alarms. If removed during renovation or demolition they should be recycled or disposed of as hazardous waste.

### **Settled and Concealed Dust**

Lead dust wipes were previously collected throughout the facility in areas of heavy dust. Actual lead content of the dust could not be determined by laboratory analysis due to insufficient sample weight. However, as noted in Table 3A above, lead was identified as at least being present in the dusts. The presence of lead in concealed dusts is typical in areas that are not routinely cleaned in most buildings of this age and may not present a hazard to workers if proper work practices and engineering controls are used.

## **4. PCB-Containing Materials**

### **Light Ballasts**

Older fluorescent lights typically have PCB-containing ballasts. PCB-containing ballasts in fluorescent lights were banned in 1978, but manufacturers were allowed to use up existing stocks, and lights may have been reused from other facilities. The previous survey included examination of what were considered to be representative light fixtures, but not all fixtures were able to be accessed. All lights shall be inspected during removal or relocation. Unless ballasts were marked "No PCBs," they must be assumed to contain PCBs and must be disposed of as a hazardous waste when removed for disposal. Fluorescent light fixtures with PCB-containing ballasts were found in the previous survey in the building, and most of the light fixtures were replaced as part of that comprehensive renovation. Some original light fixtures may remain in the "interstitial space", which are not likely to be disturbed by this project.

Older HID lights may have PCB-containing ballasts. Due to height restrictions and sealed ballast enclosures, the HID fixtures were not able to be accessed. All HID lights shall be inspected during removal or relocation. If ballasts are not marked "No PCBs," we suggest contacting the manufacturer of the lights to determine if the ballasts contain PCB's, or assume that they contain PCB's and be disposed of as a hazardous waste. The HID light fixtures are unlikely to be disturbed by this project.

### **Bulk Products**

Some older paints, sealants and other building materials may contain measurable amounts of PCB's. PCB use in paints and sealants was supposed to have been discontinued in 1979. The EPA does not require the sampling of bulk products, and no sampling of "Bulk Products" were authorized for this project.

## **5. Mercury-Containing Materials**

### **Fluorescent Lamps**

Fluorescent lamps use mercury to excite the phosphor crystals that coat the inside of the lamp. These lamps contain from 15 to 48 milligrams of mercury depending on their age and manufacturer. The fluorescent light fixtures will be replaced as shown on the drawings.

### **Thermostats**

Older thermostats or other electrical switches that may contain mercury were previously noted in the building.

### **High Intensity Discharge Lamps**

High Intensity Discharge (HID) lamps use mercury and sodium vapors in the lamp, and also typically have lead-containing solders at the bases. These lamps contain varying amounts of mercury depending on their age and manufacturer. The HID light fixtures are unlikely to be disturbed by this project.

All mercury-containing items being removed by this project are required to be disposed of as hazardous waste or recycled.

## **6. Other Hazardous Materials**

### **Self-Illuminating Exit Signs**

Radioactive, self-illuminating exit signs and smoke detectors are assumed to be present in the renovation area. No radioactive exit signs are scheduled to be replaced by this project. If any radioactive items are removed by this project, they are required be disposed of as hazardous waste or recycled.

### **Soil Contamination**

The scope of work for EHS-Alaska, Inc. did not include investigation of soils for petroleum or other contaminations.

### **Refrigerants**

Refrigerators, freezers, ice machines, and water coolers were identified in the building that may contain ozone depleting refrigerants. Air conditioning units are also be present. Ozone depleting substances (ODS) are regulated by the EPA and must be removed by certified technicians prior to equipment disposal.

### **Glycol**

The existing heating system reportedly contains heating system glycol. Any glycol removed from the heating system shall be recovered and properly disposed of or recycled.

## **E. REGULATORY CONSTRAINTS**

### **1. Asbestos-Containing Materials**

The Federal Occupational Safety and Health Administration (29 CFR 1926.1101) and the State of Alaska Department of Labor (8 AAC 61) have promulgated regulations requiring testing for airborne asbestos fibers; setting allowable exposure limits for workers potentially exposed to airborne asbestos fibers; establishing contamination controls, work practices, and medical surveillance; and setting worker certification and protection requirements. These regulations apply to all workplace activities involving asbestos-containing materials.

The EPA regulations, issued as Title 40 of the Code of Federal Regulations, Part 61 (40 CFR 61) under the National Emission Standards for Hazardous Air Pollutants (NESHAP) established procedures for handling ACM during asbestos removal and waste disposal. These regulations required an owner (or the owner's contractor) to notify the EPA of asbestos removal operations and to establish responsibility for the removal, transportation, and disposal of asbestos. It is recommended that clearance sampling which

complies with the EPA's Asbestos Hazard Emergency Response Act (AHERA) protocol be required following removal of asbestos-containing materials to document that the asbestos has been properly removed.

The disposal of asbestos waste is regulated by the EPA, the Alaska Department of Environmental Conservation, and the disposal site operator. Wastes being transported to the disposal site must be sealed in leak tight containers prior to disposal and must be accompanied by disposal permits and waste manifests.

## **2. Dusts with Asbestos**

The dust samples taken at UAA Science Building contained less than 1 percent asbestos. The concentrations of asbestos structures per unit area of dust analyzed by ASTM D5756 are not directly comparable to the majority of dust sampling literature which use ASTM 5755 analysis due to differences in sample preparation. Both types of analysis include ultrasonic treatment to separate asbestos from interfering particulates. However, the D5756 method includes a much longer ultrasonication step that tends to break down the larger asbestos structures, such as bundles or groups of asbestos fibers into more simple, individual asbestos fibers to allow more accurate estimations of the weight of the fibers. That has a tendency to "create" multiple asbestos structures out of what was originally a single asbestos structure. Area concentrations for samples analyzed by ASTM D5756 for weight percentage may have a higher concentration than if the same sample was analyzed by ASTM D5755. This should not have any effect on the weight percentage results, as no asbestos structures are actually "created", but are just more finely divided. The structures per unit area results from ASTM D5756 analysis are given as a courtesy by the laboratory, and should be used as a general comparison of relative concentrations, and not compared to the ASTM D5755 analysis results or the indications of "background", "medium" or "high" concentrations as discussed below and in the published literature on the implications of asbestos in dusts. The differences between the two types of analysis will depend on the relative sizes of the asbestos structures present in the dusts. If the dust has mostly single fibers, there would not be much effect. If the dust has bundles, clusters or matrixes of asbestos present, the concentration of structures per unit area may be reported as much higher by ASTM D5756 analysis than if it was analyzed by ASTM D5755.

Concentrations of asbestos in dust are considered to be at "background" levels when the concentrations are between 1,000 to 10,000 St./cm<sup>2</sup> when analyzed by ASTM D5755. Background levels for a particular location will depend on many factors, including whether or not asbestos occurs naturally in soils in the area. Concentrations greater than approximately 100,000 St./cm<sup>2</sup> are considered to have a higher likelihood of causing an exposure to asbestos fibers when the settled dusts are disturbed. Concentrations between 10,000 and 100,000 St./cm<sup>2</sup> lie in a median range. In all cases, the possible airborne concentrations of asbestos will depend on the type of disturbance, the quantity of dust that is disturbed, and the size of the area into which the dust is made airborne.

### **D5756-Weight Percentage Samples**

The asbestos in dust concentrations found throughout UAA Science Building ranged from 620 St./cm<sup>2</sup> to 15,000 St./cm<sup>2</sup>, when analyzed by ASTM D5756, and as discussed above, may not be comparable to the research that produced the above classifications of "background, medium and high" concentrations.

### **Likely sources of asbestos in dusts include natural occurrences of asbestos**

The types of asbestos found in the dust samples included Chrysotile, Amosite, and Actinolite forms of asbestos. One sample contained only Chrysotile. One samples contained Chrysotile and Amosite and two samples contained Chrysotile and Actinolite. Actinolite was not identified in bulk samples taken of materials within the building that form of asbestos may have come from natural occurrences of asbestos in an outside source, such as rock or ore deposits, which appear to be common in the Anchorage area.

Because the type of disturbance, concentration of asbestos in the dusts, quantity of dust disturbed, cohesiveness of the dusts and room sizes will change, the airborne asbestos levels expected during the project will depend on the contractor's means and methods of conducting the work. The mere presence of asbestos in the dusts does not necessarily imply that a "hazard" exists which would require the use of specially trained workers to "abate" the "hazard". All dusts will be required to be removed from the areas where asbestos-containing materials are being removed (abatement areas). The dusts in the other areas are to be controlled so as to limit worker exposures and prevent contamination of occupied areas of the building.

There is no established correlation between settled or adhered dusts with measurable concentrations of asbestos and airborne concentrations. The definition in the OSHA regulations of asbestos-containing materials as those materials that contain 1 percent or more asbestos by weight, apply to cohesive materials and not to dusts. The OSHA regulations are essentially "performance based", if workers are exposed above the permissible exposure limits, then all of the requirements in the regulations become effective.

### **3. Lead-Containing Materials**

The EPA Standard 40 CFR 745, Lead-Based Paint Poisoning Prevention in Certain Residential Structures, defines lead-based paint hazards and regulates lead based paint activities in target housing and child-occupied facilities. The requirements of this regulation include training certification, pre-work notifications, work practice standards and record keeping. Areas in facilities built before 1978 that are typically classified as child occupied facilities may include but are not limited to: residential homes, day care facilities, preschools, kindergarten classrooms, restrooms, multipurpose rooms, cafeterias, gyms, libraries and other areas routinely used by children under 6 years of age. New training requirements for Firms (Contractors) and Renovators (Workers) became effective on April 22, 2010. The building is not classified as a child occupied facility, therefore the requirements of 40 CFR 745 do not apply.

Federal OSHA (29 CFR 1926.62) and the State of Alaska (8 AAC Chapter 61) have promulgated regulations that apply to all construction work where employees may be exposed to lead. The disturbance of any surfaces painted with lead-containing paint requires lead-trained personnel, personnel protective procedures, and air monitoring until exposure levels can be determined. If initial monitoring verifies that the work practices being used are not exposing workers, monitoring and protection procedures may be relaxed. Experience has shown that some paints in most buildings will contain low concentrations of lead and disturbance of those paints are still regulated under the OSHA lead standard, 29 CFR 1926.62. Low levels of lead found by XRF testing does not mean that the paints are free of lead, the paints may contain lead, and OSHA regulations apply anytime measurable amounts of lead are present in paints.

Because the type of disturbance, quantity of lead dusts, cohesiveness of the dusts and room sizes will change, the airborne lead levels expected during the project will depend on the contractor's means and methods of conducting the work. The mere presence of lead in the dusts does not necessarily imply that a "hazard" exists which would require the use of specially trained workers to "abate" the "hazard". There is no established correlation between settled or adhered lead dust concentrations and airborne concentrations. The OSHA regulations are essentially "performance based", if workers are exposed above the permissible exposure limits, then all of the requirements in the regulations become effective.

The EPA requires that actual construction or demolition debris that contains lead or lead-containing paint or other heavy metals be tested using the TCLP test to determine if the waste must be treated as hazardous waste. All federal, state and local standards regulating lead and lead-containing wastes are required to be followed during the renovation or demolition of portions of this building. Lead-acid batteries and other batteries are classified by the EPA as Universal Wastes. The EPA encourages that all Universal Wastes be recycled in accordance with 40 CFR 273, or in the case of lead-acid batteries, in accordance with 40 CFR 266, subpart G.



There are no hazardous waste landfills in Alaska and the lead-containing wastes (if shown to be hazardous waste) will have to be packaged for shipping and disposal. This report assumes that disposal will take place in Seattle or elsewhere in the Pacific Northwest.

#### **4. PCB-Containing Materials**

The EPA has promulgated regulations (40 CFR Part 761) that cover the proper handling and disposal of PCB-containing materials. If any PCB-containing equipment is discovered and if they will be removed, those materials are required to be disposed of at fully permitted hazardous waste facilities. The EPA regulates liquid PCBs differently from non-liquid materials. Workers who remove or handle PCB-containing or PCB-contaminated materials or who transport or dispose of PCB wastes must be trained and certified in hazardous waste operations and emergency response (HAZWOPER) as required by 29 CFR 1910.120 and the State of Alaska Department of Labor (8 AAC 61). The Department of Transportation under 49 CFR Parts 100-199 regulates the marking, packaging, handling and transportation of hazardous materials. All federal, state and local standards regulating PCBs and PCB waste must be followed during this project.

#### **5. Mercury-Containing Materials**

Thermostats and mercury-containing lamps are classified by the EPA as Universal Wastes. The EPA encourages that all Universal Wastes be recycled in accordance with 40 CFR 273. Mercury and mercury-containing products are considered hazardous waste if TCLP testing of the waste for mercury confirms the mercury content to be greater than the EPA criteria of 0.2 mg/l.

#### **6. Other Hazardous Materials**

##### **Refrigerants**

Refrigerators, freezers, ice machines, and water coolers were present that are scheduled to remain. Air conditioning systems were present that are scheduled to remain. Typically, refrigeration and air conditioning systems with ODS shall be maintained in order to prevent discharge of ODS. Systems that are to be removed, or dismantled shall have refrigerants containing ODS recovered and disposed of or recycled in accordance with 40 CFR 82.

##### **Chemical Hazards**

The EPA has promulgated regulations (40 CFR Parts 260 to 299 amongst others) that cover the proper handling and disposal of waste chemicals, including listed wastes, which are ignitable, corrosive, reactive, toxic, or an acute hazardous waste or wastes that exhibit the characteristics of toxicity. All construction workers who are required to remove or handle chemical hazards or to transport or dispose of chemical wastes shall be trained and certified as required by the U.S. Department of Labor (29 CFR 1910.120) and the State of Alaska Department of Labor (8 AAC 61). Transportation of chemical hazards are regulated by Department of Transportation regulations under 49 CFR Parts 171 to 178 amongst others.

##### **Radioactive Materials**

Self-luminous products that contain Tritium, Krypton-85, or Promethium-147 are considered radioactive. There are special disposal requirements for products that contain Tritium, Krypton-85, or Promethium-147 that are generally licensed. Data from the Nuclear Regulatory Commission (NRC) indicates that most all Tritium powered exit signs are generally licensed and therefore must be disposed of at a licensed disposal facility or returned to the manufacturer/distributor for disposal. Licensed radioactive products are regulated by Nuclear Regulatory Commission standard 10 CFR 20 and 10 CFR 32. Smoke detectors were present in the project area that may contain a radioactive material. If the detectors are of the ionization type they typically contain a small amount of Americium. If removed during renovation, the detectors should be returned to the owner for reuse or returned to the manufacturer for disposal or recycling. There are no licensed disposal facilities for radioactive wastes in Alaska.

**F. RECOMMENDATIONS****1. Asbestos-Containing Materials**

The asbestos-containing materials identified in the building are typically in intact condition and are classified as non-friable ACM. All asbestos-containing materials that will be disturbed by the planned renovation work are required to be removed by trained asbestos workers. Refer to Section 02 8233 Removal and Disposal of Asbestos Containing Materials.

**2. Dusts with Asbestos**

Dusts with measurable concentrations of asbestos were found, but are not classified as asbestos-containing materials, or as debris from asbestos-containing materials. Workers disturbing dusts are required to have hazard communication training in accordance with OSHA regulations, but are not required to receive 40 hours of training, which is required for asbestos workers. The contractor will need to choose means and methods to control worker exposures to airborne contaminants. At least an initial exposure assessment or data from previous air monitoring is needed to show that worker exposures are maintained below the OSHA permissible exposure limits (PELs). Refer to Section 01 3545 Airborne Contaminant Control.

**3. Lead-Containing Materials**

Federal OSHA (29 CFR 1926.62) and the State of Alaska (8 AAC Chapter 61) have promulgated regulations that apply to all construction work where employees may be exposed to lead, including disturbance of paints with low concentrations of lead.

Worker exposure to lead may be able to be controlled below the OSHA permissible exposure limit if proper engineering controls and procedures are used during renovation. Lead is a potentially hazardous waste and the EPA requires that all wastes that contains lead be tested to determine if they must be treated as hazardous waste. A TCLP test of the waste stream(s) produced by the Contractor's means and methods are required to be performed to determine if those wastes will be hazardous or non-hazardous. Refer to Section 01 3545 Airborne Contaminant Control and Section 02 8333 Removal and Disposal of Materials Containing Lead.

**4. PCB-Containing Materials**

IF any PCB-containing ballasts are discovered, and they are removed or replaced, they will need to be removed, handled, packaged and disposed of in accordance with all regulations. Refer to Section 02 8418 Removal and Disposal of Chemical Hazards.

**5. Mercury-Containing Materials**

Mercury-containing materials scheduled for removal or replacement will need to be removed, handled, packaged and disposed of in accordance with all regulations. If mercury-containing lamps and thermostats are handled and disposed of in accordance with the Universal Waste Regulations, no TCLP test is required. If the Contractor chooses to perform a TCLP test of fluorescent lamps, the test shall be conducted in accordance with the requirements of ANSI/NEMA Standard Procedure for Fluorescent Lamp Sample Preparation and Toxicity Characteristic Leaching Procedure, C78.LL 1256-2003 or latest version. Refer to Section 02 8418 Removal and Disposal of Chemical Hazards.

**6. Other Hazardous Materials**

IF any radioactive materials are removed or replaced, they will need to be removed, handled, packaged and disposed of in accordance with all regulations. Refer to Section 02 8418 Removal and Disposal of Chemical Hazards.

IF any refrigeration units or Air Conditioners with ODS are scheduled for removal they will need to be removed, handled, packaged and disposed of in accordance with all regulations. Refer to Section 02 8418 Removal and Disposal of Chemical Hazards.

## **G. LIMITATIONS**

The conclusions and recommendations contained in this report are based upon professional opinions with regard to the subject matter. These opinions have been arrived at in accordance with currently accepted environmental consulting and engineering standards and practices and are subject to the following inherent limitations:

### **1. Accuracy of Information**

The laboratory reports utilized in this assessment were provided by the accredited laboratories cited in this report. Although the conclusions, opinions, and recommendations are based in part, on such information, our services did not include the verification of accuracy or authenticity of such reports. Should such information provided be found to be inaccurate or unreliable, EHS-Alaska, Inc. reserves the right to amend or revise its conclusions, opinions, and/or recommendations.

### **2. Site Conditions**

This information from a previous survey did not include investigation of the areas of the building affected by this project, and was based on older information and may not be valid outside the survey area. The intent of this survey was to identify common hazardous materials that may be disturbed during renovations. This survey is not intended to be utilized as the sole design document for abatement. This survey was conducted while the site was occupied. All inspections were performed with furniture, equipment and/or stored items in place. The scope of work for this survey did not include identification of all potentially hazardous materials that may be present at this site, and was limited to the scope of work agreed upon with our client. Although a concerted effort was made to identify those common hazardous materials likely to be affected by this project, some hazardous materials may have been hidden by furniture, equipment or stored items and may not have been identified. The survey investigated representative materials and items, such as lights and mechanical components. Variations may occur between materials and items that appear to be the same, but are actually of different construction or materials. Other asbestos-containing or potentially hazardous materials may be present in the facilities that were concealed by structural members, walls, ceilings or floor coverings, or in materials where testing was not conducted.

### **3. Changing Regulatory Constraints**

The regulations concerning hazardous materials are constantly changing, including the interpretations of the regulations by the local and national regulating agencies. Should the regulations or their interpretation be changed from our current understanding, EHS-Alaska, Inc. reserves the right to amend or revise its conclusions, opinions, and/or recommendations.

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## SECTION 02 4113 – ABANDON EXISTING UTILITIES IN PLACE

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. The Contractor shall provide all equipment, materials, labor to abandon existing utilities in place.
  - 1. Submittals:

The Contractor shall submit one digital copy (in PDF format) for each of the following items prior to commencement of construction. A resubmittal shall be required for all unapproved submittals. Construction shall not begin until all submittals are received and approved.

    - a. Concrete, Grout, and Sand Slurry

## PART 2 - PRODUCTS

## 2.1 SAND SLURRY

- A. Sand slurry consists of a mixture of water and sand with an approximate ratio of seven (7) gallons of water per cubic foot of sand. Sand may consist of native material with a particle size distribution such that one hundred percent (100%) of the material passes the No. 4 U.S. Standard Sieve and contains no lumps, frozen material, organic matter, or other deleterious material.

## 2.2 GROUT

- A. Grout is to consist of a Portland cement, water, lime and sand. Portland cement is to be Type II, sand is to meet the requirements of sand slurry.

## 2.3 CONCRETE

- A. Concrete is to be class C-6 in accordance with MASS Division 30.

## PART 3 - EXECUTION

## 3.1 EXCAVATION

- A. Excavate to expose ends of pipe to be abandoned in place.

### 3.2 ABANDON IN PLACE

- A. Empty lines to be abandoned in place. Collect fluids and dispose of properly.
- B. Contractor shall install a locator wire inside of pipes to be abandoned in place. Locator wire shall be compatible with an above ground wire tracer.
- C. Construct a one foot thick concrete plug with vent tube at the high end of the pipe.
- D. From the downhill side of the pipe fill the pipe with a quantity of sand slurry or grout equal to the calculated volume of the pipe.
- E. Place a one foot concrete plug at the downhill side of the pipe.

END OF SECTION 02 4113

## SECTION 02 4119 - SELECTIVE DEMOLITION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.
- B. Related Requirements:
  - 1. Division 01 Section "Summary of Work" for restrictions on use of the premises, and Owner-occupancy requirements
  - 2. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
  - 3. Division 01 Section "Cleaning" for management of construction waste.
  - 4. Division 01 Section "Temporary Controls".
  - 5. Division 01 Section "Site Safety Requirements".
  - 6. Division 01 Section "Airborne Contaminant Control".
  - 7. Division 02 Sections "Removal and Disposal of Asbestos Containing Materials", "Removal and Disposal of Materials Containing Lead", and "Removal and Disposal of Chemical Hazards".

## 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

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1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

## 1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in materials to be selectively demolished. A report on the presence of hazardous materials is included in Division 01 specifications.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents. Refer to Division 01 and 02 specifications listed in 'Related Requirements' earlier in this specification section.
- E. Storage or sale of removed items or materials on-site is not permitted.



- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

## 1.8 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
  - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
  - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
  1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  5. Maintain fire watch during and for at least 48 hours after flame-cutting operations.
  6. Maintain adequate ventilation when using cutting torches.
  7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Cleaning."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Comply with requirements specified in Division 01 Sections "Cleaning" and "Site Safety Requirements".
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

### 3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: Existing construction to be removed includes work shown in civil, architectural, structural, mechanical and electrical drawings and the following:
  - 1. Remove section of existing CMU wall for new door and frame.
  - 2. Remove sections of existing concrete floor, walls and lid over Room 101 as required for installation of new mechanical ducts and piping.
  - 3. Floor and wall finishes where indicated on the Drawings.
  - 4. Remove sections of existing insulated honeycomb metal panels as required for installation of new exhaust vents and intake louver.
- B. Remove and Salvage: Wall mounted clock and other items as indicated on the Drawings.
- C. Remove and Reinstall: Mechanical equipment as indicated on the Drawings.
- D. Existing to Remain: Existing ceiling, wall and floor assemblies where not indicated to be removed on the Drawings and the following:
  - 1. Existing casework in Room 101 including upper and lower cabinets and counter top,

2. Wall mounted fire extinguisher
3. Other items as indicated on the Drawings.

END OF SECTION 02 4119

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## SECTION 02 8233 - REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS

## PART 1 - GENERAL

## 1.1 DESCRIPTION OF WORK

- A. The work requires the disturbance, demolition, removal, and disposal of the following asbestos-containing materials (ACM) from the NSB EM-2 Mechanical Systems Conversion/Upgrades Project as shown on the drawings and as specified herein. Bulk samples have been taken of suspect materials in this facility and the results are documented in Section 02 2600, Hazardous Materials Assessment. Quantities of asbestos-containing materials to be disturbed or removed shown below will depend on the contractor's means and methods and may vary slightly from quantities shown. It is the contractor's responsibility to identify locations where asbestos-containing materials will require disturbance or removal and to remove and dispose of all ACMs affected by the project work from the site in accordance with applicable regulations. The contractor shall immediately notify the owner if other unidentified ACMs are discovered.
1. Gray sealants of the exterior metal "insulated sandwich panels". Quantity estimate: 6 linear feet.
  2. Cement asbestos "stiffeners" at the interlocking joints of the exterior metal "insulated sandwich panels" (assumed ACM). Quantity estimate: 8 linear feet.
  3. Exterior tarry dampproofing at foundation (assumed ACM). Quantity estimate: 10 square feet.
  4. Flange gaskets and valve packing on piping (to be inspected): refer to discussion in Hazardous Materials Assessment.
  5. Buried "transite" piping (assumed ACM, to be field verified by contractor): Quantity to be removed, if present: 175 linear feet of pipe.
- B. In addition to the above materials, the following materials are located in other areas of the building, and may require disturbance for auxiliary support, such as electrical and mechanical equipment and installation of equipment. Not all ACM is to be removed from these areas, only that required to complete the project work need be removed:
1. Joint compound in original gypsum wall board systems on the ceilings and walls (not found at modular vinyl finished partition system walls). The previous project removed the original finishes in the renovation area.
  2. Older cove base mastic at original wall locations. The previous project removed the original finishes in the renovation area.
  3. Various colors of ventilation system duct sealants. The previous project removed a majority of the asbestos-containing duct sealants in the renovation area.
  4. Hard and chalky insulation at concealed pipe valves and fittings (assumed ACM) not likely to be affected by this project.
  5. High temperature wiring insulation at autoclaves and incubator ovens (assumed ACM).

6. Remnants of asbestos-containing Patching Tars at older Roof mounted Exhaust fans.
  7. Original fire door insulation. The previous project removed most of the original fire doors, including all of the doors in the renovation area.
  8. Remnants of concealed asbestos-containing flooring mastics (assumed ACM).
- C. Notification of Potential Hazards: Asbestos, lead and other potentially hazardous materials are present in the building that may impact the work of all trades. Regulated air contaminants, including asbestos and lead, are also present in settled and concealed dust in and on architectural, structural, mechanical and electrical components or systems throughout the building. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to Specification Divisions 0, 1 and 2 for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.
- D. Asbestos-containing materials may have come loose and fallen onto or into, floors, ceilings, walls, chases, wall cavities or mechanical, electrical and structural system components. The Contractor shall immediately notify the Owner if and when they encounter worn, damaged, or deteriorated ACM as evidenced by dust or debris adjacent to ACM materials.
- E. Work may be required while faculty and students are occupying the building. Work during occupied periods involving disturbance of asbestos-containing materials inside the building shall be performed using critical barriers and negative air pressure enclosures. Access to work area from within the building shall be blocked to prevent unauthorized or inadvertent entry by students or faculty. Access to work area shall be secured by lock when work is not ongoing.
- F. Clearance sampling is required if the necessary disturbance of asbestos-containing material is not classified as "Small-Scale, Short-Duration" work as defined in 40 CFR 763, and is not required for work that only involves the disturbance of dusts with asbestos. Visual inspections are required for all work disturbing or removing asbestos. Due to the limited scope of interior work, it is assumed that Phase Contrast Microscopy (PCM) Clearance samples will be sufficient, unless a larger quantity of materials are disturbed. Therefore, clearance air samples shall include a minimum of five (5) PCM samples from each affected space, taken using aggressive methods as outlined in Appendix A to 40 CFR 763 and analyzed in accordance with 40 CFR 763.90.
- 1.2 RELATED WORK SPECIFIED ELSEWHERE
- A. Section 02 2600 Hazardous Materials Assessment
  - B. Section 01 3545 Airborne Contaminant Control
  - C. Section 02 8333 Removal and Disposal of Materials Containing Lead
  - D. Section 02 8418 Removal and Disposal of Chemical Hazards



- 1.3 DEFINITIONS AND ABBREVIATIONS: Definitions and abbreviations are provided in the applicable publications listed in Paragraph 1.4 of this section.
- 1.4 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced.
- A. General Requirements: All work shall be performed in compliance with the International Building, Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Code; Uniform Plumbing Code; the National Electrical Code; and the publications listed in this section that are in effect at the time of the bidding of this contract.
  - B. Title 29 Codes of Federal Regulations (CFR), Department of Labor (USDOL)
    - Part 1910 General Occupational Safety and Health Standards
    - Part 1926 Safety and Health Regulations for Construction
  - C. Title 40 CFR, Environmental Protection Agency (EPA)
    - Part 61 National Emission Standards for Hazardous Air Pollutants
    - Part 311 Worker Protection
    - Part 763 Asbestos
  - D. Title 49 CFR, Department of Transportation (DOT)
    - Part 171 General Information, Regulations and Definitions
    - Part 172 Hazardous Materials Communication and Regulations
    - Part 173 General Requirements for Shipments and Packaging
    - Part 177 Carriage by Public Highway
    - Part 178 Specifications for Packaging
    - Part 382 Requirements for Drug Testing
    - Part 383 Commercial Driver's License Standards
  - E. State of Alaska Administrative Codes (AAC)
    - 8 AAC 61 Occupational Safety and Health Standards
    - 18 AAC 60 Solid Waste Management
  - F. State of Alaska Statutes
    - AS 18.31 Health and Safety - Asbestos
    - AS 45.50.477 Titles Relating to Industrial Hygiene
  - G. Public Law 101-637
    - Asbestos School Hazard Abatement Reauthorization Act
  - H. Federal Standards
    - 313E Safety Data Sheets

- I. American National Standard Institute (ANSI)
  - Z9.2 Local Exhaust Systems
  - Z87.1 Eye and Face Protection
  - Z88.2 Practices for Respiratory Protection
- J. American Society for Testing and Materials (ASTM)
  - D-4397 Polyethylene Sheeting
- K. International Code Council
  - International Building (IBC), Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Codes Current Standards
- L. National Fire Protection Association (NFPA)
  - NFPA 701 Fire Tests for Flame Resistant Textiles and Films
- M. National Institute of Occupational Safety and Health (NIOSH)
  - Manual of Analytical Methods, Current Edition
- N. Underwriters Laboratories (UL)
  - UL 586 High-Efficiency, Particulate, Air (HEPA) Filter Units

## 1.5 QUALITY ASSURANCE

- A. On-site Observation:
  - 1. The safety and protection of the Contractor's employees, sub-contractor's employees, Owner's employees, the facility, and the public is the sole responsibility of the Contractor.
  - 2. The Owner, the Owner's Representative or representatives of State or Federal agencies may make unannounced visits to the site during the work. The contractor shall make available two complete sets of clean, protective clothing for such visitor use. If the work requires the use of PAPR or Supplied Air Respirators, the contractor shall provide respirators to the visitor to ensure compatibility with fresh batteries or supplied air system. It is the visitor's responsibility to ensure medical qualification, training, and current "fit test" prior to using any respirator provided by the Contractor.
  - 3. If the Owner or agency visitor determines that practices are in violation of applicable regulations, they will immediately notify the Contractor that operations must cease until corrective action is taken. Such notification will be followed by formal confirmation.
  - 4. The Contractor shall stop work after receiving such notification. The work may not be restarted until the Contractor receives written authorization from the Owner.
  - 5. All costs resulting from such a stop work order shall be borne by the Contractor and shall not be a basis for an increase in the contract amount or an extension of time.

- B. Air Monitoring: Air monitoring during the work shall be performed as follows:
1. The Contractor shall hire Independent Testing Laboratories to collect and evaluate all air samples that are the responsibility of the Contractor. The Contractor shall direct its laboratories, in writing, to release air monitoring data, and all other pertinent data and records, to the Owner. A copy of this written direction shall be submitted to the Owner along with the information required by Paragraph 1.13 of this Specification.
  2. The Contractor shall be responsible for monitoring its employees for potential exposure to airborne asbestos fibers as required by this specification and all applicable regulations.
  3. The Contractor shall be responsible for work area monitoring and environmental monitoring outside the work area as required by this specification.
  4. The Owner may perform air monitoring inside the building, inside the work areas, and on the Contractor's employees while asbestos work is underway and at any time during the work.
  5. Final inspection and clearance air monitoring shall be conducted by the Contractor's Independent Testing Laboratory. The Independent Testing Laboratory may not be hired by the Abatement Subcontractor to perform final visual inspections and clearance air monitoring.
  6. The Contractor shall have its Independent Testing Laboratories archive all air samples until the successful completion of the project.
- C. Additional Sampling of Suspect Materials:
1. The Contractor and all Subcontractors shall be vigilant during demolition and construction in the event additional suspect asbestos or hazardous materials are encountered. If suspect asbestos or hazardous materials not previously identified are encountered, the contractor shall stop work that may be affected by this material and immediately notify the Owner. The Owner or the Owner's Representative will provide recommendations and additional testing if necessary.
  2. The Contractor and all Subcontractors shall notify the Owner prior to any bulk sampling of suspect asbestos-containing material or other hazardous materials to allow the Owner or Owner's Representative to be present during such sampling. All results of bulk sampling conducted by the Contractor or Subcontractors shall be submitted to the Owner.
- 1.6 PROTECTION OF EXISTING WORK TO REMAIN: Perform asbestos removal in the project work areas without contamination of adjacent work or the facility.
- 1.7 MEDICAL REQUIREMENTS
- A. Institute and maintain a medical surveillance program for employees in accordance with 29 CFR 1926.1101 and 29 CFR 1910.134.
  - B. Institute and maintain a random drug testing program, as required by 49 CFR 382, for all drivers of vehicles transporting asbestos or hazardous materials.

- 1.8 TRAINING: Employ only workers who are trained and certified as required by 29 CFR 1910, 29 CFR 1926, 40 CFR 763, and 49 CFR 383 to remove, encapsulate, barricade, transport, or dispose of asbestos.
- 1.9 PERMITS AND NOTIFICATIONS: Secure necessary permits for asbestos removal, hauling, and disposal and provide timely notification as required by federal, state, and local authorities.
- 1.10 SAFETY AND ENVIRONMENTAL COMPLIANCE: Comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding handling, storing, transporting, and disposing of hazardous materials and all other construction activities.
- 1.11 RESPIRATOR PROGRAM: Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.
- 1.12 HAZARD COMMUNICATION PROGRAM: Implement a hazard communication program in accordance with 29 CFR 1910.1200.
- 1.13 SUBMITTALS
- A. The Contractor shall submit the following documentation to the Owner for review, approval or rejection. Work shall not begin until submittals are approved.
1. Shop drawings.
  2. Work plan.
  3. Liability insurance policy and performance bond.
  4. Schedule.
  5. Testing laboratory and laboratory personnel.
  6. Disposal site designations and disposal authorizations.
  7. Waste transporter designation.
  8. Notifications and certifications.
  9. "Competent Person" designation and experience.
  10. Request for substitutions.
- B. Shop drawings shall show:
1. Boundaries of each regulated work area.
  2. Location and construction of decontamination areas.
  3. Location of temporary site storage facilities.
  4. Location of air monitoring stations, both in and outside of the work area.
  5. Emergency egress route(s).
  6. Location of negative pressure exhaust systems, if required.

- C. The work plan shall include procedures for:
1. Work area setup and protection.
  2. Worker protection and decontamination.
  3. Initial exposure assessment procedures.
  4. Asbestos removal procedures.
  5. Waste load-out, transport, and disposal procedures.
  6. Air monitoring procedures.
    - a. Air monitoring procedures shall include the number of daily samples and the target volumes of each type of sample.
    - b. Clearance air monitoring procedures and protocols for each work area.
  7. Determination by the Certified Project Designer of the estimated quantities of ACM and PACM to be removed, and determination of clearance requirements for each different type or phase of work.
  8. Emergency procedures.
  9. The Work Plan shall be prepared, signed and dated by an Environmental Protection Agency (EPA) Certified Project Designer.
- D. Insurance Policy and Bond: Submit copies of the Contractor's or Subcontractor's insurance policy and performance bond. Submittal requirement is only to ensure that the insurance certificate(s) show specific coverage for the potentially hazardous materials being handled by this project. The insurance and bond amounts and certificate holder requirements are addressed in other portions of the contract documents and are not covered as part of this submittal requirement.
- E. Schedule: Submit construction schedule by work area.
- F. Independent Testing Laboratories and Laboratory Personnel: Submit the name, location, and phone number of proposed independent testing laboratories, and the names and certifications of the industrial hygiene technicians. Include the laboratory's accreditation. Not all laboratories will require all accreditations.
1. The Independent Testing Laboratories shall be acceptable to Owner.
  2. The laboratories shall be proficient in the National Institute of Occupational Safety and Health (NIOSH) Proficiency in Analytical Testing (PAT) program and shall be accredited by the National Institute of Science and Technology (NIST) under their National Voluntary Laboratory Accreditation Program (NVLAP) for bulk asbestos analysis and airborne asbestos fibers as appropriate. NVLAP accreditation for bulk asbestos analysis may be waived if the microscopists are listed in the American Industrial Hygiene Association (AIHA) Asbestos Analyst Registry (AAR).
  3. Provide a current list of their microscopists who have participated in the latest PAT and NVLAP programs and provide the names of microscopists and evidence that they have completed the NIOSH 582 course or equivalent. Provide latest AAR report of performance for microscopists.
  4. Provide name(s) and resume(s) of proposed on-site industrial hygiene technician(s) showing academic degrees and Alaska Abatement Certificate(s).

- G. Disposal Site: Submit the name and location of the proposed Alaska Department of Environmental Conservation/ U.S. Environmental Protection Agency (DEC/EPA) permitted disposal site. Submit authorization to dispose of asbestos waste by the proposed disposal site operator.
  - H. Waste Transporter: Submit the name and address of the proposed waste transporter.
  - I. Representations: Submit a signed statement by the Contractor that records of employees' work assignments, certifications, respirator fit tests, and medical records are accurate, up-to-date, and available for inspection.
  - J. Notifications and Certificates:
    - 1. Submit a copy of the written "Notification of Demolition and Renovation" to the Environmental Protection Agency. (If required by NESHAP).
    - 2. Submit a State of Alaska Department of Labor (ADOL) approved copy of the written ADOL notification of proposed workers.
    - 3. Submit a copy of Project Designer's current certification.
  - K. Competent Person: Submit the name and certifications of the Contractor's proposed Competent Person and a list of their previous projects. Certify by signed statement that the Competent Person has the knowledge and training to supervise the work in compliance with the publications listed in Paragraph 1.4 above.
  - L. Substitutions: Submit requests for substitutions of materials, equipment and methods.
  - M. Updated Project Information: Submit changes to the submitted project information at least 24 hours prior to the effective time of change for the following:
    - 1. Updated schedules.
    - 2. Change in Competent Person.
    - 3. ADOL approval for additional workers.
    - 4. Changes to work plan.
    - 5. Revisions to the EPA notification.
- 1.14 TEST REPORTS: Contractor shall submit periodic test reports, daily logs, monitoring results as specified herein. Submit two (2) copies of the following information within twenty-four (24) hours after the end of a shift:
- A. Initial Exposure Assessment(s): Submit the results of the Contractor's initial exposure assessment(s).
  - B. Daily Air Monitoring: Submit daily, all results of Contractor's air monitoring (submit no later than 24 hours after the end of the shift). Submittal shall consist of negative air pressure recordings, daily monitoring report, field data sheets, the analytical laboratory's results, and sketch of sample locations. Submit all results of any sampling of bulk materials to Owner within 24 hours of receipt of results. Bulk sample submittal shall consist of daily monitoring report, field data sheets, and the analytical laboratory's results, and sketch of sample locations.

- C. Project Daily Logs: Submit the previous day's Daily Logs. Logs shall include regulated area sign-in sheets and list of asbestos-containing materials removed including quantities and locations of those materials, in the units used on the drawings. Claims for additional quantities will not be addressed unless daily quantities are submitted.
  - D. Clearance Air Monitoring: Submit draft results of Contractor's clearance air monitoring for each work area for Owner's review and approval prior to releasing the work area to unprotected workers. FAX or electronic submittals are acceptable. Submittal shall include the following:
    - 1. A signed and dated copy of the final visual inspection report (completed prior to clearance air monitoring) certifying that all dust and debris have been removed from the work area and that all ACM to be removed as required by the contract, were removed. Visual inspection reports are required for all removal, even if clearance air monitoring is not required.
    - 2. Documentation that clearance air sample collection complied with 40 CFR 763, contract specifications and the approved work plan.
    - 3. Drawings of the work area with sampling locations clearly marked. Work area drawings shall be clearly identified as to their location within the facility.
    - 4. Field data sheets for sampling including: sample locations, calibration device serial number, initial and final pump calibration readings, pump time on and off, initial and final sampling flow rate, pump type and serial number, and sample cassette identification.
    - 5. Laboratory results, signed and dated by the analyst.
    - 6. Data sheets and visual inspection sheets shall be signed and dated by the Industrial Hygiene Technician performing the work.
- 1.15 PROJECT COMPLIANCE DOCUMENTS: Prepare and submit the following records of compliance with hazardous materials regulations following each work area clearance. Submittals may contain segregated submittals for more than one (1) work area. Submittal shall be received by Owner within four (4) weeks following work area clearance. Compliance documents shall be signed and dated and shall include as a minimum:
- A. Waste transport records (40 CFR 61, Figure 4).
  - B. Disposal site receipts.
  - C. Contractor's "Start" and Finish" dates for the work area(s).
  - D. Daily logs, including regulated area sign in sheets, materials summary, etc (if not previously submitted).
  - E. Final work area inspection report(s) and inspector certifications (if not previously submitted).
  - F. Final, signed, clean copies of all bulk and air sampling field data sheets, location drawings, and air monitoring log, including all clearance data.

- G. Final, signed, clear, legible copies of all analytical laboratory bulk and air monitoring test results, including all clearance data, and current laboratory certifications (if changed from previously submitted).
  - H. Copies of Asbestos Worker Training certificates for workers performing work on this project and all approved Alaska DOL notifications for those workers, and any revisions to the EPA notification(s).
- 1.16 SANITARY FACILITIES: Provide adequate toilet and hygiene facilities.
- 1.17 MATERIAL STORAGE: Store all materials subject to damage off the ground and secure from damage, weather, or vandalism.
- 1.18 ON-SITE DOCUMENTATION: The Contractor shall maintain on the job site, at a location approved by the owner, copies of the following data for safety procedures, equipment, and supplies used for the work
- A. Equipment: Show the model, style, capacity and the operation and maintenance procedures for the following, as applicable:
    - 1. High-Efficiency, Particulate, Air (HEPA) Filtration units.
    - 2. HEPA Vacuum cleaners.
    - 3. Pressure differential recording equipment.
    - 4. Heat stress monitoring equipment.
  - B. Safety Data Sheets (SDS): Maintain SDSs for each encapsulant, surfactant, solvent, detergent, and other material proposed to be used.
  - C. Respiratory Protection Plan: The Contractor's and/or Subcontractor's written respirator program.

## PART 2 - PRODUCTS

- 2.1 PERSONAL PROTECTIVE EQUIPMENT: Provide personal protective clothing as approved and selected by the IH.
- A. Respirators: Provide personally issued and marked respirators approved by the National Institute of Occupational Safety and Health (NIOSH). Provide sufficient replacements for respirators with disposable canisters. Use respirators equipped with dual cartridges whenever both asbestos hazards and other respiratory hazards exist in the work area.
  - B. Provide filter cartridges approved for each airborne contaminant which may be present. NIOSH approved filter cartridges shall be used. At no time shall the permissible exposure limit (PEL) for the contaminant exceed the PEL listed in 8 AAC 61.1100.



- C. Whole Body Protection: Provide approved disposable fire retardant, full body coveralls and hoods fabricated from nonwoven fabric, gloves, eye protection, and hard-hats, and other protective clothing as required to meet applicable safety regulations to personnel potentially exposed to asbestos above the permissible exposure limits (PELs). Wear this protection properly. Full facepiece respirators shall meet the requirements of ANSI Z87.1.
- D. Provide protective personal equipment and clothing at no cost to the workers.

## 2.2 DECONTAMINATION UNIT

- A. Provide a temporary three-stage decontamination unit, attached in a leak-tight manner to each negative pressure work area. Decontamination units shall consist of a clean room equipped with separate lockers for each worker, a shower room, and an equipment locker room equipped with separate lockers for each worker.
- B. Shower specifications: Locate flow and temperature controls within the shower where adjustable by the user. Hot water service may be secured from the building hot water system if available, but only with back-flow protection installed by the Contractor at the point of connection, and with prior notification and approval by the Owner. Should sufficient hot water be unavailable, the Contractor shall provide a minimum 40-gallon electric hot water heater with a minimum recovery rate of 20 gallons per minute. Water from the shower room shall not be allowed to wet the floor in the clean room.

- 2.3 WASTE WATER FILTERS: Provide Water Filtration Units with filters of adequate capacity to treat decontamination water and shower flows. Water filtration unit effluent shall contain less than 7,000,000 asbestos fibers per liter prior to discharge to sanitary sewer or storm drains.

- 2.4 DANGER SIGNS AND TAPE: Post danger signs and tape signs to demarcate areas where asbestos waste is temporarily stored, and, in areas not accessible to the public, where asbestos-containing materials are left in place. Signs and labels shall be in accordance with applicable regulations and codes. The signs posted at work area entrances, exits, decontamination areas, emergency egress, and waste disposal areas shall comply with 29 CFR 1926.1101 and the International Fire Code.

- 2.5 WARNING LABELS: Affix warning labels to all components or containers containing asbestos wastes. Conform labeling to 29 CFR 1926.1101 and 49 CFR 172.

- 2.6 HEPA FILTRATION UNITS: (if required) shall conform to ANSI Z9.2, and HEPA filters shall be UL-586 labeled.

- 2.7 PRESSURE DIFFERENTIAL MONITORING EQUIPMENT: Provide continuous monitoring of the pressure differential with an automatic recording instrument for each negative pressure enclosure. Locate the instrument in a clean area where personnel

have access to it without respiratory protection. The instrument shall be fitted with an alarm should the negative pressure drop below -0.02 inches of water column relative to the air outside containment.

## 2.8 CHEMICALS

- A. Adhesives: Adhesives shall be capable of sealing joints of adjacent sheets of polyethylene to finished or unfinished surfaces and of adhering under both dry and wet conditions.
- B. Mastic Removal Solvents: Mastic removal solvents shall not contain halogenated compounds or compounds with flashpoints less than 60° C (140° F). Solvents shall be compatible with replacement materials.
- C. Sealants and Encapsulants: Penetrating and bridging encapsulants for asbestos applications. Tint "Lock-Down" encapsulants used in non-finished areas for identification in a color that will not obscure residual asbestos. Encapsulants shall be compatible with replacement materials.
- D. Surfactant: Use a surfactant specifically designed to effectively wet asbestos. Mix and apply the surfactant as recommended by the manufacturer.

## 2.9 SAFETY DATA SHEETS (SDSs): Provide SDSs for all chemical materials brought onto the work-site.

## 2.10 MATERIALS

- A. Disposal Containers: Use disposal containers to receive, retain, and dispose of asbestos-containing or contaminated materials. Label leak tight containers in accordance with the applicable regulations. Non-leak tight containers are not acceptable. Plastic bags shall be a minimum 6-mil polyethylene, pre-printed with approved warning labels. Plastic wrap shall be 6-mil polyethylene sheets, securely wrapped and taped. Disposal containers shall be labeled with "ASBESTOS NA 2212," Contractor's name and location, and a Class 9 label.
- B. Glove Bags: The glove bags shall be a minimum of 6-mil polyethylene or polyvinylchloride plastic, and specially designed for removal of asbestos-containing materials, with two inward projecting long sleeves and rubber gloves, one inward projecting water wand sleeve, an internal tool pouch, and an attached, labeled receptacle for asbestos waste.
- C. Plastic Sheet: A minimum 6-mil thick flame resistant polyethylene (in accordance with NFPA 701) shall be used unless otherwise specified.
- D. Tape: Tape shall be capable of sealing joints of adjacent sheets of polyethylene, for attachment of polyethylene sheets to finished or unfinished surfaces and of adhering under both dry and wet conditions.

2.11 OTHER MATERIALS: The Contractor shall provide standard commercial quality of all other materials as required to prepare and complete the work.

## 2.12 TOOLS AND EQUIPMENT

- A. The Contractor shall provide tools and equipment as required to prepare and complete the work. Tools and equipment shall meet all applicable safety regulations.
- B. Transportation equipment shall be suitable for loading, temporary storage, transit, and unloading of contaminated waste without exposure to persons or property. All trucks or vans used to transport asbestos shall be enclosed and all containers sealed leaktight. Truck drivers shall have a commercial driver's license with hazardous material endorsement.

## PART 3 - EXECUTION

### 3.1 WORK AREAS

- A. Regulated Work Areas: Establish regulated work areas in compliance with 29 CFR 1926.1101.
- B. Decontamination Area: Install decontamination areas in compliance with 29 CFR 1926.1101. Decontamination area shall meet fire-exiting requirements of the International Fire Code. Showers shall be provided with hot water and water filtration units.
- C. Negative Pressure Enclosure System: Construct Negative Pressure Enclosure Systems as required by 29 CFR 1926.1101, these specifications, and approved work plan. Signage shall conform to the International Fire Code and 29 CFR 1926.1101. Exhausts from HEPA Filtration Units shall terminate outside of the building.
- D. Notify applicable Fire Marshal as required by the International Fire Code.

### 3.2 PERSONNEL PROTECTION PROCEDURES

- A. Contractor's Competent Person shall strictly enforce personal protection procedures as required by the approved work plan and all applicable regulations.
- B. Post the decontamination, safety, and work procedures to be followed by workers.
- C. Provide continuous on-site supervision by the approved Competent Person.
- D. Maintain a daily log of all workers and visitors entering regulated work areas. Log shall contain the name of each individual, his or her organization, accurate time of entering and leaving, and purpose of visit.

3.3 ASBESTOS REMOVAL PROCEDURES: Remove asbestos in accordance with the Contractor's Approved Work Plan, applicable regulations and this specification. The Owner shall be notified 24-hours in advance of any asbestos disturbance taking place outside of a Negative Pressure Enclosure System.

### 3.4 AIR MONITORING

- A. Perform personal, work area, and environmental monitoring for airborne asbestos fibers by industrial hygiene technicians who are employees of (one of) the Contractor's Independent Testing Laboratories.
- B. Conduct air monitoring in accordance with 29 CFR 1926.1101, current EPA guidance, and as specified herein. Calibrate all sampling pumps on-site with a calibrated transfer standard before and after each sample. Built-in rotameters on pumps are not acceptable for calibration. Additional samples beyond the minimum numbers shown below may be necessary if samples are overloaded or require shorter sampling periods to achieve readable samples, due to size of the work force, or due to more than one 8-hour work shifts.
- C. Conduct daily work area and environmental air monitoring per shift as follows:
  - 1. Three (3) air samples within the work area.
  - 2. One (1) air sample located outside the entrance to the work area.
  - 3. One (1) air sample located at the exhaust(s) of the HEPA filtration unit(s) (if more than one unit is used, the sampling may be rotated between units, however, each unit must be sampled at least once every three days).
  - 4. Three (3) air samples located in adjacent occupied areas.
  - 5. Two (2) waste load-out samples for the full duration of the operation, one taken inside the wash-down station and one taken on the clean side of the wash-down station, in addition to the daily work area and environmental samples, (no samples are necessary if no load-out operation is performed).
- D. Clearance air monitoring shall be conducted by the Contractor's Independent Testing Laboratory subcontractor. The Independent Testing Laboratory may not be hired by the Abatement Subcontractor to perform visual inspections and clearance air monitoring. Owner approval is required before a work area is released to unprotected workers. The Contractor is responsible for all costs associated with clearance and scheduling of visual inspection and clearance air monitoring. The maximum acceptable level of airborne asbestos fibers for work area clearance is as published in 40 CFR 763 for PCM analysis. A minimum of five aggressive clearance samples are required for each work area, regardless of the type of analysis. PCM analysis shall be used unless Transmission Electron Microscopy (TEM) analysis is required by 40 CFR 763 due to quantities of materials removed. The Contractor has the option, at its expense and at no cost to the Owner, of re-cleaning the work area and repeating the clearance air monitoring procedures or of having failed phase contrast microscopy (PCM) sample media sent to an approved NVLAP accredited laboratory for TEM analysis by NIOSH Method 7402.
- E. For small-scale, short-duration work, such as minor penetrations of gypsum wall board with asbestos-containing joint compound, gasket removal, or similar work, that work

may be requested to be "cleared" on the basis of a minimum of 5 air samples taken inside the work area during the work, immediately adjacent to where removal is taking place, and where each of those air samples have fiber counts of less than 0.01 f/cc. These alternative "clearance" sampling protocols will only be allowed if fully outlined in the contractor's work plan, with specific pre-approval by the Owner. Visual inspections are required for all removal work, including small-scale, short-duration work.

- F. For exterior removal, where the interior of the building is sealed off, and the materials are removed essentially intact, entirely from the outside, the work may be requested to be "cleared" on the basis of a minimum of 5 or more air samples taken during the work, within the building, with at least 1 sample within each room where the window removal is taking place, and where each of those air samples have fiber counts of less than 0.01 f/cc. These alternative "clearance" sampling protocols will only be allowed if fully outlined in the contractor's work plan, with specific pre-approval by the Owner. Visual inspections are required for all removal work, including exterior work.
- G. Conduct personal air monitoring in accordance with 29 CFR 1926.1101 and as specified herein.
  - 1. Take personnel samples (excluding excursion samples) at least twice per eight-hour work shift at the rate of one sample for every six people performing that task in the same work area. Persons performing separate tasks or in separate work areas shall be sampled separately.
  - 2. Collect and analyze excursion samples as required by 29 CFR 1926.1101.
  - 3. Continuously monitor all workers disturbing asbestos outside of a Negative-Pressure Enclosure System if that work is conducted indoors.
- H. Daily personnel monitoring may be discontinued only after the Contractor's Independent Testing Laboratory certifies in writing that a Negative Exposure Assessment has been obtained and the Owner has reviewed and approved the negative exposure assessment data.
- I. Submit air monitoring results to the Owner as specified in Paragraphs 1.14 and 1.15.

### 3.5 DISPOSAL

- A. Dispose of asbestos wastes in an EPA/DEC permitted asbestos landfill.
- B. Comply with current waste disposal, handling, labeling, storage, and transportation requirements of the waste disposal facility, U.S. Department of Transportation, and EPA regulations.
- C. Workers handling waste shall wear protective clothing and canister type respirators.
- D. Drivers of the waste transport vehicles need not wear respirators while enroute.
- E. Workers shall wear respirators when handling asbestos material at the disposal site.

### 3.6 CLEANING OF WORK AREA

- A. Remove all asbestos material and debris upon completion of asbestos repair or removal within a work area. Wet clean or HEPA vacuum all surfaces within the work area.
- B. Notify the Owner and the Independent Testing Laboratory that asbestos work has been completed and the work area is ready for visual inspection. Visual inspections are required even if clearance air monitoring is not required. Include in the visual inspection report a statement that all asbestos in the work area has been removed, repaired and/or encapsulated as required by the contract, and that all debris has been removed.
- C. All required demolition (ACM and non-ACM) shall be completed in each work area prior to clearance air monitoring. Exceptions may be made with prior approval of the Owner.
- D. A lockdown encapsulant shall be applied to all surfaces within the abatement areas prior to performing clearance air monitoring.

### 3.7 CLEARANCE AIR MONITORING

- A. The Contractor and its Independent Testing Laboratory shall conduct and document a visual inspection to verify that all asbestos in the work area has been removed, repaired and/or encapsulated as required by the contract, and that all debris has been removed.
- B. Final clearance air monitoring tests shall not be performed until all areas and materials within the work area are fully clean and dry.
- C. Final clearance air monitoring shall be conducted by the Contractor's Independent Testing Laboratory in accordance with all applicable regulations and the Contractor's approved work plan after passing the visual inspection. The clearance criteria shall include a minimum of five clearance samples using "aggressive methods" collected and analyzed in accordance with 40 CFR 763. PCM analysis is allowed, unless TEM analysis is specifically required due to the quantities of asbestos removed.
- D. If the final clearance air monitoring results show that the work area has failed to meet the clearance criteria, the Independent Testing Laboratory shall notify the Owner and the Contractor. The Contractor shall reclean the work area and request the Independent Testing Laboratory to conduct a follow-up inspection to be followed by another set of clearance air monitoring samples. All work specified in this paragraph shall be done at no additional expense to the Owner.
- E. If the clearance air monitoring results meet the clearance criteria of 40 CFR 763 and the specifications for the work and the Owner has reviewed and accepted the clearance results as required by 1.14 D, then the HEPA filtration units may be deactivated (if applicable) and all seals, barriers, barricades, and decontamination areas shall be dismantled and removed and the work area released to unprotected workers.
- F. Submit the final work area inspection report, clearance air monitoring field data sheets and the laboratory air monitoring report to the Owner as specified in Paragraph 1.15.

### 3.8 SUBSTANTIAL COMPLETION

- A. After the work area barriers and temporary construction and equipment have been removed, the Contractor shall inspect the work area to verify that no asbestos debris, contaminated water, or other residue remains. Any remaining residue shall be cleaned up using HEPA vacuum cleaners and wet wiping methods.
- B. The Contractor shall certify that the work area has been cleaned of all asbestos in compliance with the contract, and that there is no unrepaired damage to walls, ceilings, doors, surfaces, equipment or finishes other than that called for by the scope of work.
- C. Costs of restoration of damaged finishes shall be borne by the Contractor.

END OF SECTION 02 8233

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## SECTION 02 8333 - REMOVAL AND DISPOSAL OF MATERIALS CONTAINING LEAD

## PART 1 - GENERAL

## 1.1 DESCRIPTION OF WORK

- A. The work may require the disturbance (including cleanup of existing loose paint), demolition, or removal, and disposal of lead painted and/or lead-containing materials related to the NSB EM-2 Mechanical Systems Conversion/Upgrades Project as shown on the drawings and as specified herein. Items to be disturbed may include, but are not limited to:
  - 1. Painted interior and exterior surfaces.
  - 2. Painted mechanical and electrical equipment.
  - 3. Lead-containing dust in and on architectural, structural, mechanical, and electrical components.
- B. In addition to the above materials, the following materials are located in other areas of the building, and may require disturbance for auxiliary support, such as electrical and mechanical equipment and installation of equipment. Not all lead-containing materials are to be removed from these areas, only that required to complete the project work need be removed:
  - 1. Painted windows, doors and frames.
  - 2. Lead-acid batteries for exit and emergency lights, and other equipment.
  - 3. Lead caulking in bell and spigot pipe joints.
  - 4. Lead in pipe solder at copper pipe fittings.
  - 5. Painted structural and miscellaneous steel.
- C. Notification of Potential Hazards: Asbestos, lead and other potentially hazardous materials are present in the building that may impact the work of all trades. Regulated air contaminants, including asbestos and lead, are also present in settled and concealed dust in and on architectural, structural, mechanical and electrical components or systems throughout the building. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to Specification Divisions 0, 1 and 2 for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.
- D. The work includes all air monitoring, dust sampling, waste testing and disposal as specified herein. Materials listed are not necessarily hazardous waste or hazardous to handle. Lead-containing paints or materials identified for demolition and disposal shall be tested by the Toxicity Characteristics Leaching Procedure (TCLP) to determine if they are hazardous waste prior to disposal. Metal waste shall be recycled where practical.

## 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02 2600 Hazardous Materials Assessment
- B. Section 01 3545 Airborne Contaminant Control
- C. Section 02 8233 Removal and Disposal of Asbestos Containing Materials
- D. Section 02 8418 Removal and Disposal of Chemical Hazards

## 1.3 DEFINITIONS AND ABBREVIATIONS: Definitions and abbreviations are provided in the applicable publications listed in Paragraph 1.4 of this section.

## 1.4 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced.

- A. General Requirements: All work shall be performed in compliance with the International Building (IBC), Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Code; Uniform Plumbing Code; the National Electrical Code; and the publications listed in this section that are in effect at the time of the bidding of this contract.
- B. Title 29 Code of Federal Regulations (CFR), Department of Labor (USDOL)
  - Part 1910 General Occupational Safety and Health Standards
  - Part 1926 Safety and Health Regulations for Construction
- C. Title 40 CFR, Environmental Protection Agency (EPA)
  - Part 260 Hazardous Waste Management System: General
  - Part 261 Identification and Listing of Hazardous Wastes
  - Part 262 Standards Applicable to Generators of Hazardous Waste
  - Part 263 Standards Applicable to Transporters of Hazardous Waste
  - Part 270 Hazardous Waste Permit Program
  - Part 273 Standards for Universal Waste Management
  - Part 311 Worker Protection
  - Part 745 Lead Based Paint Poisoning Prevention in Certain Residential Structures
- D. Title 49 CFR, Department of Transportation (DOT)
  - Part 171 General Information, Regulations and Definitions
  - Part 172 Hazardous Materials Communication and Regulations
  - Part 173 General Requirements for Shipments and Packaging
  - Part 176 Carriage by Vessel
  - Part 177 Carriage by Public Highway
  - Part 178 Specifications for Packaging

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|----------|---------------------------------------|
| Part 382 | Requirements for Drug Testing         |
| Part 383 | Commercial Driver's License Standards |
- E. Alaska Administrative Codes (AAC)
- |           |  |
|-----------|--|
| 8 AAC 61  | Occupational Safety and Health Standards       |
| 18 AAC 60 | Solid Waste Management                         |
| 18 AAC 62 | Hazardous Waste Management                     |
| 18 AAC 70 | Water Quality Standards                        |
| 18 AAC 75 | Oil and Hazardous Substances Pollution Control |
- F. Alaska Statutes (AS)
- |              |                                       |
|--------------|---------------------------------------|
| AS 45.50.477 | Titles Relating to Industrial Hygiene |
|--------------|---------------------------------------|
- G. Municipality of Anchorage
- |               |                                |
|---------------|--------------------------------|
| AMC 26.50.060 | Specific Discharge Limitations |
|---------------|--------------------------------|
- H. Federal Standards
- |      |                    |
|------|--------------------|
| 313E | Safety Data Sheets |
|------|--------------------|
- I. American National Standards Institute (ANSI)
- |       |                                      |
|-------|--------------------------------------|
| Z9.2  | Local Exhaust Systems                |
| Z87.1 | Eye and Face Protection              |
| Z88.2 | Practices for Respiratory Protection |
- J. American Society For Testing and Materials (ASTM)
- |        |  |
|--------|--|
| D 4397 | Polyethylene Sheeting  |
| E 1728 | Standard Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Lead Determination |
| E 1792 | Specification for Wipe Sampling Materials for Lead in Surface Dust   |
- K. International Code Council
- |  |                   |
|--|-------------------|
| International Building (IBC), Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Code | Current Standards |
|--|-------------------|
- L. National Fire Protection Association (NFPA)
- |          |   |
|----------|---|
| NFPA 701 | Fire Tests for Flame Resistant Textiles and Films |
|----------|---|
- M. National Institute of Occupational Safety and Health (NIOSH)
- |   |  |
|---|--|
| Manual of Analytical Methods, Current Edition |  |
|---|--|
- N. Underwriters Laboratories (UL)
- |        |   |
|--------|---|
| UL 586 | High-Efficiency, Particulate, Air (HEPA) Filter Units |
|--------|---|

## 1.5 QUALITY ASSURANCE

### A. On-site Observation:

1. The safety and protection of the Contractor's employees, Subcontractor's employees, Owner's employees, the facility, and the public is the sole responsibility of the Contractor.
2. The Owner, the Owner's Representative, or representatives of State or Federal agencies may make unannounced visits to the site during the work. The Contractor shall make available two complete sets of clean, protective clothing for such visitor use. If the work requires the use of PAPR or Supplied Air Respirators, the contractor shall provide respirators to the visitor to ensure compatibility with fresh batteries or supplied air system. It is the visitor's responsibility to ensure medical qualification, training, and current "fit test" prior to using any respirator provided by the Contractor.
3. If the Owner or agency visitor determines that practices are in violation of applicable regulations, they will immediately notify the Contractor that operations must cease until corrective action is taken. Such notification will be followed by formal confirmation.
4. The Contractor shall stop work after receiving such notification. The work may not be restarted until the Contractor receives written authorization from the Owner.
5. All costs resulting from such a stop work order shall be borne by the Contractor and shall not be a basis for an increase in the contract amount or an extension of time.

### B. Monitoring and Testing: Monitoring and testing during the work shall be performed as follows:

1. The Contractor shall hire Independent Testing Laboratories to collect and evaluate all air, dust, bulk, and toxicity characteristic leaching procedure (TCLP) samples that are the responsibility of the Contractor. The Contractor shall direct its laboratories, in writing, to release monitoring and testing data, and all other pertinent data and records, to the Owner.
2. The Contractor shall be responsible for monitoring its employees for potential exposure to airborne contaminants as required by this specification and all applicable regulations.
3. The Contractor shall be responsible for work area monitoring and environmental monitoring outside the work area as required by this specification.
4. The Owner may perform monitoring and testing inside the building, inside the work areas, and on the Contractor's employees while work is underway and at any time during the work.
5. Final inspection and clearance testing shall be conducted by the Contractor.
6. The Contractor shall have its Independent Testing Laboratories archive all samples until the successful completion of the project.

### C. Additional Sampling of Suspect Materials:

1. The Contractor and all Subcontractors shall be vigilant during demolition and construction in the event additional suspect lead or hazardous materials are

encountered. If suspect lead or hazardous materials not previously identified are encountered, the contractor shall stop work that may be affected by this material and immediately notify the Owner. The Owner or the Owner's Representative will provide recommendations and additional testing if necessary.

2. The Contractor and all Subcontractors shall notify the Owner prior to any bulk sampling of suspect lead-containing material or other hazardous materials to allow the Owner or Owner's Representative to be present during such sampling.
- 
- 1.6 PROTECTION OF EXISTING WORK TO REMAIN: Perform lead removal in the project work areas without damage or contamination of adjacent work or the facility.
  - 1.7 MEDICAL REQUIREMENTS
    - A. Institute and maintain a surveillance program in accordance with 29 CFR 1926.62 and 29 CFR 1910.134.
    - B. Institute and maintain a random drug testing program, as required by 49 CFR 382, for all drivers of vehicles transporting hazardous materials.
  - 1.8 TRAINING: Employ only workers who are trained and certified as required by 29 CFR 1910, 29 CFR 1926, 40 CFR 311, 40 CFR 745 and 49 CFR 383 to remove, encapsulate, barricade, transport, or dispose of lead-containing materials.
  - 1.9 PERMITS, IDENTIFICATION NUMBERS AND NOTIFICATIONS: Secure necessary permits for hazardous material removal, storage, transport and disposal and provide timely notification as required by federal, state, and local authorities.
  - 1.10 SAFETY AND ENVIRONMENTAL COMPLIANCE: Comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding handling, storing, transporting, and disposing of hazardous materials and all other construction activities.
  - 1.11 RESPIRATOR PROGRAM: Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.
  - 1.12 HAZARD COMMUNICATION PROGRAM: Implement a hazard communication program in accordance with 29 CFR 1910.1200.
  - 1.13 SUBMITTALS
    - A. Submit the following documentation to the Owner for review, approval or rejection. Work shall not begin until submittals are approved.
      1. Shop drawings.
      2. Work plan.

3. Liability insurance policy and performance bond.
  4. Schedule.
  5. Independent testing laboratory and laboratory personnel.
  6. Disposal site designations.
  7. Waste transporter designations.
  8. Representations.
  9. "Competent Person" designation and experience.
  10. Request for substitutions.
- B. Shop drawings shall show:
1. Boundaries of each lead work area, if required.
  2. Location and construction of decontamination stations, if required.
  3. Location of temporary site storage facilities.
  4. Location of air monitoring stations, both in and outside of the work area.
  5. Emergency egress route(s).
  6. Location of negative pressure exhaust systems, if required.
- C. The work plan shall include procedures for:
1. Work area set-up and protection.
  2. Worker protection and decontamination.
  3. Initial exposure determination(s).
  4. Lead removal procedures.
  5. Waste testing, transport, and disposal procedures.
  6. Monitoring and testing procedures (Sampling and Analysis Plan).
  7. Spill clean-up emergency procedures.
- D. Insurance Policy and Bond: Submit copies of the Contractor's or Subcontractor's insurance policy and performance bond. Submittal requirement is only to ensure that the insurance certificate(s) show specific coverage for the potentially hazardous materials being handled by this project. The insurance and bond amounts and certificate holder requirements are addressed in other portions of the contract documents and are not covered as part of this submittal requirement.
- E. Schedule: Submit construction schedule by work area.
- F. Independent Testing Laboratories and Laboratory Personnel: Submit the name, location, and phone number of proposed independent testing laboratories, and the names and certifications of the industrial hygiene technicians. Include the laboratory's accreditation. Not all laboratories will require all accreditations.
1. The Independent Testing Laboratories shall be acceptable to Owner.
  2. Submit evidence that the laboratory is currently judged proficient in lead analysis, as determined by the Environmental Lead Proficiency Analytical Testing (ELPAT) Program, of the American Industrial Hygiene Association (AIHA)

Environmental Lead Laboratory Accreditation Program (ELLAP) for lead in paint chip, soil, and dust wipe samples.

3. Submit evidence that the laboratory is currently certified by OSHA to perform blood lead analysis.
  4. Submit evidence that the laboratory has demonstrated proficiency as determined by ELPAT or ELLAP performance for NIOSH Method 7082 and/or NIOSH Method 7105 analytical method for the determination of lead in air.
  5. Submit evidence that the laboratory has demonstrated proficiency in performing analyses according to Method 1311 TCLP, corresponding to the current version of Test Methods for Evaluating Solid Wastes (Chemical Physical Methods), SW-846. Evidence may include successful participation in a recognized inter-laboratory quality control program such as a laboratory certified by the California Health and Welfare Agency, Department of Health Services, or a more informal inter-laboratory quality control program.
  6. Submit evidence that the laboratory is currently accredited by the American Industrial Hygiene Association (AIHA).
  7. Submit the name, address, telephone number, and résumé of the Contractor's Industrial Hygienist (IH) who prepared the Sampling and Analysis Plan and will oversee the on-site monitoring, visual inspections and clearance testing. Submit the names, addresses, and résumés of industrial hygiene technicians who may assist the IH for on-site tasks. Submit documentation that the IH has all the qualifications for the assigned duties as required by the Contractor's liability insurance policy.
  8. Submit copies of the Contractor's letter to each of the independent testing laboratories, directing each to release all the results for this project to the Owner, as these results become available and as specified herein.
- G. Disposal Site: Submit the name and location of the proposed Environmental Protection Agency (EPA) permitted disposal site.
- H. Waste Transporter: Submit the name and address of the proposed waste transporter.
- I. Representations: Submit statement by the Contractor that records of employees' work assignments, certifications, respirator fit tests, and medical records are accurate, up-to-date, and available for inspection.
- J. Competent Person: Submit the name and certifications of the Contractor's proposed Competent Person and a list of their previous projects. Certify that the Competent Person has the knowledge and training to supervise the work in compliance with the publications listed in Paragraph 1.4 above.
- K. Substitutions: Submit requests for substitutions of materials, equipment and methods.
- L. Updated Project Information: Submit changes to the submitted project information at least 24 hours prior to the effective time of change for the following:
1. Updated schedules for lead removal.
  2. Change in Competent Person.

3. Changes to work plan.

- 1.14 TEST REPORTS: Submit the following documentation produced during the work as soon as received:
- A. Project Daily Logs: Submit the previous day's Daily Logs. Logs shall include regulated area sign-in sheets and list of lead-containing materials removed, including quantities and locations of those materials, in the units used on the drawings. Claims for additional quantities will not be addressed unless daily quantities are submitted.
  - B. Daily Monitoring: Submit daily, all results of Contractor's air, and dust monitoring (submit no later than 24 hours after the end of the shift). Submittal shall consist of daily monitoring report, field data sheets, the analytical laboratory's results, and sketch of sample locations. Submit all results of any TCLP sampling or testing of bulk materials to Owner within 24 hours of receipt of results. Bulk or TCLP sample submittal shall consist of daily monitoring report, field data sheets, the analytical laboratory's results, and sketch of sample locations (sketch not required for TCLP samples, but descriptions of materials included is required).
- 1.15 PROJECT COMPLIANCE DOCUMENTS: Submit the following documents to the Owner with application for final payment:
- A. Contractor's actual project "Start and Finish" dates.
  - B. Waste testing results per Paragraph 3.5 (A).
  - C. Waste Shipment Records (Manifest EPA form 8700-22) if required.
  - D. Clearance sampling and soil sampling data sheets (if required) and laboratory reports.
  - E. Disposal site receipts.
  - F. Final clearance submittals as outlined in 3.7 (if required).
  - G. Evidence that each employee who was engaged in lead disturbance/removal work or who was exposed to lead completed training on lead covering the requirements of 29 CFR 1926.62.
- 1.16 SANITARY FACILITIES: Provide adequate toilet and hygiene facilities.
- 1.17 MATERIAL STORAGE: Store all materials subject to damage off the ground and secure from damage, weather, or vandalism.
- 1.18 ON-SITE DOCUMENTATION: The Contractor shall maintain on the job site, at a location approved by the owner, copies of the following data for safety procedures, equipment, and supplies used for the work



- A. Equipment: Show the model, style, capacity and the operation and maintenance procedures for the following, as applicable:
  - 1. High-Efficiency, Particulate, Air (HEPA) Filtration units.
  - 2. HEPA Vacuum cleaners.
  - 3. Pressure differential recording equipment.
  - 4. Heat stress monitoring equipment.
- B. Safety Data Sheets (SDSs): Maintain SDSs for each encapsulant, surfactant, solvent, detergent, and other material proposed to be used.
- C. Respiratory Protection Plan: The Contractor's written respirator program.

## PART 2 - PRODUCTS

### 2.1 PERSONAL PROTECTIVE EQUIPMENT: Provide personal protective clothing as approved and selected by the IH.

- A. Respirators: Provide personally issued and marked respirators approved by the National Institute of Occupational Safety and Health (NIOSH). Provide sufficient replacements for respirators with disposable canisters. Use respirators equipped with dual cartridges whenever both lead hazards and other respiratory hazards exist in the work area.
- B. Provide filter cartridges approved for each airborne contaminant which may be present. NIOSH approved filter cartridges shall be used. At no time shall the permissible exposure limit (PEL) for the contaminant exceed the PEL listed in 8 AAC 61.1100.
- C. Whole Body Protection: Provide approved aprons, gloves, eye protection, and hard-hats, and other protective clothing as required to meet applicable safety regulations to personnel potentially exposed to lead dust or fumes above the permissible exposure limit (PEL). Wear this protection properly. Full facepiece respirators shall meet the requirements of ANSI Z87.1.
- D. Provide protective personal equipment and clothing at no cost to the workers.

### 2.2 DECONTAMINATION UNIT

- A. Provide a temporary three-stage decontamination unit, attached in a leak-tight manner to each Contained Work Area. Decontamination units shall consist of a clean room equipped with separate lockers for each worker, a shower room, and an equipment locker room equipped with separate lockers for each worker.
- B. Shower specifications: Locate flow and temperature controls within the shower and be adjustable by the user. Hot water service may be secured from the building hot water system if available, but only with back-flow protection installed by the Contractor at the point of connection, and with prior notification and approval by the Owner. Should sufficient hot water be unavailable, the Contractor shall provide a minimum 40 gallon

electric hot water heater with a minimum recovery rate of 20 gallons per hour. Water from the shower room shall not be allowed to wet the floor in the clean room.

- 2.3 WASTE WATER FILTERS: Install the waste water filters in a series of stages with the final filtration stage sufficient to meet discharge standard of 18 AAC 70 and/or any local sewage system discharge limit for lead. Size the waste water pump for 1.25 times the shower head flow-rate. Dispose all filters as lead contaminated waste.
- 2.4 WARNING SIGNS AND TAPE: Post warning signs and tape at the boundaries and entrances to lead disturbance and removal work areas. Signs required by other statutes, regulations, or ordinances may be posted in addition to, or in combination with, this warning sign. Conform warning signs and tape to the requirements of 29 CFR 1926.62.
- 2.5 WARNING LABELS: Affix warning labels to all hazardous waste disposal containers as described in the Contractor's approved Solid Waste Disposal Plan. Conform labeling to 29 CFR 1926.62 and 49 CFR 100-199.
- 2.6 NEGATIVE PRESSURE EXHAUST SYSTEM: Use the negative pressure exhaust systems to exhaust each contained work area where the PEL will or is expected to be exceeded. Operate the negative pressure exhaust system continuously (24 hours a day) during lead work. Select the negative pressure exhaust system equipment to provide a minimum of 4 air changes per hour under load within the work area. The negative pressure exhaust system shall have a minimum of two stages of pre-filtration ahead of the HEPA filter: The HEPA filter shall bear the UL-586 label. In no case shall the building ventilation system be used as the local exhaust for the contained work area. Terminate the exhaust outside of the building. The exhaust ventilation system equipment shall be equipped with lock-out protection to prevent operation without a HEPA filter properly installed. The exhaust system equipment shall be equipped with the following instrumentation: a static pressure gauge with low flow alarm, an elapsed time indicator, automatic shutdown capability in the event of a major rupture in the HEPA filter or blocked air discharge and an automatic re-start when power is restored after a power failure.
- 2.7 PRESSURE DIFFERENTIAL MONITORING EQUIPMENT: Provide continuous monitoring of the pressure differential with an automatic recording instrument for each contained work area. Locate the instrument in a clean area where personnel have access to it without respiratory protection. The instrument shall be fitted with an alarm should the negative pressure drop below -0.02 inches of water column relative to the air outside containment.
- 2.8 TOOLS: Vacuum cleaners shall be equipped with HEPA filters. Use only approved power tools to remove lead-containing material. Do not use open-flame and electric element heat-gun type tools with temperatures in excess of 700° F to remove lead-containing material. Remove all residual lead contamination from reusable tools being

removed from lead disturbance or removal work areas. Electrical tools and equipment shall be UL listed.

- 2.9 AIR MONITORING EQUIPMENT: The Contractor's IH shall select the air monitoring equipment to be used for the evaluation of airborne lead.
- 2.10 EXPENDABLE SUPPLIES: Provide flame resistant 6-mil thick polyethylene sheet plastic shall be provided in widths necessary to minimize seams.
- 2.11 SAFETY DATA SHEETS (SDSs): Provide SDSs for all chemical materials brought onto the work-site.
- 2.12 OTHER ITEMS: Provide other items, such as consumable materials, disposable and/or reusable cleaning equipment and hand tools, or miscellaneous construction equipment and materials, in sufficient quantity as necessary to fulfill and complete the requirements of the contract. Electrical equipment and supplies shall be UL listed.
- 2.13 ENCAPSULANTS: Encapsulants shall contain no toxic or hazardous substances. Encapsulants shall be compatible with the products to which they are applied and be compatible with replacement products.

### PART 3 - EXECUTION

#### 3.1 WORK AREAS

- A. Lead Control Areas: A control area, structure or containment where lead-containing or contaminated materials are being disturbed. Critical barriers and/or physical boundaries shall be employed to isolate the lead control area and to prevent migration of lead contamination and unauthorized entry of personnel.
- B. Contained Lead Work Area Requirements: Construct contained lead work areas as described in the Contractor's approved work plan. A contained lead work area is required whenever airborne lead levels cannot be maintained below the OSHA action level at the boundary of a lead work area.
- C. Building Ventilation System: Shut down and isolate by air-tight seals all building ventilation systems supplying air into or returning air from a lead control area or contained lead work area.
- D. Building Electrical Systems: Verify that the electrical service is deactivated, disconnected and locked out where necessary for wet washing and/or removal. Provide temporary electrical service, equipped with ground fault protection, where needed.

### 3.2 PERSONNEL PROTECTION PROCEDURES

- A. Initial Determination: An initial determination is required in the absence of acceptable prior exposure data in accordance with 29 CFR 1926.62. Establish an initial lead work area for each material to be disturbed and each disturbance procedure if required. Isolate these lead work areas from the rest of the building. Personnel working in these areas shall wear respiratory protection and personal protective equipment as directed by the IH. Perform personal and work area air monitoring as directed by the IH. Operational decontamination facilities shall be available. Work performed shall be representative of the work to be done during the remainder of the project.
- B. Respirator Evaluation: Upgrading, downgrading, or not requiring respirators shall be recommended by the Contractor's IH based on the measured airborne lead-containing dust or fume concentrations. Immediately implement recommendations to upgrade the respiratory protection, followed by notification to the Owner. NOTE: Submit recommendations in writing to downgrade respirator type or not require respirators to the Owner for review and written approval prior to implementation.
- C. Decontamination Procedures: Worker and material decontamination procedures shall be as described in the Contractor's approved work plan. Worker decontamination shall be as directed by the Contractor's competent person.
- D. Work Stoppage: Stop work if the IH, the Owner, or a representative of a regulatory agency determines that the work is not in compliance with the Contractor's approved work plan, these specifications, or applicable laws and regulations. The Contractor shall stop work and notify the Owner whenever the measured concentrations of lead outside the lead control area equal or exceed  $30 \mu\text{g}/\text{m}^3$  for airborne lead or  $200 \mu\text{g}/\text{ft}^2$  for lead dust on surfaces that would normally be accessible by building occupants. When such work stoppage occurs, the cause of the contamination shall be corrected and the damaged or contaminated area shall be restored to its original decontaminated condition by the Contractor at no expense to the Owner. The Contractor is responsible for removing dusts and debris that were generated as a result of his work.
- E. The Contractor shall adhere to all applicable regulations regarding entry into confined spaces.

### 3.3 LEAD DISTURBANCE AND REMOVAL PROCEDURES:

- A. General: Perform lead disturbance or removal work in accordance with the Contractor's approved work plan, applicable regulations and this specification.
- B. Pre-Cleaning: Removal of existing loose paint chips is included in the scope of work. Pre-clean surfaces by HEPA vacuum and wet washing/wiping prior to the establishment of a work area.
- C. Perform waste battery storage and disposal in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273 and 8 AAC.

- 3.4 MONITORING AND TESTING: Conduct daily sampling in accordance with the Contractor's accepted Sampling and Analysis Plan and this specification. The Owner may conduct air monitoring in the Contractor's work areas and on the Contractor's employees.
- A. Perform environmental air monitoring outside the lead work area for each lead work area without a negative initial determination. Include at least one sample immediately outside the entrance to the lead work area.
  - B. Perform dust wipe sampling for each lead work area without a negative initial determination. Include at least one sample immediately outside the entrance to the work area daily.
  - C. Take personnel samples in accordance with 29 CFR 1926.62. Personal samples for an employee will include a minimum of two samples per 8 hour shift. Employees will be monitored at the rate of at least one employee for every eight people performing each task in each work area. Persons performing separate tasks or in separate lead work areas shall be sampled separately.
  - D. Reduction of monitoring: For each operation for which the Negative Initial Determination established workers' exposure will be below the action level, the Contractor's IH may petition the Owner's Representative to recommend that the monitoring as required above be reduced for the specific task or operation.
- 3.5 DISPOSAL
- A. Sampling of Waste Materials: The Contractor shall test waste materials according to 40 CFR 261 and the disposal site's permit to determine if they are hazardous waste and to dispose of them accordingly. Collect, package and transport to an EPA approved Hazardous Waste Disposal Site all bulk debris, loose paint chips, fines, dust from HEPA filters and vacuum bags, unfiltered waste water, water filter cartridges, disposable personal protective equipment (including respirator filters, poly, and tape) which do not have TCLP test results that classify the material as non-hazardous for lead. Lead-acid batteries and other batteries are classified by the EPA as Universal Wastes. The EPA encourages that all Universal Wastes be recycled in accordance with 40 CFR 273, or in the case of lead-acid batteries, in accordance with 40 CFR 266, subpart G.
  - B. Hazardous Waste Disposal: Dispose of hazardous project wastes as required by 40 CFR 260 and the Contractor's approved work plan.
  - C. Construction (Non-Hazardous) Waste Disposal: Dispose of solid (non-hazardous) waste in a permitted waste facility, in accordance with applicable federal, state, and local laws and regulations. Burning of waste is prohibited.
  - D. Salvageable Materials: The Contractor may salvage metallic lead, lead-acid batteries and other materials to keep such materials from entering the project waste stream. Sell or transfer salvage with a document of exempt status as provided by 40 CFR 261.
  - E. Waste Storage: Temporarily store solid wastes as described in the approved work plan.

- 3.6 FINAL CLEANING AND VISUAL INSPECTION: Perform a final cleaning and visual inspection of each lead control area prior to release to unprotected workers in accordance with the Contractor's approved work plan. Clean the lead control area by vacuuming with a HEPA filtered vacuum cleaner, wet mopping or wet wiping. Do not dry sweep or use pressurized air to clean up the area. A final visual inspection report shall be provided verifying that all lead disturbance required by the contract has been completed and that all visible dust and debris subject to disturbance by the planned work under this contract have been removed and the area HEPA vacuumed, wet mopped or wet wiped.
- 3.7 WORK AREA CLEARANCE TESTING: Work area clearance testing by the Contractor is required for each lead control area where the lead action level has been exceeded. Clearance testing shall be performed only after a visual inspection report by the Contractor's IH Technician has documented that the work area is clean and that all lead disturbance required by the contract has been completed. Clearance testing shall include the following:
- A. A visual inspection report by the Contractor's IH Technician verifying that all lead disturbance required by the contract has been completed and that all visible dust and debris subject to disturbance by the planned work under this contract have been removed and the area HEPA vacuumed, wet mopped or wet wiped.
  - B. Three (3) lead wipe and/or lead soil sample results from within the lead control area per the Contractor's approved work plan and in accordance with NIOSH method 9100. Clearance levels shall be 200 µg/ft<sup>2</sup> for wipes or 500 ppm in soil.
  - C. The Owner may conduct concurrent clearance testing.
  - D. Work area barriers or containments shall not be removed until clearance testing results are reviewed and approved by the Owner.
- 3.8 SUBSTANTIAL COMPLETION
- A. After the work area barriers and temporary construction and equipment have been removed, the Contractor shall inspect the work area to verify that no lead debris, contaminated water, or other residue remains. Any remaining residue shall be cleaned up using HEPA vacuum cleaners and wet wiping methods.
  - B. The Contractor shall certify that the work area has been cleaned of all lead in compliance with the contract, and that there is no unrepaired damage to walls, ceilings, doors or surfaces or finishes other than that called for by the scope of work.
  - C. Costs of restoration of damaged finishes shall be borne by the Contractor.

END OF SECTION 02 8333

## SECTION 02 8418 – REMOVAL AND DISPOSAL OF CHEMICAL HAZARDS

## PART 1 - GENERAL

- 1.1 DESCRIPTION OF WORK: The work includes proper removal and disposal of electrical equipment and chemical hazards related to the NSB EM-2 Mechanical Systems Conversion/Upgrades Project as shown on the drawings and as specified herein. Items to be removed or disturbed may include, but are not limited to:
- A. Mercury and mercury compounds in fluorescent light tubes. The following approximate removal quantities are included as a basis for design. Coordinate final quantities with all trades.
    - 1. 35 Mercury-containing Bulbs from Fluorescent Light Fixtures.
  - B. Heating system components with glycol. Quantities depend on Contractor's Means and Methods.
  - C. Radioactive components in smoke detectors: Quantity: one.
  - D. Lead-acid batteries for exit and emergency lights, and other equipment. Quantity: None anticipated at this time.
  - E. Notification of Potential Hazards: Asbestos, lead and other potentially hazardous materials are present in the building that may impact the work of all trades. Regulated air contaminants, including asbestos and lead, are also present in settled and concealed dust in and on architectural, structural, mechanical and electrical components or systems throughout the building. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to Specification Divisions 0, 1 and 2 for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.
- 1.2 RELATED WORK SPECIFIED ELSEWHERE
- A. Section 02 2600 Hazardous Materials Assessment
  - B. Section 01 3545 Airborne Contaminant Control
  - C. Section 02 8233 Removal and Disposal of Asbestos Containing Materials
  - D. Section 02 8333 Removal and Disposal of Materials Containing Lead
- 1.3 DEFINITIONS AND ABBREVIATIONS: Definitions and abbreviations are provided in the applicable publications listed in Paragraph 1.4 of this Section.

1.4 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced.

- A. General Requirements: All work shall be performed in compliance with the International Building (IBC), Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Code; Uniform Plumbing Code; the National Electrical Code; and the publications listed in this section that are in effect at the time of the bidding of this contract.
- B. Title 10 Code of Federal Regulations (CFR), Nuclear Regulatory Commission
  - Part 20 Standard for Protection Against Radiation
- C. Title 29 CFR, Department of Labor (USDOL)
  - Part 1910 General Occupational Safety and Health Standards
  - Part 1926 Safety and Health Regulations for Construction
- D. Title 40 CFR, Environmental Protection Agency (EPA)
  - Part 61 National Emission Standards for Hazardous Air Pollutants
  - Part 260 Hazardous Waste Management System: General
  - Part 261 Identification and Listing of Hazardous Waste
  - Part 262 Standards Applicable to Generators of Hazardous Waste
  - Part 263 Standards Applicable to Transporters of Hazardous Waste
  - Part 270 The Hazardous Waste Permit Program
  - Part 273 Standards for Universal Waste Management
  - Part 311 Worker Protection
  - Part 761 Polychlorinated Biphenyls (PCBs)
- E. Title 49 CFR, Department of Transportation (DOT)
  - Part 171 General Information, Regulations and Definitions
  - Part 172 Hazardous Materials Communication and Regulations
  - Part 173 General Requirements for Shipments and Packaging
  - Part 177 Carriage by Public Highway
  - Part 178 Specifications for Packagings
  - Part 382 Requirements for Drug Testing
  - Part 383 Commercial Driver's License Standards
- F. State of Alaska Administrative Codes (AAC)
  - 8 AAC 61 Occupational Safety and Health Standards
  - 18 AAC 60 Solid Waste Management
  - 18 AAC 62 Hazardous Wastes
  - 18 AAC 75 Oil and Hazardous Substances Pollution Control



- G. State of Alaska Statutes (AS)
  - AS 45.50.477 Titles Relating to Industrial Hygiene
- H. Federal Standards
  - 313E Safety Data Sheets
- I. American National Standard Institute (ANSI)
  - Z9.2 Local Exhaust Systems
  - Z87.1 Eye and Face Protection
  - Z88.2 Practices for Respiratory Protection
  - C78.LL 1256 Procedures for Fluorescent Lamp Sample Preparation and Toxicity Characteristic Leaching Procedure.
- J. American Society for Testing and Materials (ASTM)
  - D-4397 Polyethylene Sheeting
- K. International Code Council
  - International Building (IBC), Fire, Fuel Gas, Mechanical, Residential, Energy Conservation and Administrative Code Current IC Standards
- L. National Fire Protection Association (NFPA)
  - NFPA 701 Fire Tests for Flame Resistant Textiles and Films
- M. National Institute of Occupational Safety and Health (NIOSH)
  - Manual of Analytical Methods, Current Edition

## 1.5 QUALITY ASSURANCE

- A. On-site Observation:
  - 1. The safety and protection of the Contractor's employees, sub-contractor's employees, Owner's employees, the facility, and the public is the sole responsibility of the Contractor.
  - 2. The Owner, the Owner's Representative, or representatives of State or Federal agencies may make unannounced visits to the site during the work. The contractor shall make available two complete sets of clean protective clothing for such visitor use. If the work requires the use of PAPR or Supplied Air Respirators, the contractor shall provide respirators to the visitor to ensure compatibility with fresh batteries or supplied air system. It is the visitor's responsibility to ensure medical qualification, training, and current "fit test" prior to using any respirator provided by the Contractor.
  - 3. If the Owner or agency visitor determines that practices are in violation of applicable regulations, they will immediately notify the Contractor that operations must cease until corrective action is taken. Such notification will be followed by formal confirmation.

4. The Contractor shall stop work after receiving such notification. The work may not be restarted until the Contractor receives written authorization from the Owner.
  5. All costs resulting from such a stop work order shall be borne by the Contractor and shall not be a basis for an increase in the contract amount or an extension of time.
- B. Monitoring and Testing: Monitoring and testing during the work shall be performed as follows:
1. The Contractor shall hire Independent Testing Laboratories to collect and evaluate all air, bulk, and toxicity characteristic leaching procedure (TCLP) samples, which are the responsibility of the Contractor. The Contractor shall direct its laboratories, in writing, to release monitoring and testing data, and all other pertinent data and records, to the Owner.
  2. The Contractor shall be responsible for monitoring its employees for potential exposure to airborne contaminants as required by specification 01 3545 and all applicable regulations.
  3. The Contractor shall be responsible for work area monitoring and environmental monitoring outside the work area as required by this specification.
  4. The Owner may perform monitoring and testing inside the building, inside the work areas, and on the Contractor's employees while work is underway and at any time during the work.
  5. The Contractor shall have its Independent Testing Laboratories archive all samples until the successful completion of the project.
  6. Final inspection and clearance testing shall be conducted by the Contractor.
- 1.6 PROTECTION OF EXISTING WORK TO REMAIN: Perform hazardous material removal work without damage or contamination of adjacent work or the site.
- 1.7 MEDICAL REQUIREMENTS
- A. Institute and maintain a medical surveillance program in accordance with 29 CFR 1910.134.
  - B. Institute and maintain a random drug testing program, as required by 49 CFR 382, for all drivers of vehicles transporting hazardous materials.
- 1.8 TRAINING: Employ only workers who are trained and certified as required by 29 CFR 1910, 29 CFR 1926, 40 CFR 311, and 49 CFR 383 to remove, encapsulate, barricade, transport, or dispose of hazardous materials.
- 1.9 PERMITS AND NOTIFICATIONS: Secure necessary permits for hazardous material removal, storage, transport and disposal and provide timely notification as required by federal, state, and local authorities.

- 1.10 SAFETY AND ENVIRONMENTAL COMPLIANCE: Comply with laws, ordinances, rules, and regulations of federal, state, and local authorities regarding handling, storing, transporting, and disposing of hazardous materials and all other construction activities.
- 1.11 RESPIRATOR PROGRAM: Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134.
- 1.12 HAZARD COMMUNICATION PROGRAM: Implement a hazard communication program in accordance with 29 CFR 1910.1200.
- 1.13 SUBMITTALS
- A. Approval: Submit the following documentation to the Owner for review, approval, or rejection. Work shall not begin until submittals are approved.
1. Shop drawings.
  2. Hazardous material removal work plan.
  3. Liability insurance policy and performance bond.
  4. Schedule.
  5. Independent testing laboratories.
  6. Disposal site designations.
  7. Waste Transporter Designations.
  8. Notifications and certifications.
  9. Competent Person Designation Notifications and Certifications.
  10. Request for Substitutions.
- B. Shop drawings shall show:
1. Boundaries of all hazardous material removal areas.
  2. Location and construction of decontamination stations, if required.
  3. Location of temporary site storage facilities.
  4. Location of air monitoring stations, if required.
  5. Emergency egress route(s).
- C. The work plan shall include procedures for:
1. Work area set-up and protection.
  2. Worker protection and decontamination.
  3. PCB removal procedures.
  4. Mercury-containing lamp removal and packaging procedures.
  5. Mercury-containing material removal procedures.
  6. Monitoring and testing procedures (Sampling and Analysis Plan).
  7. Radioactive materials removal and tracking procedures.
  8. Waste handling, packaging, labeling, manifesting and disposal procedures.

- D. Insurance Policy and Performance Bond: Submit copies of the Contractor's or Subcontractor's insurance policy and performance bond. Submittal requirement is only to ensure that the insurance certificate(s) show specific coverage for the potentially hazardous materials being handled by this project. The insurance and bond amounts and certificate holder requirements are addressed in other portions of the contract documents and are not covered as part of this submittal requirement.
- E. Schedule: Submit construction schedule by work area.
- F. Independent Testing Laboratories and Laboratory Personnel: Submit the name, location, and phone number of proposed independent testing laboratories, and the names and certifications of industrial hygiene technicians. Include the laboratory's accreditation. Not all laboratories will require all accreditations.
1. The Independent Testing Laboratories shall be acceptable to the Owner.
  2. Evidence that a laboratory has demonstrated proficiency in performing analyses according to Method 1311 TCLP, corresponding to the current version of Test Methods for Evaluating Solid Wastes (Chemical Physical Methods), SW-846. Evidence may include successful participation in a recognized inter-laboratory quality control program such as a laboratory certified by the California Health and Welfare Agency, Department of Health Services, or a more informal inter-laboratory quality control program.
  3. Submit the name, address, telephone number, and résumé of the Industrial Hygienist (IH) who prepared the Sampling and Analysis Plan and will oversee the on-site monitoring. Submit the names, addresses, and résumés of industrial hygiene technicians who may assist the IH for on-site tasks. The Contractor shall submit documentation that the IH has all the qualifications for the assigned duties as required by the Contractor's liability insurance policy.
  4. Submit copies of the Contractor's letters to the independent testing laboratories, directing each to release all the results for this project to the Owner, as these results become available and as specified herein.
- G. Disposal Site: Submit the name and location of the proposed Alaska Department of Environmental Conservation (DEC) or U.S. Environmental Protection Agency (EPA) permitted disposal sites.
- H. Waste Transporter: Submit the name, address and EPA Hazardous Waste Transporter identification number for the proposed waste transporters.
- I. Certifications, Permits, and Notifications: Obtain and submit copies of EPA Hazardous Waste Generator identification number for the purpose of accumulating hazardous waste in accordance with 40 CFR 262. Submit copies of refrigerant recovery technician's EPA certification and company name when refrigeration systems are being demolished or deactivated. If the site does not have an EPA ID number for hazardous wastes, the contractor will need to assist the Owner in obtaining the EPA ID number, but the Owner will be available to sign the application documents and shipment records prepared by the contractor.
- J. Representations: Submit statement by the Contractor that records of employees' work assignments, certifications, respirator fit tests, and medical records are accurate, up-to-date, and available for inspection.

- K. Competent Person: Submit the name and certifications of the Contractor's proposed Competent Person and a list of their previous projects. Certify that the Competent Person has the knowledge and training to supervise the work in compliance with the publications listed in Paragraph 1.4 above.
  - L. Substitutions: Submit requests for substitutions of materials, equipment and methods.
  - M. Updated Project Information: Submit changes to the submitted project information at least 24 hours prior to the effective time of change for the following:
    - 1. Updated schedules for hazardous material removal.
    - 2. Change in competent person.
    - 3. Changes to work plan.
- 1.14 TEST REPORTS: Submit the following documentation produced during the work as received:
- A. Project Daily Logs: Submit the previous day's Daily Logs. Logs shall include regulated area sign-in sheets and list of chemical hazards removed including quantities and locations of those materials, in the units used on the drawings. Claims for additional quantities will not be addressed unless daily quantities are submitted.
  - B. Monitoring and testing data sheets and laboratory reports.
- 1.15 PROJECT COMPLIANCE DOCUMENTS: Submit the following documents with the application for final payment.
- A. Daily sign-in sheets.
  - B. Contractor's actual "start and finish" project dates.
  - C. All hazardous waste shipping manifests.
  - D. Disposal site receipts, including manufacturer name and serial numbers from each radioactive exit sign (if removed).
  - E. All final laboratory results.
  - F. Submit legible copies of the each Worker's Hazardous Waste Operations and Emergency Response (HAZWOPR) cards and/or a copy of the refresher training certificate to show that all workers have received their initial training or an eight-hour refresher course within the past year.
- 1.16 SANITARY FACILITIES: Provide adequate toilet and hygiene facilities.
- 1.17 MATERIAL STORAGE: Store all materials subject to damage off the ground and secure from damage, weather, or vandalism.

- 1.18 ON-SITE DOCUMENTATION: The Contractor shall maintain on the job site, at a location approved by the owner, copies of the following data for safety procedures, equipment, and supplies used for the work
- A. Equipment: Show the model, style, operations, and maintenance for the following, as applicable:
    - 1. Respirators, PAPR and canister types.
    - 2. Decontamination facilities.
    - 3. Specialized hazards handling equipment.
  - B. Expendable supplies: Maintain the manufacturer's safety data, and use the data for the following supplies:
    - 1. Coveralls and headgear.
    - 2. Boots, aprons, and gloves.
    - 3. Disposal containers.
    - 4. Solvents and degreasers.
  - C. Safety Data Sheets (SDS): Maintain SDSs for each encapsulant, surfactant, solvent, detergent, and other material proposed to be used.
  - D. Respirator Program: The Contractor's written respirator program.

## PART 2 - PRODUCTS

- 2.1 PERSONAL PROTECTIVE EQUIPMENT: Provide personal protective clothing as approved and selected by the IH.
- A. Respirators: Provide personally issued and marked respirators approved by the National Institute of Occupational Safety and Health (NIOSH). Provide sufficient replacements for respirators with disposable canisters.
  - B. Provide filter cartridges approved for each airborne contaminant which may be present. NIOSH approved filter cartridges shall be used. At no time shall the permissible exposure limit (PEL) for the contaminant exceed the PEL listed in 8 AAC 61.1100.
  - C. Whole Body Protection: Provide approved aprons, gloves, goggles, face shields, and hard-hats, and other protective clothing as required to meet applicable safety regulations to all workers engaged in hazardous materials removal. Full facepiece respirators shall meet the requirements of ANSI Z87.1.
  - D. Provide protective personal equipment and clothing at no cost to the workers.
- 2.2 DECONTAMINATION UNIT: Provide a decontamination station in accordance with the Contractor's accepted work plan and applicable regulations.

- 2.3     **WARNING SIGNS AND TAPE:** Post warning signs and tape at the boundaries and entrances to chemical hazards removal areas. Signs required by other statutes, regulations, or ordinances may be posted in addition to, or in combination with, this warning sign.
- 2.4     **WARNING LABELS:** Affix warning labels to all hazardous waste disposal containers as described in the Contractor's approved Solid Waste Disposal Plan. Conform labeling to 49 CFR 100-199.
- 2.5     **SPECIALIZED EQUIPMENT:** Lamp crushers and other specialized equipment to consolidate, reduce or treat hazardous materials are classified as RCRA treatment and the EPA specifically prohibits the use of Drum Top Crushers for management of fluorescent lamps as universal waste unless an equivalency determination is made by the state.
- 2.6     **EXPENDABLE SUPPLIES:** Provide flame resistant 6-mil thick polyethylene sheet plastic in widths necessary to minimize seams.
- 2.7     **SAFETY DATA SHEETS (SDSs):** Provide SDSs for all chemical materials brought onto the work-site.
- 2.8     **OTHER ITEMS:** Provide other items, such as consumable materials, disposable and/or reusable cleaning equipment and hand tools, or miscellaneous construction equipment and materials, in sufficient quantity as necessary to fulfill and complete the requirements of the contract. Electrical equipment and supplies shall be UL listed.
- 2.9     **ENCAPSULANTS:** Encapsulants shall contain no toxic or hazardous substances. Encapsulants shall be compatible with the products to which they are applied and be compatible with any replacement products.

### PART 3 - EXECUTION

#### 3.1     **WORK AREAS**

- A.     **Electrical Power:** Verify that the electrical power to the equipment being removed is deactivated, disconnected, and locked-out.
- B.     **Loaded Disposal Drums:** The Contractor shall provide handling equipment to move disposal drums loaded with hazardous wastes.

### 3.2 PERSONNEL PROTECTION PROCEDURES

- A. All personnel entering the work area shall sign the daily log and put on clean protective clothing.
- B. Basic protective clothing shall consist of aprons, gloves, goggles, face shields, and hard hats--with the addition of approved full body coveralls, bib-type aprons, and respirators as conditions warrant.
- C. Make available a contaminated material disposal drum, 6-mil. plastic wrapping and tape, or appropriate bagging materials for leaking ballasts and/or oil-contaminated components.
- D. Decontamination Procedures: All personnel handling or removing hazardous materials will comply with the decontamination procedures as described in the approved work plan.

### 3.3 HAZARDOUS MATERIAL REMOVAL PROCEDURES: Conduct hazardous materials removal, handling, packaging, storage, transport and disposal in accordance with the Contractor's approved work plan, applicable regulations, and this specification.

- A. Perform mercury-containing lamps work in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273 and 8 AAC.
- B. Perform waste battery work in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265, 40 CFR 273 and 8 AAC.
- C. Perform radioactive smoke detector work in accordance with 10 CFR 20, 8 AAC 61, 18 AAC 60 and 18 AAC 62.
- D. Perform ozone depleting substances work in accordance with 40 CFR 82, 8 AAC 61, 18 AAC 60, and 18 AAC 62.

### 3.4 MONITORING AND TESTING: Conduct daily sampling in accordance with the Contractor's accepted Sampling and Analysis Plan and this Specification. The Owner may conduct air monitoring in the Contractor's work areas and on the Contractor's employees.

- A. Personal, work area, and environmental monitoring for airborne contaminants shall be performed by industrial hygiene technicians who are employees of (one of) the Contractor's Independent Testing Laboratories.
- B. Perform air monitoring in accordance with 29 CFR 1926, current EPA guidance, and as specified herein. Calibrate all sampling pumps on-site with a calibrated transfer standard before and after each sample. Built-in rotameters on pumps are not acceptable for calibration.
- C. Monitor for all airborne contaminants listed in 29 CFR 1926.55 and 8 AAC 61.1100, which are produced by the Contractor's operations.



- D. Contractor shall test waste materials as required by 40 CFR 261, the disposal site's permit, and its approved work plan. If performed, TCLP testing of fluorescent lamps shall comply with ANSI/NEMA Standard Procedure for Fluorescent Lamp Sample Preparation and Toxicity Characteristic Leaching Procedure, C78.LL 1256-2003 or latest version.

### 3.5 DISPOSAL

- A. Dispose of hazardous wastes in an EPA permitted hazardous waste disposal site as required by 40 CFR 260 and 40 CFR 761, the Contractor's approved plan, and the disposal site operator.
- B. Comply with current waste disposal, handling, labeling, storage, and transportation requirements of the waste disposal facility, U.S. Department of Transportation, and EPA regulations.
- C. Fluorescent, mercury vapor, metal halide and high pressure sodium lamps are classified by the EPA as hazardous mercury waste under the Universal Waste Rule under 40 CFR 273. Mercury and mercury-containing products are considered hazardous waste unless TCLP testing of the waste for mercury confirms the mercury content to be less than the EPA criteria of 0.2 mg/l. If mercury-containing lamps and thermostats are handled and disposed of in accordance with the Universal Waste Regulations, no TCLP test is required. If the Contractor chooses to perform a TCLP test of fluorescent lamps, the test shall be conducted in accordance with the requirements of ANSI/NEMA Standard Procedure for Fluorescent Lamp Sample Preparation and Toxicity Characteristic Leaching Procedure, C78.LL 1256-2003 or latest version.
- D. Dispose of radioactive materials and equipment in accordance with the manufacturer's recommendations, the disposal site's requirements and 10 CFR 20, Subpart K. Provide list of manufacturer name and serial numbers for all removed radioactive exit signs to owner.
- E. Refrigerants in refrigeration and cooling systems in the building contain ODS components that must be recovered and recycled or disposed of in accordance with 40 CFR 82. Personnel decommissioning or removing ODS refrigerants shall hold appropriate EPA training and certificate for handling and recovering these materials.
- F. Heating systems containing glycol shall be drained and all glycol collected in appropriate waste containers for recycling or disposal. Glycol shall be tested for heavy metals using the Toxicity Characteristics Leaching Procedure (TCLP). Glycol that failed the TCLP shall be packaged for disposal as hazardous waste.

### 3.6 CLEANING OF WORK AREA

- A. Remove all hazardous materials and debris within a work area. Wet clean all work area surfaces.

- B. Notify the Owner that hazardous materials removal has been completed and the work area is ready for visual inspection. Include a statement that all hazardous materials and debris in the work area have been removed as required by the contract.

END OF SECTION 02 8418

## SECTION 03 3053 - MISCELLANEOUS CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.

## 1.4 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

## PART 2 - PRODUCTS

## 2.1 CONCRETE, GENERAL

- A. Comply with the following sections of ACI 301 unless modified by requirements in the Contract Documents:
  - 1. "General Requirements."
  - 2. "Formwork and Formwork Accessories."
  - 3. "Reinforcement and Reinforcement Supports."
  - 4. "Concrete Mixtures."
  - 5. "Handling, Placing, and Constructing."
  - 6. "Comply with ACI 117."

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

## 2.3 CONCRETE MATERIALS

- A. Cementitious Materials:
  - 1. Portland Cement: ASTM C 150/C 150M, Type I.
- B. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/4-inch nominal maximum aggregate size.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
- E. Water: ASTM C 94/C 94M.

## 2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Water: Potable.
- C. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.5 CONCRETE MIXTURES

- A. Comply with ACI 301.
- B. Normal-Weight Concrete:
  - 1. Minimum Compressive Strength: 4000 psi at 28 days.
  - 2. Maximum W/C Ratio: 0.50.
  - 3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content: Maintain within range permitted by ACI 301. Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

## 2.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  1. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## PART 3 - EXECUTION

### 3.1 FORMWORK INSTALLATION

- A. Design, construct, erect, brace, and maintain formwork according to ACI 301.

### 3.2 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

### 3.3 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### 3.4 CONCRETE PLACEMENT

- A. Comply with ACI 301 for placing concrete.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Do not add water to concrete during delivery, at Project site, or during placement.
- D. Consolidate concrete with mechanical vibrating equipment according to ACI 301.
- E. Equipment Bases and Foundations:
  1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

### 3.5 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.6 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
  1. Do not further disturb surfaces before starting finishing operations.
- C. Float Finish: Apply float finish to all surfaces.
- D. Trowel Finish: Apply a hard trowel finish to all surfaces.

### 3.7 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.
- B. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- C. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following method:
  1. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after

initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to ACI 301.
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

END OF SECTION 03 3053

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## SECTION 07 9200

## JOINT SEALANTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Polysulfide joint sealants.
  - 3. Smoke-resistant sealants for penetrations in smoke partitions.
- B. Related Requirements:
  - 1. Division 09 Section "Gypsum board" for interior finish at boiler room.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

## 1.4 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. Sika Corporation; Joint Sealants
- B. Silicone, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Pecora Corporation.
- b. Sika Corporation; Joint Sealants.

## 2.3 IMMERSIBLE JOINT SEALANTS

- A. Polysulfide, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T, NT, and I.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Pecora Corporation.

## 2.4 SMOKE SEALANT

- A. Acrylic latex, single component, nonsag, plus 12.5 percent and minus 12.5 percent movement capability, nontraffic-use, joint sealant; ASTM C 834, Type OP. Sealant shall have a maximum flame spread and smoke development of 5 when tested in accordance with ASTM E 84. Product shall be approved for use in smoke rated partitions or joints.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Tremco Inc.
    - b. 3M Fire Protection Products and Systems
    - c. Hilti, Inc.

## 2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. BASF Corporation; Construction Systems.
    - b. Construction Foam Products; a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
  - 3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
  - a. Metal.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
  2. Joint Sealant: Immersible Polysulfide, M, NS, 25, T, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: General uses other than those specified above, including backsplash and wall interfaces, plumbing fixture interfaces with architectural materials and elsewhere as indicated.
  1. Joint Sealant: Acrylic latex joint sealant.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Joints and penetrations through smoke rated partitions.
  1. Joint Sealant: Silicone joint sealant.

2. Joint-Sealant Color: Manufacturer's standard white color.

END OF SECTION 07 9200

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## SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
- B. Related Requirements:
  - 1. Division 08 Section "Door Hardware" for door hardware for hollow-metal doors.

## 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

## 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Curries Company; ASSA ABLOY.
  - 3. Republic Doors and Frames.

## 2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches (44.5 mm).
    - c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    - d. Edge Construction: Model 1, Full Flush.
    - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - f. Core: Manufacturer's standard Vertical steel stiffener.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
    - b. Construction: Full profile welded.
  - 3. Exposed Finish: Prime.

## 2.3 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- C. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

## 2.5 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 2. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- B. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

## 2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with SDI A250.11.
  1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  2. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

## 4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

- a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
- b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
- c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
- d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

## C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
2. Smoke-Control Doors: Install doors according to NFPA 105.

## 3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 1113

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## SECTION 08 710 – FINISH HARDWARE

## PART 1 - GENERAL

## 1.1 SUMMARY:

This Section includes items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

- A. Related Sections: The following Sections contain requirements that relate to this Section:
1. Division 08 Section 'Hollow Metal Door and Frames' for interior and exterior hollow-metal doors.

## 1.2 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.
1. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  2. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
  3. Product Data: Manufacturer's data for each product keyed to the finish hardware schedule.

## 1.3 QUALITY ASSURANCE:

- A. Supplier Qualifications:
1. Direct factory contract supplier who has been furnishing hardware in the projects vicinity for a period of not less than 5 years.
  2. Employs a certified architectural hardware consultant (AHC), available at reasonable times during course Work for project hardware consultation to Owner, Architect and Contractor. Responsible for detailing, scheduling and ordering of finish hardware.
  3. Supplier willing to agree in writing to maintain parts inventory of items supplied for future service to Owner.

## 1.4 PRODUCT HANDLING:

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

- C. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. All manufacturers and models shall be as indicated or approved equal.

### 2.2 HARDWARE FINISH

- A. Finishes for hardware items specified are as listed in the hardware groups.

### 2.3 HINGES

- A. Standard Hinge Manufacturer: Ives - Accepted: Hager, Stanley
- B. All hinges to be heavy weight 4 ½ x 4 ½ for doors up to 36". 5 x 4 ½ for doors over 36".
- C. Provide 3 hinges for doors up to 7'6". Provide one additional hinge every additional 30"
- D. For unusual size or weight of doors, furnish type, sizes and quantity recommended by hinge manufacturer.

### 2.4 LOCKSETS, STANDARD

- A. Manufacturer Listed: Schlage L9000. – Accepted: None
- B. Design: 06L.
- C. Backset: 2-3/4 inches.
- D. Locksets and latchsets shall be furnished with sufficient strike lip to protect trim. (Note: 3/4 inch latchbolts require 3/4 inch minimum clearance for trim, otherwise extended lip strikes must be furnished.)
- E. All locks shall have ANSI strikes.

### 2.6 DOOR CLOSERS, SURFACE

- A. Manufacturer Listed: LCN - Accepted : None
- B. Furnish drop plates where required.
- C. Furnish sex nuts and bolts for all doors.



D. Provide as specified in hardware groups.

E. Closers shall have a 30-year guarantee.

## 2.7 STOPS

A. Manufacturer Listed: Ives - Accepted : Trimco, Rockwood

B. Contractor to provide solid backing for all wall mounted stops.

## 2.9 PUSH, PULL AND PROTECTION PLATES

A. Manufacturer Listed: Ives - Accepted : Trimco, Rockwood

B. Type: As listed.

C. Size: All plates shall be 2 inches less than door width on push side.  
1. Kickplates shall be 10 inches in height, as listed.

## 2.10 GASKET

A. Manufacturer Listed: Zero - Accepted : Pemko

B. Types: As specified in hardware groups.

## 2.11 DOOR SILENCERS

A. Manufacturer Listed: Ives.

B. Quantity: Furnish three (3) for each single door frame, and four (4) for each pair of door frames.

C. Types: 64 or 65.

## 2.13 KEYING

A. Key Systems: Initiate and conduct meeting(s) with Owner to determine system keyway(s) and structure, furnish Owner's written approval of the system.

B. Permanent keys and cores: secured shipment direct from point of origination to Owner's representative.

C. Bitting List: Secured shipment direct from point of origination to Owner upon completion.

D. All locks to be keyed to the existing University's Grandmaster Key System.

E. All locks to be construction keyed.

- F. Key Quantity
1. Provide 6 GMK  
6 MK  
6 Construction keys  
1 Control Key  
1 Construction Control Key  
3 Change keys per lock

## 2.15 Hardware Groups

HW 01

3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080BDC 06L	626	SCH
1	EA	PERMANENT CORE	AS REQUIRED	626	BES
1	EA	SURFACE CLOSER	4011 SRI TBWMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

- A. Unless a conflict arises, the following are standard mounting heights on some products. If a question or conflict should arise, the hardware supplier, if requested shall assist the Contractor and Architect in determining mounting heights.
- B. All measurements are from finish floor except top hinge.
- C. HINGES
1. Top: 11-3/4 inch center of hinge to top of door.
  2. Intermediate: Equal distance between top and bottom hinges.
  3. Bottom: 13 inches center of hinge.
- D. LEVER LOCKS
1. 40-5/16 inches to center of strike.
- F. DOOR CLOSERS
1. As per manufacturers instructions.
- G. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate

removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

- H. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- I. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- J. Weatherstripping and Gasketing: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

### 3.2 ADJUSTING, CLEANING, AND DEMONSTRATING:

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
  - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

END OF SECTION 08 7100

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## SECTION 09 2900 - GYPSUM BOARD

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
- B. Related Requirements:
  - 1. Division 09 Section "Interior Painting" for finish of interior gypsum board.

## 1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

## 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Georgia-Pacific Building Products.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch (15.9 mm).
  - 3. Long Edges: Tapered.

## 2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
  - 2. Shapes:
    - a. Cornerbead.
    - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - c. L-Bead: L-shaped; exposed long flange receives joint compound.

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.

- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

## 2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

- D. Form control and expansion joints with space between edges of adjoining gypsum panels.
- E. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- F. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical surfaces unless otherwise indicated.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:



1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 09 sections.

### 3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

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## SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Resilient base.

## 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

## 1.4 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

## 2.1 RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  2. Flexco.
  3. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
1. Style and Location:
    - a. Style B, Cove (based with toe).
- C. Thickness: 0.125 inch (3.2 mm).
- D. Height: 4 inches (102 mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated on the Drawings by manufacturer's designations. Use of manufacturer's name and designation is not intended to limit products by other manufacturers.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 PREPARATION

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

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
    - a. Miter or cope corners to minimize open joints.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  1. Remove adhesive and other blemishes from surfaces.
  2. Sweep and vacuum horizontal surfaces thoroughly.
  3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513

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## SECTION 09 9123 - INTERIOR PAINTING

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
  - 1. Steel and iron.
  - 2. Gypsum board.
  - 3. Concrete
- B. Related Requirements:
  - 1. Division 09 Section "Gypsum Board" for interior wall finish at boiler room.

## 1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  2. Apply coats on Samples in steps to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.



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PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Benjamin Moore & Co.
  2. Dulux (formerly ICI Paints); a brand of AkzoNobel.
  3. Sherwin-Williams Company (The).

## 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As indicated in the Drawings on a color schedule. Use of a particular manufacturer's color designation is not intended to prevent submittal of products with comparable colors from another manufacturer.

## 2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  2. Testing agency will perform tests for compliance with product requirements.
  3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
  - 2. Concrete: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms or occupied spaces:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

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

### 3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
  1. Water-Based Concrete Floor Sealer System MPI INT 3.2G:
    - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
    - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- B. Steel Substrates:
  1. Latex System, Alkyd Primer MPI INT 5.1QQ:
    - a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
    - b. Prime Coat: Shop primer specified in Section where substrate is specified.
    - c. Intermediate Coat: Latex, interior, matching topcoat.
    - d. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
- C. Gypsum Board Substrates:
  1. Latex over Latex Sealer System MPI INT 9.2A:
    - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - b. Prime Coat: Latex, interior, matching topcoat.
    - c. Intermediate Coat: Latex, interior, matching topcoat.
    - d. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.

END OF SECTION 09 9123

## SECTION 20 0000

## MECHANICAL GENERAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Supplemental requirements in addition to Division 1 - General Requirements applicable to all Divisions 20, 22, 23, 25 - Mechanical specification sections.
- B. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 20 0513 - Common Motor Requirements
  - 3. 20 0529 - Mechanical Hangers and Supports
  - 4. 20 0553 - Mechanical Identification
  - 5. 20 0556 - Interior Trench Excavation and Backfill
  - 6. 20 0700 - Mechanical Insulation
  - 7. 20 4100 - Mechanical Demolition
  - 8. 22 1100 - Domestic Water Piping and Specialties
  - 9. 22 1300 - Sanitary Waste and Vent Piping and Specialties
  - 10. 23 0593 - Testing, Adjusting and Balancing
  - 11. 23 1123 - Fuel Gas Piping and Specialties
  - 12. 23 2113 - Hydronic Piping and Specialties
  - 13. 23 2115 - Well Water Cooling Piping and Specialties
  - 14. 23 2123 - Hydronic Pumps
  - 15. 23 3100 - Ducts and Accessories
  - 16. 23 3600 - Air Terminal Units
  - 17. 23 3700 - Air Outlets and Inlets
  - 18. 23 5216 - Condensing Boilers and Accessories
  - 19. 25 3000 - Building Automation System Field Devices
  - 20. 25 4000 - Variable Speed Drives
  - 21. 25 5000 - Building Automation System
  - 22. 25 9000 - Sequence of Operations

## 1.2 NOTIFICATION OF POTENTIAL HAZARDS

- A. Asbestos, lead and other hazardous materials may be present in the building that may impact the work of all trades. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to specification Section 02 2600 Hazardous Materials Summary Report, Section 01 3545 Airborne Contaminate Control; and Division 02 Specifications for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.

## 1.3 REFERENCES

- A. Codes and Standards:
  - 1. Perform work in accordance with the legally enacted editions of applicable international, state and local codes with locally accepted amendments to include:
    - a. 2012 International Building Code (IBC).
    - b. 2012 International Mechanical Code (IMC).
    - c. 2012 International Fuel Gas Code (IFGC).
    - d. 2012 Uniform Plumbing Code (UPC).
    - e. 2012 International Fire Code (IFC).
    - f. 2014 NFPA 70, National Electric Code (NEC).
    - g. Standard for Accessible and Usable Buildings and Facilities (ANSI A117.1-2009).
  - 2. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:
    - a. American Gas Association - AGA.
    - b. American National Standards Institute - ANSI.
    - c. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE.
    - d. American Society of Mechanical Engineers - ASME.
    - e. American Society for Testing and Materials - ASTM.
    - f. National Electrical Manufacturers' Association - NEMA.
    - g. National Fire Protection Association - NFPA.
    - h. Sheet Metal and Air Conditioning Contractors National Association, Inc. - SMACNA.
- B. Definitions:
  - 1. "Accessible" means arranged so that an appropriately dressed man 6'-2" tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended; and may then position himself to

- properly perform the task to be accomplished, without disassembly or damage to the surrounding installation.
2. "Authority Having Jurisdiction" is the individual official, board, department, or agency established and authorized by the political subdivision created by law to administer and enforce the provisions of the Code as adopted or amended.
  3. "As Specified" denotes a product, system, or installation that:
    - a. Includes salient characteristics identified in the Drawings and Specifications.
    - b. Meets the requirements of the "Basis of Design".
    - c. Is produced by a manufacturer listed as acceptable on the Drawings or in the Specifications.
  4. "Basis of Design" refers to products around which the design was prepared. Some or all of the particular characteristics of Basis of Design products may be critical to the fit or performance of the completed installation. Such characteristics are often subtle. Where substitutions are made to products that are the Basis of Design, the Contractor is alerted that nominally acceptable substitutions may produce undesirable side effects such as products that no longer fit the space due to increased product dimensions. The Contractor is responsible for resolving impacts of substitutions. Approval of a substitution request does not relieve the Contractor of complying with the design intent and applicable Codes. Reference to a specific manufacturer's product (even as "Basis of Design") does not necessarily establish acceptability of that product without regard to compliance with other provisions of these specifications.
  5. "Contracting Agency" is the Owner as defined in the General Conditions of the Contract.
  6. "Demolish" means to permanently remove a component, equipment, or system and its appurtenances with no intent for reuse and to properly disposal of it.
  7. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere, as noted or agreed, to be installed by supporting crafts.
  8. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.
  9. "Product" is a generic term that includes materials, equipment, fixtures and any physical item used on the project.
  10. "Provide" means furnish products, labor, subcontracts, and appurtenances required and install to a complete and properly operating, finished condition.
  11. "Remove" means to remove a component, equipment, or system and its appurtenances and either store it for re-installation/reuse, or turn it over to the Contracting Agency.
  12. "Rough-in and Connect" means provide an appropriate system connection such as water services with stops, continuous wastes with traps, shutoff valves, and piping connections, testing, etc., for proper operation, ready for furnished products to be installed. Equipment furnished is received, uncrated, assembled and set in place by supporting crafts unless prior arrangements are made to hire the rough-in installer for this work.



13. "Serviceable" means arranged so that the component or product in question may be properly removed and replaced without disassembly, destruction or damage to the surrounding installation. "Serviceable" components shall be "accessible".
14. "Shop Drawings" are dimensioned working construction drawings drawn to scale to show an entire area of work in sufficient detail to demonstrate service and maintenance clearances and coordination of all trades.
15. "Substitution" is a product, system or installation that is not by a listed manufacturer or does not conform to all salient characteristics identified in the Project Manual, but that the Contractor warrants meets specific requirements listed in the Project Manual.
16. "System Drawing" is a diagrammatic engineered drawing that shows the interconnection and relationship between products to demonstrate how the products interact to accomplish the function intended. Examples of system drawings include plumbing diagrams, control and instrumentation diagrams, and wiring diagrams. Some drawings, such as dimensioned and complete Fire Suppression Drawings may be both System Drawings and Shop Drawings.

#### 1.4 SYSTEM DESCRIPTION

##### A. Performance Requirements:

1. Provide labor, products and services required for the complete installation, checkout, and startup of mechanical systems shown and specified. Coordinate related work, including the work of other crafts, to provide each system complete and in proper operating order.
2. Cooperate with others involved in the project; with due regard to their work, to promote rapid completion of the entire project.
3. Become thoroughly familiar with the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climatic conditions, and other local conditions that may affect the progress and quality of the work.
4. Coordinate and perform demolition in support of the project whether or not such requirements are described on the Drawings. Restore systems that are to remain but that are affected in any way by demolition work. Conduct a site visit prior to bid to determine Scope.
5. In general, the mechanical, electrical and building automation systems are interrelated. Coordinate the interface and operation of systems so that interrelated systems operate in proper synchronization and balance.
6. Provide labor, materials, and equipment to facilitate the commissioning process of systems and equipment within this scope of work. Perform tests and verification procedures required for the commissioning process as requested by the Contracting Agency.

#### 1.5 PREINSTALLATION MEETINGS

- ##### A.
- Meet with and coordinate Divisions 20, 21, 22, 23, 25 work with the interrelated work of other trades including Architectural, Civil, Structural, and Electrical to identify and resolve potential conflicts.



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1.6 SUBMITTALS

- A. Refer to Division 1 for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. General:
  - 1. The Contracting Agency's obligation to review submittals and to return them in a timely manner is conditioned upon the prior review and approval of the submittals by the Contractor as required by the Construction Contract.
  - 2. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Project Manual.
    - a. Submittals will not be checked for quantity, dimension, fit, or for proper technical design of manufactured equipment.
    - b. Provision of a complete and satisfactory working installation is the responsibility of the Contractor.
  - 3. Furnish suppliers with the applicable portions of the Project Manual and review and verify that the suppliers' submittals clearly represent products which comply with the Project Manual.
  - 4. Master Submittal Log
    - a. Create and maintain a master submittal log for items submitted in Divisions 20, 21, 22, 23, 25, including test results, certifications, record drawings, etc.
    - b. Submit master submittal log, independent of other submittals, as the first submittal for review and approval by the Contracting Agency.
    - c. Update submittal log with each submittal action.
    - d. Share an electronic copy with Contracting Agency and Engineer at two week intervals, or as requested by the Contracting Agency.
- C. Coordination:
  - 1. Prior to a submittal's submission for approval, hold a meeting of all construction trades to review shop drawings and submittals. Each trade shall cross-check shop drawings and submittals for conflicts, clearances, physical space allocation and routing, discrepancies, dimensional errors, omissions, contradictions, departures from the Contract requirements, correct electrical/mechanical services and connections, and provisions for commissioning.
  - 2. Review, revise, correct, and appropriately annotate submittals prior to submission for approval.
  - 3. Keep a current copy of approved submittals and the submittal log at the job site.
- D. Electronic Submittals:
  - 1. Provide electronic submittals in PDF format in addition to hard copy submittal. Maximum file size to be coordinated with Contracting Agency.
  - 2. Follow the organization and formatting required for paper submittals.
  - 3. Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.

4. If individual PDF files are provided for a product or shop drawing sheet(s), organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
5. Create PDF documents without security, to be searchable, and to allow copy and paste. For scanned documents, run the optical character recognition (OCR) function to ensure the document is searchable and can be copied and pasted.

E. Product Data:

1. General:

- a. This section describes in detail the preparation of mechanical product submittals. Submittals not provided as described shall be rejected without review. This procedure is designed to accelerate and improve the accuracy of the technical review process, as well as, simplify the preparation of the Installation, Operation, and Maintenance Manuals (IO&Ms).
- b. Product data for each specification section shall be submitted in one complete package, except as noted in this section.

2. Submittal Organization:

- a. Organize product submittal information in the same order as the products are specified. Provide a separate tabbed divider for each Divisions 20, 21, 22, 23, 25 specification section. Provide the typed section number on each tab.
- b. Within each section, organize product information in the same order as products are specified in Part 2 of each applicable specification section. Provide sub-tabs within each section for each separate product article. Provide the typed product article number on each tab.
- c. Provide product submittal information for each product specified in 8-1/2" x 11" format. Fold-out 11" x 17" format is also acceptable.
- d. If a particular specified product is being omitted from the product submittal or will not be used for the project, provide a single sheet within the article tab identifying the product and annotated with a brief reason why the product is not being submitted, for example: "NOT USED," "NO SUBMITTAL REQUIRED," "TO BE SUBMITTED BY (PROVIDE DATE)," etc. This will inform the reviewer that the product was not overlooked.
- e. Partial submittals from individual subcontractors may be provided which cover a particular sub-contractor's scope of work. In this case, arrange partial submittals by system classification such as: PLUMBING, HEATING, FIRE SUPPRESSION, VENTILATION, BUILDING AUTOMATION SYSTEM, etc. Within each system classification, arrange product submittals by specification section, as described, such that each specification section can easily be reorganized into a master set of Divisions 20, 21, 22, 23, 25 product submittals organized by specification section. This will greatly simplify the preparation of IO&M manuals as described below.
- f. Bind product submittal information in identical 3 inch wide, hard-backed, loose-leaf, 3 ring binders with clear front and spine insert pockets. Divide

- information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
- g. Provide a master table of contents at the front of each volume which lists the Divisions 20, 21, 22, 23, 25 specification sections and indicates which sections are located within each volume.
  - h. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
  - i. Provide identical cover and spine inserts for each product submittal volume, to include the following typed information:
    - 1). The Contracting Agency Name.
    - 2). Project Name.
    - 3). Contractor Name.
    - 4). Subcontractor Name preparing the submittal.
    - 5). Date that the submittal or resubmittal was initiated.
    - 6). "Mechanical Product Submittals" or "Plumbing Product Submittals" etc. as appropriate.
    - 7). "Volume 1 of X, Volume 2 of X," etc.
3. Product Information:
- a. Indicate manufacturer's name and address, and local supplier's name, address, phone number.
  - b. Indicate each product as "Basis of Design", "Specified Equal" or "Proposed Substitution."
  - c. Identify catalog designation and/or model number.
  - d. Provide manufacturer's product literature. Neatly annotate to indicate specified salient features, appurtenances and performance criteria for each product specified to demonstrate compliance with the Project Manual to include scheduled information, drawing information and specified information.
  - e. Indicate product deviations from the Project Manual and mark out non-applicable items on generic "cut-sheets."
  - f. Include manufacturer provided dimensioned equipment drawings with rough-in mechanical and electrical connections.
  - g. Include operation characteristics, performance curves and rated capacities.
  - h. Include motor characteristics and wiring diagrams.
  - i. Include weight of equipment. Including accessories.
  - j. Provide basic manufacturer's installation instructions.
4. Product Substitutions:
- a. Clearly indicate both in the section table of contents and on the individual product submittal information each proposed substitution, deviation or change from the product as described in the Project Manual.
  - b. Submittal approval does not include substitutions, deviations or changes from the requirements of the Project Manual unless they are specifically

itemized and approved. The term "No Exceptions Taken" will not apply to substitutions, deviations or changes not clearly identified.

- c. Provision of a satisfactory working installation of equal quality to the system as described in the Project Manual shall be the responsibility of the Contractor.
- d. Correct unapproved deviations from the Project Manual discovered in the field as directed by and at no additional cost to the Contracting Agency.
- e. Cost of any design modifications as a result of proposed product substitutions shall be borne by the Contractor.

F. System Drawings:

- 1. Submit System Drawings for dynamic elements/systems of the project which are performance specified to include but not limited to: Fire Suppression Systems, Building Automation Systems and stand-alone packaged equipment.
- 2. Prepare system drawings on full sized sheets of the same size as the original construction drawings.
- 3. Include with each system a sequence of operation narrative which describes each mode of system operation in sufficient detail to demonstrate compliance with the Project Manual to the satisfaction of the Contracting Agency.

G. Shop Drawings:

- 1. General:
  - a. The Project Manual documents are not intended for nor are they suitable for use as shop drawings. Project Manual documents shall not be utilized for the actual fabrication or installation of products or equipment.
  - b. The Drawings are partly diagrammatic and do not show all offsets in piping or ducts, and may not show in minute detail all features of the installation; however, provide systems complete and in proper operating order.
  - c. Locations of products are approximate unless dimensioned.
  - d. Divisions 20, 21, 22, 23, 25 products and systems shall not be installed without shop drawings approved by the Contracting Agency.
  - e. Rework, changes or additional engineering support required as a result of the installation of products and systems prior to the approval of applicable shop drawings by the Contracting Agency shall be provided at the Contractor's expense.
  - f. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry. Special items are identified by a supplementary list of graphical illustrations, or identified on the drawings or specifications.
- 2. Preparation:
  - a. Review each Divisions 20, 21, 22, 23, 25 specification section and identify the shop drawing requirements.
  - b. Combine the shop drawing requirements first by system (i.e. ventilation system, heating system, plumbing system, etc.) and then by area (i.e. fan room, boiler room, etc.).

- c. Prepare shop drawings on full sized sheets of the same size as the original construction drawings.
  - d. Arrange shop drawings to scale, showing dimensions where accuracy of location is necessary for coordination or communication purposes.
  - e. Incorporate the actual dimensions and configurations of the products and systems approved through the product submittal process into the shop drawings.
  - f. Provide dimensioned maintenance clearance areas around each product as recommended by the manufacturer.
  - g. Coordinate Divisions 20, 21, 22, 23, 25 work with the interrelated work of other trades including Architectural, Civil, Structural, and Electrical.
  - h. Identify and provide recommendations to resolve major conflicts which may impact the design of the systems as shown. Such conflicts will be resolved during the shop drawing review process.
  - i. Identify locations where field coordination between various trades is necessary to avoid conflicts.
  - j. Indicate elevation of piping, ductwork and equipment above or below finished floor at various locations and in sufficient detail to demonstrate clearance from structural elements and the work of other trades.
  - k. Coordinate placement of openings and holes through structure, walls, floors, ceilings, and roof with Structural and Architectural.
3. Submittal:
- a. Submit dimensioned shop drawings as specified to demonstrate proper planning and sequencing of the applicable trades for the installation and arrangement of Divisions 20, 21, 22, 23, 25 with respect to other interrelated work.
  - b. Partial shop drawings submittals (i.e. heating system only) will be rejected without review, as the interrelationship with other related work and overall system fit cannot be evaluated.
    - 1). Underslab shop drawings may be submitted separately for review to accommodate the construction schedule.
  - c. It is assumed that shop drawings submitted for review have been thoroughly prepared and coordinated and that the products and systems can and shall be installed as shown. Conflicts which are not clearly identified and annotated on the submitted shop drawings are assumed not to exist.
  - d. Installation conflicts arising from the failure to properly coordinate the work of related trades shall be provided at the Contractor's expense.
- H. Certificates:
- 1. Review the submittal requirements for Certificates for each Divisions 20, 21, 22, 23, 25 specification section.
  - 2. Submit copies of certificates as specified. This information may be included within the Installation, Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
- I. Test and Evaluation Reports:

1. Review the submittal requirements for Test and Evaluation Reports for each Divisions 20, 21, 22, 23, 25 specification section.
  2. Submit copies of reports as specified. Also include these reports within the Installation, Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
- J. Installation, Operations and Maintenance (IO&M) Manuals:
1. Review the submittal requirements for IO&M manuals for each Divisions 20, 21, 22, 23, 25 specification section.
  2. Begin the preparation of the mechanical IO&M manuals with a complete and fully approved set of mechanical product data submittals organized, annotated and with the product information as indicated within the "Product Data" submittals article above and in each Divisions 20, 21, 22, 23, 25 section.
  3. Next, augment each individual product submittal with the written installation, operations and maintenance information for each approved product. This type of information is not applicable (or available) for bulk commodity or simplistic products such as copper pipe, basic pipe hangers or equipment tags, etc.
  4. Annotate the installation, operations and maintenance information to indicate applicable information for the specific equipment model(s) installed.
  5. Maintenance information shall include:
    - a. Preventive maintenance requirements for each product, including the recommended frequency of performing each preventive maintenance task.
    - b. Instructions for troubleshooting, minor repair and adjustments required for preventive maintenance routines, limited to repairs and adjustments that may be performed without special tools or test equipment and that require no extensive special training or skills.
    - c. Information of a maintenance nature covering warranty items, etc., that have not been discussed in the manufacturers' literature.
    - d. Information on the spare and replacement parts for each product and system. Properly identify each part by part number and manufacturer.
    - e. Recommended spare parts list.
  6. Organize the IO&M manual information by specification section (not by sub-contractor) with a tabbed divider separating each section. Provide the typed section number on each tab.
  7. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable section. Provide sub-tabs within each section for each product. Provide the typed product article number on each tab.
  8. Bind the information in identical 3 inch wide; hard-backed, loose-leaf, 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
  9. Provide a master table of contents at the front of each volume which lists the Divisions 20, 21, 22, 23, 25 specification sections and indicates which sections are located within each volume.



10. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
11. Provide identical cover and spine inserts for each IO&M manual volume, to include the following typed information:
  - a. The Contracting Agency Name.
  - b. Project Name.
  - c. "Mechanical Installation, Operations and Maintenance Manual".
  - d. "Volume 1 of X, Volume 2 of X," etc.
12. Submit copies of Operation and Maintenance Manuals in electronic format (Adobe PDF).

## 1.7 CLOSEOUT SUBMITTALS

### A. Warranty Documentation:

1. Review the manufacturer's warranty requirements for each Divisions 20, 21, 22, 23, 25 specification section.
2. Submit required warranty documentation to the applicable Manufacturer's Representative to validate standard manufacturer's warranty for each required product. Obtain written confirmation of receipt from each applicable Manufacturer's Representative.
3. Provide Contracting Agency one copy of submitted warranty documentation and written confirmation of receipt for each applicable Manufacturer's Representative. This information may be included within the Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
4. Provide statement of Contractor's warranty of workmanship, labor, and materials, as described under Article 1.12 Warranty below.

### B. Record Documentation:

1. General: As the Work progresses, neatly annotate a designated and otherwise unused set of Divisions 20, 21, 22, 23, 25 Contract Drawings to show the actual locations and routing of Divisions 20, 21, 22, 23, 25 Work and the terminal connection points to related Work. As a minimum, include the following:
  - a. Annotate record drawings to incorporate each applicable addendum.
  - b. Annotate record drawings as directed by each applicable Request for Information (RFI) and accepted Change Order Proposal.
  - c. Modify record drawings to show actual equipment sizes and locations and pipe and duct routing. Revise pipe and duct sizes as appropriate.
  - d. Provide dimensioned locations for permanently concealed piping and ductwork (i.e. piping cast in concrete or buried underground/underslab).
  - e. Show the actual locations of system isolation valves, especially valves which are concealed above ceilings and behind access panels.
2. Preparation:
  - a. Neatly annotate record drawings to provide clear interpretation to support electronic drafting by a third party.

- b. Tape electronic sketches from addendums and/or RFIs directly to the record drawings as overlays.
  - c. Annotate the record drawings in colored pencil using the same symbols and abbreviations as indicated in the Divisions 20, 21, 22, 23, 25 legends and schedules of the Contract Drawings.
    - 1). Red to add information.
    - 2). Green to delete information.
    - 3). Blue to provide additional clarifying information which is not to be drafted.
  - d. After submittal to the Contracting Agency, provide additional clarification, information or rework as necessary to support the accurate interpretation and electronic drafting of the record drawings.
3. Submittals:
- a. Provide dimensioned underslab record drawings to the Contracting Agency prior to placing the slab. For slabs placed in multiple sections, provide record drawings for the applicable slab sections to the Contracting Agency prior to each pour.
  - b. Provide complete record drawings for concealed areas (i.e. above lay-in and hard ceilings and inside walls) to the Contracting Agency prior to concealment.
  - c. Provide the remaining portion of the record drawings for exposed areas to the Contracting Agency prior to the final completion of the project.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

### A. Spare Parts:

- 1. Furnish spare parts for systems and equipment as listed in applicable sections of Divisions 20, 21, 22, 23, 25.
- 2. Clearly label each part with name, manufacturer's part number, system and/or equipment where used and location.
- 3. Deliver parts to location and person designated by the Contracting Agency, in durable storage boxes.
- 4. Group cartons containing smaller items by system or application and deliver in an appropriate number of storage boxes.

- B. Tools: Provide three sets of special tools and testing and monitoring equipment as listed in applicable sections of Divisions 20, 21, 22, 23, 25.

## 1.9 QUALITY ASSURANCE

### A. Qualifications:

- 1. Manufacturers: Companies specializing in manufacturing the Products specified in the Divisions 20, 21, 22, 23, 25 sections with documented experience.



2. Fabricators: Companies specializing in fabricating the Products specified in the Divisions 20, 21, 22, 23, 25 sections with documented experience.
3. Installers: Perform the Work using qualified workmen that are experienced and usually employed in the trade.
4. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

B. Product Testing and Certification:

1. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors shall be "Approved," "Certified," "Identified," or "Listed" and "Labeled" to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
2. Where the words Listed, UL Listed, UL Labeled, Underwriters Laboratories, Inc., UL, or variations of this terminology, appear under this Division of the Specifications or the associated drawings, it is understood that a comparable testing agency as defined by NRTL above is acceptable.
3. Such testing and certification is generally applicable to products within the following categories:
  - a. Life safety and fire suppression.
  - b. Fuel burning equipment, except certain classes of power or industrial equipment for which other recognized certification applies as well.
  - c. Factory fabricated and wired electrical control panels and packaged equipment with factory installed electrical controls or panels.
  - d. Components for life safety systems, fuel systems and medical gas systems.
4. The listing under Paragraph '3' above is provided for illustration of requirements and is not exclusive. Provide products that have been tested and listed for the intended application when such products are available unless the Contracting Agency has provided written exemption on an itemized basis.
5. Provide electrical products listed and labeled by UL, FM, ETL or other approved NRTL. If listing and labeling is not available, stamp the submittal for these products by an Alaska Registered Professional Engineer approved by the Authority Having Jurisdiction, at no additional cost.
6. Where interpretation is required, the Contracting Agency will provide direction and will be the sole judge in cases of compliance with this subsection.

1.10 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Verify products are new and delivered in original factory packaging/crating and are free from damage and corrosion.

2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.
3. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction area until installed.
2. Store products in original factory packaging until actual installation.
3. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
4. Replace damaged items with same item in new condition.

1.11 WARRANTY

- A. See Division 1 for general warranty requirements.
- B. Warranty workmanship, labor, and materials for a period of one year from the date of final acceptance, without limitation, except where longer warranty periods are specified in a specific Section under this Division, or in the General Conditions of the Contract. Promptly coordinate and perform Warranty work at the Contractor's sole expense.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
  1. Cover and protect open ends and individual components of the ventilation and piping systems during construction when dust, dirt, debris, overspray, or other potential construction contaminants could enter the air distribution system or elements (ducts, fans, VAV boxes, silencers, etc.).
  2. Provide temporary construction filters over return airshaft openings and at air handling unit return air dampers.
- B. Demolition/Removal:
  1. Examination:
    - a. Drawings involving existing conditions are based on building record drawings and limited field observation.
    - b. Conduct a site inspection prior to submission of Bid to become thoroughly familiar with the Scope of Work.
    - c. Report discrepancies to the Contracting Agency before disturbing existing installation.

- d. Verify field measurements, locations, sizes, and routing arrangements and site conditions.
  - e. Commencement of demolition implies Contractor accepts existing conditions.
2. Preparation:
- a. This facility will remain occupied during construction. Coordinate with the Contracting Agency in advance before scheduling disruption of services.
  - b. Accommodate the Contracting Agency's normal business schedule to the maximum extent possible.
  - c. Provide temporary mechanical systems to maintain existing systems in service during construction. Submit plan for providing temporary services for approval.
  - d. Cover and protect open ends and individual components of the ventilation and piping systems during construction when dust, dirt, debris, overspray, or other potential construction contaminants could enter the air distribution system or elements (ducts, fans, VAV boxes, silencers, etc.).
  - e. Provide temporary construction filters over return air openings and at air handling unit return air dampers.
  - f. When work must be performed on operating equipment or systems, use personnel experienced in the operation of the specific equipment affected.
  - g. Submit work plan and schedule for approval prior to beginning work.
  - h. Notify the Contracting Agency and the Fire Department Agencies at least 24 hours before partially or completely disabling Fire Suppression, Alarm, or Notification Systems.
3. Execution:
- a. Remove, relocate, and extend existing installations to accommodate new construction as shown and as required for phasing or final systems operations.
  - b. Disconnect and remove abandoned fixtures, terminal units and other products. Remove abandoned controls and associated wiring to source of signal and supply.
  - c. Remove abandoned piping and ductwork back to source of supply or other point as shown, and cap tight to accept normal system test pressures.
  - d. Remove exposed abandoned or indicated for demolition controls, equipment, pipes and ducts, including abandoned items above ceiling finishes. Cut concealed pipes and ducts flush with walls and floors. Remove brackets, stems, hangers and other accessories. Fill and repair surfaces to match surrounding finish work.
  - e. Repair damaged surfaces, insulation, ceiling tiles, and fireproofing. Plug, patch, repair holes, and surfaces. Repair assemblies to match existing fire, temperature, and/or smoke ratings. Refinish surface to match surrounding finish work.
  - f. Seal room penetrations to maintain pressure relationships to adjacent spaces.

- g. Maintain access to existing mechanical and electrical installations that remain active. Modify installation or provide access panels as appropriate; coordinate with the Contracting Agency.
- h. Turn salvaged items over to the Contracting Agency as noted on the Drawings. Dispose of items that the Contracting Agency does not desire to retain at a legal disposal site.
- i. Recover refrigerant charge from existing units to be demolished in accordance with EPA section 608 of the Clean Air Act of 1990. Remove recovered refrigerant from the premises.

### 3.2 INSTALLATION

#### A. Special Techniques:

- 1. Provide temporary heating to maintain the building at 65 degrees F.

#### B. Interface with Other Work:

##### 1. Electrical Work:

- a. Coordinate with Division 26.
- b. See also specification section 20 0513 - Common Motor Requirements.
- c. Suggested Coordination Schedule: The Contractor is responsible to provide heating, ventilating, and plumbing equipment motors and controls, including fire suppression controls. Unless otherwise indicated on the Drawings, it is recommended that motors and controls be furnished, set in place, and wired in accordance with the following schedule. "CC" applies to either a Control subcontractor working as a sub to the General Contractor or to the Divisions 20, 21, 22, 23, 25 Mechanical subcontractor. Coordinate work between subcontractors.

MC - Divisions 20, 21, 22, 23, 25-Mechanical CC - Divisions 20, 21, 22, 23, 25-Controls EC - Divisions 26, 27 and 28-Electrical	Furnished By	Set in Place By	Power By	Control By
Equipment Motors	MC	MC	EC	CC
*Magnetic motor starters:				
Automatic controlled, w/ or w/o HOA switches	EC	EC	EC	CC
Automatic controlled, w/ or w/o HOA switches, and that are furnished as part of factory wired equipment	MC	MC	EC	MC
*Manual Motor Starters:				
Manually controlled	EC	EC	EC	EC
Manually controlled, and that are furnished as part of factory wired equipment	MC	MC	EC	MC

MC - Divisions 20, 21, 22, 23, 25-Mechanical CC - Divisions 20, 21, 22, 23, 25-Controls EC - Divisions 26, 27 and 28-Electrical	Furnished By	Set in Place By	Power By	Control By
Combination disconnect and motor starter	EC	EC	EC	CC
Motor Control Centers	EC	EC	EC	CC
Variable Speed Drives	MC	EC	EC	CC
Push-button stations, pilot lights, contactors, multi-speed switches	EC	EC	EC	EC
Disconnect switches, thermal overload switches, manual operating switches	EC	EC	EC	--
Multi-speed switches furnished as part of factory wired equipment	MC	MC	EC	MC
Temperature control relays, transformers, electric thermostats, time clocks, etc., that are not part of factory furnished equipment	CC	CC	CC	CC
Remote bulb thermostats, motor valves, controls, which are an integral part of factory furnished mechanical equipment.	MC	MC	EC	MC
Fire sprinkler suppression controls	MC	MC	EC	MC
Duct smoke detectors, including relays for fan shutdown	MC	MC	EC	EC
Fire/Smoke Dampers	MC	MC	EC	EC
Control Systems	CC	CC	CC	CC
Damper & Valve Actuators (120 v)	CC	CC	EC	CC
Damper & Valve Actuators (24 v)	CC	CC	CC	CC
Master Building Power quality monitors (loss/reversal)	EC	EC	EC	CC
Boiler and water heater controls, boiler burner control panels, internally wired	MC	MC	EC	MC
Electric Generator(s)				
Genset(s)	EC	EC	EC	EC
Fuel Lines	MC	MC	--	--
Day Tank (if separately furnished)	MC	MC	EC	MC
Silencer	EC	MC		

\* Provide starters in accordance with the Electrical Division of these Specifications. Note that a thermal overload relay in each phase is required for each starter (packaged equipment included)

### 3.3 REPAIR/RESTORATION

- A. Touch-up, repair or replace product components broken during installation or startup with new replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.
- C. Clean and repair existing identification tags/labels, hangers, supports, insulation, materials, instrumentation, and equipment that remain or are to be reused or are affected by this work. Materials and equipment which require major repair may be replaced at the Contractor's option.
- D. Plug, patch and repair surfaces, adjacent construction, and finishes damaged during demolition and new work. Restore to original condition or better including fire, smoke or temperature ratings or listings. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish. Replace cracked or damaged ceiling tiles. Repair fire proofing, assembly fire ratings, and construction resistant to the passage of smoke.

### 3.4 SITE QUALITY CONTROL

#### A. Site Tests and Inspections:

- 1. The Contracting Agency may inspect and approve sample installation of systems and equipment prior to general installation of units.
- 2. Schedule, obtain, and pay for fees and/or services required by the local Authorities Having Jurisdiction and by these specifications, to test the mechanical systems.
- 3. Notify the Contracting Agency a minimum of 24 hours in advance of tests. Certify in writing that specified tests have been made in accordance with the specifications.
- 4. Immediately correct deficiencies that are discovered during the tests and repeat tests until system is approved. Do not cover or conceal piping, equipment or other portions of the mechanical installations until satisfactory tests are made and approved.
- 5. Under the direction of the Contractor and in the presence of the Contracting Agency, place the entire mechanical installation and/or any portion thereof in operation to demonstrate satisfactory operation.
- 6. Arrange for the Contracting Agency to witness tests. The Contracting Agency may waive witnessing any specific test at its discretion.

#### B. Non-Conforming Work:

- 1. Expediently remove and provide new for work not conforming to the Project Manual upon discovery; including warranty and discovery periods.
- 2. Warranty period shall start over for replaced equipment and installation from the date of accepted by the Contracting Agency.

#### C. Manufacturer Services:

1. Authorized manufacturer's representative shall be on-site for testing, start-up, functional check-out, and commissioning of equipment and systems.
2. Procurement, installation, start-up, and warranty services to be provided by manufacturer's authorized representative and service company.
3. Equipment, devices, hardware, and software to be approved for application, and of current production. Original manufacturer's parts, hardware, software, and support to be available for ten years after installation.

### 3.5 CLEANING

- A. Upon completion of installation and prior to initial operation, remove debris, and clean and wipe down equipment, piping, ductwork and floor to eliminate dust and dirt.

### 3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Provide demonstration, conducted by authorized factory start-up personnel, to the Contracting Agencies authorized personnel as listed in each individual specification section.

END OF SECTION 20 0000

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## SECTION 20 0513

## COMMON MOTOR REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: This section describes general requirements, products and methods of execution relating to electric motors in general and shall apply to motors furnished as integral parts of equipment specified in this and other Divisions.
- B. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 23 2123 - Hydronic Pumps
  - 3. 25 4000 - Variable Speed Drives

## 1.2 REFERENCES

- A. Codes and Standards: National Electrical Manufacturers Association, NEMA, Standards Publication Motors and Generators, MG-1.

## 1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide product performance characteristics as specified or scheduled on drawings.

## 1.4 PREINSTALLATION MEETINGS

- A. Coordinate installation of electrical motors with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

## 1.5 SUBMITTALS

- A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:

1. Provide a tabular listing of motors including the following information: Tag (from drawings), location, function, actual nameplate FLA, fuse size used, overload relay used, and overload setting.
2. Make copy of list available during Substantial Completion observation by the Contracting Agency. Include list in Operations and Maintenance Manuals.

#### 1.6 QUALITY ASSURANCE

- A. Qualifications:
  1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum 3 years' experience.
- B. Certifications: Motors shall conform to governing NEMA Standards and ASA Form C-50 for rotating machinery.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements:
  1. Verify motors are new and delivered in original product/factory packaging/crating and are free from damage and corrosion.
  2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.
- B. Storage and Handling Requirements:
  1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
  2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
  3. Replace damaged items with same item in new condition.

#### 1.8 WARRANTY

- A. Manufacturer Warranty: See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

### PART 2 - PRODUCTS

#### 2.1 MOTORS IN ELECTRICAL CLASSIFIED LOCATIONS

- A. Motors used in environments indicated to be NEC Class I, Division I shall be built and labeled as explosion-proof for the Group and autoignition temperature, NEC T-code.
- B. Motors used in environments indicated to be NEC Class I, Division II:
  1. Listed for Class I Division I environments.

2. Listed for Class I Division II environments.
3. Does not have arc-producing brushes or switching mechanisms which could act as ignition sources.
4. Motors that include a space heater, its surface temperature may not exceed 80% of the autoignition temperature of the hazard.

## 2.2 SUPPLY VOLTAGE

- A. Supply voltage shall be determined from the electrical plans where nominal utility voltage will be indicated.
- B. Motor voltage shall be stamped on the nameplate and relate to the nominal voltage as follows:

THREE PHASE MOTORS	
Nominal Volts	Motor Ratings
208 volts	200V, 208V, or 208/220V
240 volts	220V or 208/220V
480 volts	460V
SINGLE PHASE MOTORS	
Nominal Volts	Motor Ratings
120 volts	115V or 115/230V
240 volts	230V or 115/230V
208 volts	200V or 208V

Note: Provide nameplate indicating that voltage for a motor operating at 208 VAC is suitable.

- C. Voltage variation: Motors shall be designed to operate within the parameters of these requirements at rated load and with a voltage variation from the name plate voltage of plus or minus ten percent.
- D. Motors shall operate successfully at rated load and at rated voltage with a maximum frequency variation of five percent above or below rated frequency.
- E. Motors shall operate successfully at rated load with a combined maximum variation in the voltage and frequency of five percent above or below rated voltage and rated frequency.
- F. Motors that operate with Variable Speed Drive (VSD) controllers shall be suitable for the application.
  1. Motors operated using PWM type VSDS: Conform to NEMA MG 1 Part 31 requirements.

2. Motors operated using six-step type VSDS: Conform to NEMA MG 1 Part 30 or Part 31 requirements.

### 2.3 LOCKED ROTOR CURRENT

- A. No motor above 15 HP shall have a locked rotor current in excess of NEMA code letter "G". Smaller motors may have a higher locked rotor rating, but in no case exceeding the recommended NEMA rating as related to motor size.

### 2.4 MOTOR INSULATION

- A. Unless otherwise specified, motor insulation shall be NEMA Class "B" (or better). Based on 40 degrees C. maximum ambient, and 90 degrees C. maximum rise, total maximum operating temperature shall not exceed 130 degrees C.

### 2.5 MOTOR LOADING

- A. No motors shall be subjected to loads exceeding the motor nameplate rating, under any normal operating condition.

### 2.6 MOTOR RATING

- A. Motors are sized in conformity with the manufacturer's published information and shall not be interpreted as the final requirement. Check each motor for adequacy in relation to the specific application.
- B. Motors indicated as being connected to variable speed drives (VSD) shall be rated for VSD service.

### 2.7 HIGH EFFICIENCY AC MOTORS

- A. Furnished high efficiency electric motors for equipment that:
  1. Require a three horsepower or larger drive motor.
  2. Have duty cycles classified as continuous.
- B. Efficiency of the motors shall be determined by NEMA Standard MG 1 - 12.536 and shall have efficiencies equal to or better than:

Motor Size	Nominal Efficiency
Through 3 HP	89 percent
Over 3 HP through 10 HP	91 percent
Over 10 HP through 30 HP	93 percent
Over 30 HP through 60 HP	94 percent

Motor Size	Nominal Efficiency
Over 60 HP through 100 HP	95 percent
Over 100 HP	95 percent

## 2.8 MOTOR HOUSING FEATURES

- A. Open drip-proof, totally enclosed fan cooled (TEFC), or explosion-proof, as appropriate for the use intended and the environment where installed, or as noted. Provide totally enclosed fan cooled motors for equipment below grade, located outdoors, or operating in damp or dust-laden locations. Provide a continuous moisture drain that is screened against insect entry for totally enclosed motors.
- B. Oversized external conduit boxes at least one size larger than NEMA standard.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions: Cover motors to protect them from construction dirt and debris.

### 3.2 INSTALLATION

- A. Special Techniques:
  - 1. Installation of motors shall be as required by the driven equipment. Make sure motor design and characteristics are suitable for the application.
  - 2. Electrical connections for motors shall conform to NEC Articles 430 and 440 as applicable, and to any state and local code having jurisdiction.
  - 3. Unless furnished as part of a complete package including disconnects and control, and/or motor fuse protection, protect motors by Bussmann Fusetron Dual-Element Time Delay fuses, or approved equal.
  - 4. Megger motor windings prior to starting. Include log of megger readings in the Operations and Maintenance manuals.
  - 5. Verify correct rotation of motors.
  - 6. Comply with Article 460 of the National Electrical Code for installation of power factor correction capacitors.
  - 7. Motor sizes shown on the Drawings are estimates based upon the mechanical design. Where motors actually furnished are of a different size than those shown, motor circuit components (starters, disconnects, overcurrent devices, and conductors) shall be revised to suit the motors actually furnished, without increase in the Contract amount. Similarly, motor overcurrent device sizes shown on the Drawings or specified are based upon estimated motor code letters, overcurrent device manufacturers' recommendations, and full-load currents from the NEC Tables. Where the motors actually furnished require different sizing, the sizes of

the overcurrent devices shall be adjusted to conform to the NEC, without increase in the Contract amount.

### 3.3 REPAIR/RESTORATION

- A. Repair any components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

END OF SECTION 20 0513

## SECTION 20 0529

## MECHANICAL HANGERS AND SUPPORTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Hanger and support requirements for building service piping and mechanical equipment including vibration isolation, seismic and wind restraint.
  - 2. Penetrations, sleeves and seals.
  - 3. Performance based seismic restraint requirements for larger mechanical equipment.
- B. Related Sections:
  - 03 3053 – Miscellaneous Cast-In-Place-Concrete
  - 09 9123 – Interior Painting
  - 20 0000 - Mechanical General Requirements
  - 20 0700 - Mechanical Insulation
  - 22 1100 - Domestic Water Piping and Specialties
  - 22 1300 - Sanitary Waste and Vent Piping and Specialties
  - 23 1123 - Fuel Gas Piping and Specialties
  - 23 2113 - Hydronic Piping and Specialties
  - 23 2123 - Hydronic Pumps
  - 23 3100 - Ducts and Accessories
  - 23 3600 - Air Terminal Units
  - 23 5216 - Condensing Boilers and Accessories
  - 25 4000 - Variable Speed Drives
  - 25 5000 - Building Automation System

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. International Building Code (IBC).
  - 2. International Mechanical Code (IMC).
  - 3. Uniform Plumbing Code (UPC).
  - 4. MSS SP58-2009 - Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
  - 5. SMACNA HVAC Duct Construction Standards - Metal and Flexible (current edition).
  - 6. ASCE 7–16 Minimum Design Loads for Buildings and Other Structures.

### 1.3 DESCRIPTION

- A. This section applies to Divisions 20, 22, 23, and 25 equipment and systems:
1. Support fire suppression system piping and equipment in accordance with NFPA 13.
  2. Support plumbing piping in accordance with this section and Uniform Plumbing Code requirements as applicable; whichever is more restrictive. In case of conflicts, follow UPC guidance.
  3. Support ductwork in accordance with Section 23 3100 - Ducts and Accessories.
  4. Provide seismic support for mechanical equipment weighing more than 400 pounds
- B. Design Requirements:
1. Equipment and piping system support:
    - a. Select and apply pipe hangers and supports per MSS SP58 using stock or production parts whenever possible.
    - b. Design support spacing such that free span of piping does not exceed Code or MSS SP58 criteria (whichever is most restrictive).
    - c. Calculate required supporting force at each hanger location to confirm hanger type and hanger rod diameter selection.
    - d. Provide hangers such that equipment connection points do not carry connected piping load.
  2. Vibration and seismic restraint systems:
    - a. Provide design to anchor, brace, and support the facility's non-structural elements to the building's structure to include mechanical and electrical equipment, system piping, and electrical raceways.
    - b. Provide vibration isolation of rotating equipment in accordance with equipment manufacturer's written installation instructions to limit vibration transmission to supporting structures.
  3. Building Design Criteria:
    - a. Wind design data: See Structural Drawing.
    - b. Seismic design data: See Structural Drawing.
    - c. Component Importance Factors,  $I_p$ 
      - 1). Fire suppression systems:  $I_p = 1.5$
      - 2). Fuel gas system:  $I_p = 1..5$
      - 3). Piping Importance Factor:  $I_p = 1.0$
      - 4). All other components:  $I_p = 1.0$
- C. General Performance Requirements:
1. Provide hangers and supports that allow for the free expansion and contraction of system piping without transferring tensile and compressive stresses to adjacent supports or connected equipment. Coordinate hanger and support anchor locations and embedment depth requirements with structural.
  2. Systems shown as semi-diagrammatic. Provide additional expansion loops, pipe anchors and pipe guide assemblies as required to support installed systems.
  3. Special Performance Requirements for Open Ceiling Spaces:
    - a. Coordinate the support of piping, ductwork, lighting and electrical cabling in open ceiling spaces (utilizing the shop drawing review process) to provide a uniform and symmetrical appearance.
    - b. In general, utilize trapeze hanger style support systems with hangers equally spaced based on the limiting component being supported. Provide hanger



rods vertical and straight. Trim hanger rod ends to provide a "finished" appearance.

- D. Additional Seismic/Wind Load Performance Requirements:
1. Design seismic and/or windload restraint devices for non-structural mechanical and electrical equipment and building systems including pad-mounted equipment located within and exterior to the building as required by the Authority Having Jurisdiction.
  2. Submit seismic calculations for review and approval, which confirm the seismic support design for equipment and building systems requiring seismic restraint.
  3. Equipment with factory mounted internal vibration and seismic restraint devices shall meet the vibration and seismic control requirements of this section.

#### 1.4 SUBMITTALS

- A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
1. Provide manufacturers catalog data, including load capacity, embedment depth.
  2. Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.
- C. Shop Drawings:
1. Provide shop drawings for housekeeping pads and roof curbs (with dimensioned penetrations) and field fabricated support systems.
  2. Provide shop drawings to show system layout with location and detail of hangers, anchors, dimensioned expansion loops and guides.
- D. Seismic/Wind Load Calculations
1. Submit sealed structural engineering calculations, drawings, and details to support the product restraint selection and installation configuration for each seismic / wind load restraint application.
  2. Coordination and approval of non-structural element attachment techniques and design loads with the project's structural design Engineer of Record.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Record Documentation:
1. Indicate installed locations of hangers, supports and expansion control assemblies on record drawings on associated piping record drawings.
  2. Provide Operating and Maintenance Data (installation and adjustment instructions) for non-commodity products.

## 1.6 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
  - 2. Installers: Minimum 3 years' experience.
  - 3. Provide piping and support systems designed and manufactured per MSS SP58.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Section 20 0000 - Mechanical General Requirements, for general delivery, storage and handling requirements.

## 1.8 WARRANTY

- A. Manufacturer Warranty: See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

# PART 2 - PRODUCTS

## 2.1 PIPE HANGERS AND SUPPORTS

- A. General:
  - 1. Piping and support systems material: Malleable iron, steel or copper.
  - 2. Hot dipped galvanized ferrous hangers and supports installed outdoors or in unheated spaces.
  - 3. Select and apply pipe hangers and supports per MSS SP58.
    - a. Use stock or production parts whenever possible.
    - b. Calculate weight balance to determine the required supporting force at each hanger location and to eliminate pipe weight load at each equipment connection.
  - 4. Fabricate and install pipe hangers and supports per MSS SP58 recommended practices.
  - 5. Hangers shall be designed to securely lock using a mechanical fastener. Hangers and supports using gravity type locking are not acceptable. For example, adjustable swivel ring Type 6 is not allowed.
  - 6. Pre-engineered support systems such as Unistrut, Super-Strut, B-Line and K-Line may be used in accordance with manufacturers load limits.
  - 7. Manufacturers: Grinnell, M-CO Michigan Hanger Company, Kin Line.
- B. Plumbing and Hydronic Piping:
  - 1. Plumbing Piping: Conform to the Uniform Plumbing Code requirements.
  - 2. Hydronic Piping: Conform to ASME B31.9 and the International Mechanical Code.
  - 3. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Adjustable swivel ring; split ring.
  - 4. Hangers for DWV and Cold Pipe Sizes two inch and over: Carbon steel, adjustable, clevis.
  - 5. Hangers for Hot Pipe sizes two to four inch: Carbon steel, adjustable, clevis.

6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  7. Wall Supports: Welded steel bracket and wrought steel clamp.
  8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
  9. Floor Support for Hot Pipe Sizes up to four inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
  10. Vertical Support: Steel riser clamp.
  11. Provide copper plated hangers and supports for copper piping. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  12. Preinsulated pipe hanger inserts to permit continuous insulation at the pipe hangers: Armafix model IPPH or equal.
- C. Refrigerant Piping:
1. Conform to ASME B31.5.
  2. Hangers for pipe sizes 1/2 to 1-1/2 inch: Adjustable swivel ring, split ring.
  3. Hangers for pipe sizes two inches and over: Carbon steel, adjustable, clevis.
  4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  5. Wall Support: Welded steel bracket and wrought steel clamp.
  6. Vertical Support: Steel riser clamp.
  7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
  8. Provide copper plated hangers and supports for copper piping. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

## 2.2 ACCESSORIES

- A. Hanger Rods: Mild steel, threaded both ends, threaded one end, or continuous threaded.
- B. Escutcheons: Nickel or chrome plate with screws or springs for holding plate in position.
- C. Pipe Protection Saddles: Shop fabricates, or purchase specially manufactured saddles specifically designed for the intended use. Provide saddles where roller type support is used, or where the pipe hanger is installed outside the insulation for protection of insulating jacket.
- D. Outdoor applications: Metal components shall be galvanized.

## 2.3 INSERTS

- A. Provide inserts to match the load bearing capacity of hangers scheduled in Part 3.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four inches.
- C. Concrete deck inserts: Galvanized rod, steel plate, similar to Kin-Line figure 293.
- D. Screw insert for concrete: Malleable iron similar to Grinnell figure 152.

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2.4 PRE-ENGINEERED SUPPORT SYSTEMS

- A. Manufacturers:
  - 1. Unistrut.
  - 2. Super-Strut.
  - 3. B-Line.
  - 4. K-Line.
  - 5. Erico.
- B. Materials:
  - 1. Cold worked steel.
  - 2. Type 304 stainless steel: Use for PVC, liquid-tight flex, or plastic-coated conduit installed to wood construction in outdoor, damp, corrosive or marine environments.
- C. Finish:
  - 1. Heated indoor areas: Pre-galvanized zinc coating.
  - 2. Outdoor areas: Hot dipped galvanized finish. In addition, coat hot dipped galvanized finish channel field cuts with zinc rich paint provide by the support system manufacturer.
  - 3. Painted areas: Paintable galvanizing or phosphatized and primed.
  - 4. Surface metal raceways: U.L. Listed epoxy coating.
- D. Channel:
  - 1. Standard Size: 1-5/8 inch x 1-5/8 inch. Gauge thickness as required for attached load.
  - 2. Standard Hole Pattern: Slotted. Provide solid channel in exposed public areas.
- E. Nuts and Hardware:
  - 1. Channel nuts: Hardened steel (ASTM-A675 and ASTM A36).
  - 2. Bolts, screws and nuts: Hardened steel (ASTM-A307, ASTM A563 and SAE J429).
  - 3. Finish: Electroplated zinc.
- F. Fittings: Plate steel (ASTM A635). Epoxy or electroplated zinc coating.
- G. Mechanical Accessories: Provide accessories from the support system manufacturer designed for the specific equipment to be supported to include but not limited to:
  - 1. Preinsulated pipe hanger inserts to permit continuous insulation at the pipe clamps: Unistrut model PUX, Armafix model IPPH.
  - 2. Splice and gusset plates.
  - 3. Corner angles.
  - 4. Specialized support brackets.
  - 5. Beam clamps with restraints.
  - 6. Column supports.
  - 7. Strut pipe clamps.
  - 8. Straps.
  - 9. Brackets.

## 2.5 EQUIPMENT ROOF CURBS

- A. For roof mounted equipment (i.e. relief hoods and exhaust fans), provide pre-manufactured insulated roof curbs from the same manufacturer as the equipment being mounted. See applicable specification sections.

## 2.6 SEISMIC RESTRAINT SYSTEMS

- A. Approved Manufacturers
  - 1. Amber Booth
  - 2. Vibro-Acoustics.
  - 3. International Seismic Application Technology (ISAT).
  - 4. Mason Industries
  - 5. Approved equal.
- B. Provide structurally engineered equipment and building system seismic restraints in accordance with approved product manufacturers written installation instructions and seismic restraint manufacturer's product application and design recommendations.

## 2.7 SLEEVES, ACOUSTICAL SEALS AND FIRE-STOPPING

- A. Fabricate sleeves in non-load bearing walls from 20 gauge galvanized sheet steel conforming to ASTM A924 / A924M.
- B. Fabricate sleeves in load-bearing walls from standard-weight galvanized steel pipe conforming to ASTM A53 / A53M.
- C. Provide UL listed prefabricated fire rated sleeves and seals for pipes through fire rated and fire resistive floors and walls.

## 2.8 FRAMED OPENINGS

- A. Provide structural steel members for framed openings conforming to ASTM A36 / A36M.
- B. Closure Collars:
  - 1. For round and rectangular ducts with a minimum dimension less than 16 inches, fabricate collars from 20 gauge galvanized steel.
  - 2. For round and rectangular ducts with a minimum dimension of 16 inches or greater, fabricate collars from 18 gauge galvanized steel.

## 2.9 WALL PENETRATION WATER SEALS

- A. Mechanical seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
- B. EPDM seals.

- C. Type 316 stainless steel bolts and nuts.
- D. Hot-dipped galvanized or coated sleeve with full water stop flange with continuous weld on both sides.
- E. Manufacturer: Metraflex, Thunderline, Crouse-Hinds, or approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Visually inspect each location that will receive equipment and systems requiring vibration, thermal compensation, seismic control and/or wind load bracing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement, pre-placed anchors, and cast-in-place anchors to verify actual locations before installation.
- C. Project includes cast in place radiant floor heating tubing. Coordinate slab penetration locations to not damage tubing.
- D. Correct deficiencies prior to the installation.

### 3.2 PREPARATION

- A. Prior to installation, prepare detailed shop drawings of the planned installation of hanger and support products specified by this section. Coordinate the location, type and size of hangers and supports, housekeeping pads (thickness/perimeter overhang dimensions) and roof curbs with Architectural and Structural elements utilizing the shop drawing review process.
- B. Submit shop drawings required by this section coordinated with the seismic design.
- C. Do not install hangers and supports without approved shop drawings.
- D. Protection of In-Place Conditions: Caution - Project contains cast in place radiant floor heating tubing. Coordinate slab penetration locations so as not to damage tubing.

### 3.3 INSTALLATION

- A. Attachment
  - 1. Hollow masonry: Toggle bolts.
  - 2. Solid masonry and concrete: Preset inserts or expansion bolts.
  - 3. Structural steel: Beam clamps which engage both sides of structural member or have retaining clips or other approved means for positive engagement.
  - 4. Metal surfaces: Machine screws, bolts or welding.
  - 5. Wood construction: Wood or sheet metal screws.

6. Do not use powder-actuated fasteners for anchorage in tension applications. Obtain written permission from the Owner prior to using any type of powder powered studs.
  7. Plastic screw inserts and caulked lead inserts are prohibited, except for mounting instructions and control diagrams.
- B. Pipe Hangers and Supports
1. Install hangers and supports in accordance with manufacturer's instructions, applicable Code requirements and approved shop drawings.
  2. Support horizontal piping as scheduled.
  3. Independently support piping at equipment, such that the equipment supports no weight.
  4. Insulated piping: Provide insulation saddles or 18 gauge steel insulation shields combined with sections of calcium silicate or cellular glass or provide preinsulated pipe hanger inserts to permit continuous insulation at the pipe hangers or clamps
    - a. Support cold piping outside the insulation and vapor barrier where continuous vapor barrier is specified:
    - b. Subject to approval, hot piping may be insulated around the supports.
  5. Provide trapeze hangers when more than three pipes run parallel and at same elevation.
  6. Provide rollers supports for hot pipes. Provide saddles where roller type support is used, or where the pipe hanger is installed outside insulation for protection of insulating jacket.
  7. Design rods and cross members to support three times the weight of pipes and contents plus 250 pounds.
  8. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
  9. Place hangers within 12 inches of each horizontal elbow.
  10. Use hangers with 1-1/2 inch minimum vertical adjustment.
  11. Support horizontal cast iron pipe adjacent to each hub, with five feet maximum spacing between hangers.
  12. Support riser piping independently of connected horizontal piping.
- C. Piping Requiring Vibration Isolation:
1. Support main risers less than 20 feet in height only at mid level, with riser guides at other levels.
  2. Do not support vibration isolated piping along with non-isolated piping on a common trapeze.
  3. Rigidly mount steel spring hanger boxes to the supporting structure. Do not locate in the middle of the hanger rod.
  4. Rigid pipe anchors are not permitted in vibration isolated piping circuits.
- D. Equipment Bases and Supports
1. For cast-in-place concrete requirements refer to Division 3 - Concrete,
  2. Provide minimum 3-1/2 inch (2x4 form) concrete housekeeping pads for floor mounted air handling units, condensing boilers and water heaters. Coordinate perimeter overhang dimensional requirements (12 inches typical) with seismic anchoring requirements to achieve proper anchor embedment.
  3. Construct field fabricated equipment bases and supports from steel members and/or pre-engineered support systems. Prime and paint bases and supports black in accordance with Division 9 - Finishes. Pre-engineered support systems which are factory coated are not required to be painted.



- E. Roof Curbs:
1. Coordinate with Architectural and provide roof curb locations and dimensional and support requirements for roof mounted equipment.
  2. Pre-engineered roof curbs are specified with the equipment being mounted. See applicable specification sections.
- F. Penetrations:
1. Coordinate mechanical penetrations with architectural and structural construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
  2. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
  3. Provide penetrations through roof, exterior walls and floors (See floor penetration seals) to be weather and water tight.
  4. Provide UL rated fire-stopping assemblies for rated roof, wall and floor penetrations in accordance with Division 7.
  5. Seal penetrations through smoke partitions and barriers to resist passage of smoke.
    - a. Sleeves:
      - 1). Provide sleeves for pipe and round ducts less than 16 inches diameter passing through floors, walls, ceilings, or roofs.
      - 2). Provide 1 inch clearance between the pipe/duct and sleeve opening. Oversize sleeves for cold piping to allow continuous insulation through sleeve.
    - b. Framed Openings:
      - 1). Provide framed openings for round ducts 16 inch diameter and greater and rectangular ductwork passing through floors, walls, ceilings, or roofs.
      - 2). Provide 1 inch clearance between the duct and framed opening.
      - 3). Provide closure collars not less than 4 inches wide on each side of penetration.
    - c. Escutcheons:
      - 1). Provide escutcheons for piping and conduit passing through walls, floors and ceilings in finished areas, below counters and inside closets and casework subject to view when doors are open. Size escutcheons to cover sleeves. Secure escutcheons in position.
    - d. Wall Penetration Seals:
      - 1). Provide pre-engineered wall penetration water seal systems for exterior wall penetrations.
      - 2). Select appropriate wall penetration sealing systems based on pipe/conduit material and nominal pipe/conduit size in accordance with the manufacturer's selection charts.
      - 3). Install piping/conduit and sealing system prior to waterproofing the wall. Grout void between water seal and outside face of foundation wall to provide continuous bearing surface for waterproofing fabric.
    - e. Floor Penetration Seals:
      - 1). Provide water-tight sleeves at floor penetrations and extend sleeves above finished floor as specified. Sleeves may terminate flush with top of pad where sleeves installed thru concrete equipment/housekeeping pads. Grout and seal sleeves to floor and seal annulus between pipe and sleeve for watertight assembly.
      - 2). Floor penetrations to include but not limited to: Building service piping, conduit, ductwork and building automation system wiring.



- 3). Extend floor penetration sleeves 2 inches above finished floor.
  6. Roof Flashing: Provide roof penetration flashing in accordance with Division 07, as an integral part of the roofing system.
- G. Vibration, Seismic and Wind Restraint
1. Install vibration isolators, seismic control, and wind restraint systems in compliance with the manufacturer's written instructions, and certified and approved application engineering installation details.
  2. Install vibration isolators, seismic control, and wind restraints so as not to stress or misalign equipment, piping, raceways, and ductwork.
  3. Provide flexible connections for conduit, ducts, and piping for vibration isolated equipment.
  4. Coordination installation to not degrade acoustical penetrations and vibration controls for ducts, pipes, and raceways.
  5. Do not install rigid connections between isolated equipment and building structure that degrades the noise and/or vibration controls.
  6. Submit equipment loads for pre-approval by the project Structural Engineer prior to equipment installation to avoid overstressing of the building structure. Coordinate seismic restraints with project Structural Engineer and incorporate requirements.
  7. Seismic restraint systems shall not interfere with installation or maintenance access to other building systems.
  8. Provide general bracing from structural beam flanges, upper truss cords in bar joist construction, cast in place inserts, or wedge type drill-in concrete anchors.
  9. Restraining straps or J-bolts shall be used as secondary restraint on beam clamps that support dead loads. Beam claps lacking secondary restraint features shall not be used.
  10. Install seismic cable assemblies taut on non-vibration isolated systems and with a slight amount of slack for vibration isolated systems to avoid short circuiting of isolated equipment and piping.
  11. Seismic single arm braces may be used in place of cables on rigidly attached systems and in place of cables on isolated systems when resilient bushings are used.

### 3.4 INTERFACE WITH OTHER WORK

- A. Coordinate and sequence installation of hangers and supports with trades responsible for portions of this and other related sections of the Project Manual.

### 3.5 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

**3.6 SITE QUALITY CONTROL**

- A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

**3.7 CLEANING**

- A. Waste Management: After construction is completed, clean and wipe down exposed surfaces.

**3.8 ATTACHMENTS**

- A. Pipe Support Table: Provide pipe support spacing as indicated in the table below except where spacing more restrictive by Code.

PIPE SIZE (Inches)	HANGER SPACING MAX (Feet )			
	Steel		Copper	Polyethylene (1)
	Water Filled	Gas Filled		
1/2	7	9	5	
3/4	7	9	5	
1	7	9	6	
1-1/4	7	9	7	
1-1/2	9	12	8	4
2	10	13	8	4-1/2
2-1/2	11	14	9	
3	12	15	10	5
4	14	17	12	6
6	17	21	14	

Based on Table 3, MSS SP-69, except for PE piping

(1) Based on manufacturer's data

END OF SECTION 20 0529

## SECTION 20 0553

## MECHANICAL IDENTIFICATION

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section includes:

1. Equipment Nameplates.
2. Valve Tags.
3. Valve and Equipment Directories.
4. Pipe Identification.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 22 1100 - Domestic Water Piping and Specialties
3. 22 1300 - Sanitary Waste and Vent Piping and Specialties
4. 23 1123 - Fuel Gas Piping and Specialties
5. 23 2113 - Hydronic Piping and Specialties
6. 23 2115 - Well Water Cooling Piping and Specialties
7. 23 2123 - Hydronic Pumps
8. 23 3100 - Ducts and Accessories
9. 23 3600 - Air Terminal Units
10. 23 5216 - Condensing Boilers and Accessories
11. 25 4000 - Variable Speed Drives

## 1.2 REFERENCES

## A. Codes and Standards:

1. ANSI/ASME A13.1-2007 (American Society of Mechanical Engineers) - Scheme for the Identification of Piping Systems.
2. ANSI Z535.1-2006 (R2011) - Safety Color Code.

## 1.3 SYSTEM DESCRIPTION

## A. Design Requirements:

1. Provide equipment nameplates, valve tags and labels for the mechanical systems provided under this contract.

2. Provide labels for piping.

#### 1.4 SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
  1. Master Schedule of Equipment:
    - a. Submit master schedule of equipment, components, and systems that will be tagged and labeled for the project.
    - b. Include the proposed method of labeling to be implemented (nameplate, tag, label/marker, etc.), legend ("Domestic Cold Water," "PMP-1," etc.) and letter/background colors.
    - c. Match legend to Contract Document legend, abbreviations, and schedule symbols. Use standard mechanical identification products when available.
  2. Valve Directories: Submit separate proposed "Valve Directories" for each mechanical room that includes the valves located within the applicable space. Include valve designations, a brief description and normal position (open (NO), closed (NC), balanced to X GPM). For Example:

Valve Designator	Description	Normal Position
H-101	BLR-1 Supply Isolation	NO
H-102	BLR-1 Return Isolation	NO
H-103	BLR-1 Flow Balance	150 GPM
P-100	Domestic Water Service Isolation	NO
P-201	Supply Strainer Flush Valve	NC
ETC.		

#### PART 2 - PRODUCTS

##### 2.1 MANUFACTURERS

- A. Marking Services Incorporated (MSI).
- B. Seton Identification Products.
- C. Craftmark.
- D. Approved equal.

## 2.2 EQUIPMENT NAMEPLATES

### A. Plastic Engraved Equipment Nameplates:

1. Minimum letter height: 3/4 inch.
2. Tag size: Minimum 2 inches high, length to fit equipment tag lettering requirements. Provide uniform size for similar types of equipment.
3. Plastic thickness: 1/16 inch minimum.
4. Fastening method:
  - a. Mounting holes.
  - b. Adhesive backing may be provided for labeling equipment where drilling holes is not feasible, with the pre-approval of the Contracting Agency.
5. Color coding: As designated by the Contracting Agency. If specific direction is not provided, select white letters on black background.
6. Legend: As designated by the Contracting Agency. If specific direction not provided, match scheduled equipment symbols.

## 2.3 VALVE TAGS

### A. General:

1. Small equipment, such as in-line pumps may be identified with tags in lieu of nameplates if inadequate room is available.
2. Provide service indicator on top line of tag, using system abbreviations provided in Part 3 Pipe Identification Table.
3. Provide valve number on bottom line of tag. Start valve numbering with "001" for each legend series/service indicator. Assign valve numbers in a logical sequence from the source (i.e. service water entry point, gas meter service isolation) or heat source (boiler or water heater supply) and continue numbering outward to the most remote terminal connection point.

### B. Brass Stamped Tags:

1. Round, 1-1/2 inches diameter, brass with smooth edges.
2. Text stamped and filled black:
  - a. 1/4 inch service indicator on top.
  - b. 1/2 inch valve number below.
3. Beaded chain tag fasteners.

## 2.4 VALVE AND EQUIPMENT DIRECTORIES

### A. Equipment and Valve Directory Frame:

1. 8-1/2" x 11" aluminum frame with plastic lens.
2. Provide multiple frames as required.

## 2.5 PIPE IDENTIFICATION, MARKING

- A. Identify both service and flow direction.
- B. Colors and Lettering: Conform to ANSI/ASME A13.1; see tables under Article 3.2E below.
- C. Plastic Pipe Labels:
  - 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
  - 2. Larger sizes may have maximum sheet size with plastic nylon ties or straps.
- D. Plastic Tape Pipe Labels: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Degrease and clean surfaces to be painted or directly receive adhesive labels.
- B. Install identifying devices after completion of coverings and painting.

### 3.2 INSTALLATION

- A. Do not install identifying devices over factory installed equipment labels.
- B. Locate identifying devices in clear view for simple identification.
- C. Tag automatic controls, instruments, and relays. Key these to control system schematic drawings.
- D. Pipe Identification:
  - 1. Identify piping, concealed or exposed, using ANSI A13.1 compliant pipe labels. Identify both service and flow direction in accordance with the following table.

Abbreviation	Legend	Color (Letters/Background)
CW	Domestic Cold Water	White/Green
CWS	Cooling Water Supply	White/Green
CWR	Cooling Water Return	White/Green
HWS	Heating Water Supply	White/Green
HWR	Heating Water Return	White/Green
GHS	Glycol Heating Supply	White/Green

Abbreviation	Legend	Color (Letters/Background)
GHR	Glycol Heating Return	White/Green
NG	Natural Gas	Black/Yellow
W	Sanitary Drain	White/Green
V	Sanitary Vent	White/Green

2. Pipe label letters shall be a minimum of 1/2" high and increase with pipe diameter as follows:

Pipe Outside Diameter	Letter Height
0.75" to 1.25"	0.5"
1.5" to 2"	0.75"
2.5" to 6"	1.25"
8" to 10"	2.5"
over 10"	3.5"

3. Install labels in unobstructed view and aligned with horizontal or vertical axis of piping as appropriate. For piping located above the normal line of vision, place labels below the horizontal centerline of the pipe for clear unobstructed view from below.
4. Install labels not to exceed 20 foot intervals along straight piping runs (including risers and drops), close to valves, adjacent to changes in direction and branches, on each side of pipe penetrations through walls or floors, and at each access panel.

E. Pipe Painting:

1. Paint new and patched piping insulation exposed in utility areas and mechanical rooms white in accordance with Division 9 - Finishes.
2. Paint new and reworked bare steel piping exposed in utility areas and mechanical rooms black in accordance with Division 9 - Finishes.
3. Paint new and reworked bare steel piping exterior to the building gray in accordance with Division 9 - Finishes.
4. Do not paint non-ferrous piping/tubing, fittings or valves such as copper or bronze.

END OF SECTION 20 0553

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## SECTION 20 0556

## INTERIOR TRENCH EXCAVATION AND BACKFILL

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to excavation, back-fill, and compaction of inside trenches for mechanical work. Inside trenches are those which occur within an arbitrary, imaginary boundary five feet beyond the outside perimeter of the structure.
- B. Related Sections:
  - 1. 20 4100 - Mechanical Demolition
  - 2. 22 1100 - Domestic Water Piping and Specialties
  - 3. 22 1300 - Sanitary Waste and Vent Piping and Specialties

## 1.2 SYSTEM DESCRIPTION

- A. Provide trench work for mechanical work of every description and of whatever substance encountered to the depth indicated, or to provide pipe slopes and elevations shown on the Drawings. Excavate and backfill utility trenches. Place and compact bedding material. Compact backfill material.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

## 3.1 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material is not available from trench excavation, import it from sources approved by the Contracting Agency.
- B. Use granular material, free from large stones, boulders debris, and frozen material, and in accordance with the MASS specification. Maintain moisture content within a range that will allow specified compaction.

### 3.2 EXCAVATION

- A. Place excavated material suitable for back-fill in an orderly manner, and in conformance with safety codes.
- B. Dispose of material not suitable for back filling.
- C. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If trenches are below specified grade, backfill to required depth with select granular materials free from debris, rock, or frozen material, and compact to proper grade before installing piping.

### 3.3 LOCATION

- A. Locate trenches to accommodate utilities shown on the drawings.
- B. Excavate trench with adequate width to allow compaction equipment to be used at the sides of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

### 3.4 DEWATERING

- A. Perform whatever work is necessary to prevent the flow and accumulation of surface or ground water in the excavation.

### 3.5 TIMING

- A. Do not back-fill until underground mechanical system has been properly tested, inspected and approved.
- B. Coordinate with the work of others, and complete trench work in a timely manner.

### 3.6 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Contracting Agency.
- B. Use granular material, free from large stones, boulders, debris, and frozen material. Maximum aggregate size in accordance with the MASS specification. Maintain moisture content within a range that will allow specified compaction.
- C. Do not use any frost susceptible materials.

### 3.7 BEDDING

- A. Place bedding material under, around, and over the pipe in lifts not exceeding six inch in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.
- C. Cover pipe with bedding material to building sub-grade or to a minimum 12-inch depth before adding other backfill.

### 3.8 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to building sub-grade, or as shown on the Drawings.
- B. Place backfill material in lifts not to exceed 6-inches in depth.

### 3.9 COMPACTION

- A. Compact bedding material to at least 95 percent of maximum density, taking care not to damage the pipe.
- B. Compact backfill under footings, slabs, and other structures to 95 percent of maximum density or more, if required by the Contracting Agency. Where 95 percent compaction cannot be achieved, fill remaining voids with concrete. Provide compaction tests every 100 feet, in accordance with the MASS specification.
- C. Compact other areas to preclude future settlement, or at least to 85 percent of maximum density.

### 3.10 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface to grade.
- B. Do not allow heavy equipment to be used over backfilled work that does not have sufficient cover to prevent pipe damage.

### 3.11 SPECIAL PRECAUTIONS

- A. Avoid unauthorized and unnecessary excavations.
- B. Minimize number and size of excavations under footings or bearing walls.
- C. Support footings, foundations, and walls with timbers and jacks if there appears to be any possible chance of damage, and keep such precautions in place until work is completed and sufficient backfill is in place to eliminate possible damage.

- D. Avoid damage to existing underground services, cables, conduit lines or foundations. Repair any existing underground work damaged at no additional cost to the Owner.
- E. Protect excavated materials from moisture during the period prior to reinstallation.

END OF SECTION 20 0556

## SECTION 20 0700

## MECHANICAL INSULATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Specific requirements, products and methods of execution which relate to the insulation of ducts, fittings, equipment, pipes and other surfaces of the mechanical installation.
- B. Related Sections:
  - 1. 20 0529 - Mechanical Hangers and Supports
  - 2. 22 1100 - Domestic Water Piping and Specialties
  - 3. 23 2113 - Hydronic Piping and Specialties
  - 4. 23 2115 - Well Water Cooling Piping and Specialties

## 1.2 DESCRIPTION

- A. Provide thermal insulation for ventilation system ductwork and building service piping.

## 1.3 REFERENCES

- A. International Building Code (IBC).
- B. International Mechanical Code (IMC).
- C. International Energy Conservation Code (IECC)
- D. ASHRAE 90.1 - 2010 Energy Standard for Buildings Except Low-Rise Residential Buildings
- E. NFPA 90A - 2002 Standard for the Installation of Air Conditioning and Ventilating Systems.
- F. NFPA 90B - 2006 Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- G. MSS Standard Practice SP-69 Pipe Hangers and Supports - Selection and Application.

#### 1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Qualifications: Submit manufacturer and Applicator qualifications, showing compliance with Article 1.5.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years' experience.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturer of each product.

### PART 2 - PRODUCTS

#### 2.1 FIRE RATING OF MATERIALS

- A. Provide insulation products used aboveground in building with burning characteristics in compliance with NFPA Standards 90A and 90B: Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Tested according to UL 723, ASTM E84, or NFPA 255
- B. Insulation specified for use underground and aboveground away from the building might have other burning characteristics. Use such products only where specifically required.

#### 2.2 FIBERGLASS INSULATION

- A. Piping: Provide insulation products as follows:
  - 1. Thermal conductivity K equals 0.24 at 100 degrees F. mean temperature, ASTM C335.
  - 2. Factory applied vapor-barrier, flame retardant all service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
  - 3. Temperature limits for fiberglass pipe insulation: 350 degrees F, unless otherwise indicated.
  - 4. Manufacturers: Johns Manville, Owens Corning, Knauf Fiber Glass, or approved equal.
- B. Ductwork. Provide insulation products as follows:

1. Manufacturers:
  - a. Johns Manville.
  - b. Owens Corning.
  - c. Certainteed.
  - d. Knauf Fiber Glass.
  - e. Approved equal.
2. Flexible insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 1.5 pcf density, ASTM C335.
3. Rigid insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 3.0 pounds per cubic feet (pcf) density, ASTM C518.
4. Factory-applied vapor barrier flame-retardant Foil-Scrim-Kraft (FSK) or all-service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
5. Temperature limits for fiberglass duct insulation: 250 degrees F. unless otherwise indicated.

### 2.3 FLEXIBLE FOAM PLASTIC

- A. Thermal Conductivity: 0.27.
- B. Water Vapor Transmission: 0.08.
- C. Flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as tested by ASTM E 84.
- D. Manufacturer: Armaflex, Aerotube, Rubatex.

### 2.4 COATINGS

- A. Coatings: UL labeled.
- B. On cold or dual service lines, use vapor barrier type coatings.

### 2.5 PVC JACKETING

- A. 20 mil thick, white, PVC jacketing.
- B. Plenum rated; flame spread less than 25 and smoke developed rating less than 50 per ASTM E84.
- C. Manufacturer: Speedline 25/50 Smoke-Safe PVC or equal.

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PART 3 - EXECUTION

## 3.1 GENERAL

- A. Do not apply insulation materials until surfaces to be covered are clean and dry and foreign material such as rust, dirt, etc. is removed. Keep insulation clean and dry during installation and during the application of any finish.
- B. Do not install the insulation on pipe fittings and pipe joints until the piping has been tested and approved.
- C. Do not apply under conditions of excessive humidity or at temperatures below 50 degrees F. or above 100 degrees F.
- D. Provide insulation support blocks, shields, and transitions for hangers, supports, anchors, and guides.
- E. Coordinate insulation requirements through rated assemblies and Listing penetration's requirements.
- F. Adjust hangers, guides, anchors, and supports after insulation installation has been approved.

## 3.2 PIPE INSULATION

- A. Cold Piping:
  - 1. Includes rainwater piping, domestic cold water, plumbing, and other vents through roof, chilled water, well water, heat recovery, refrigeration, and other cold piping to zero degrees F.
  - 2. Insulate with sectional fiberglass and provide a completely sealed vapor barrier. Provide insulation thickness per Insulation Thickness Table.
- B. Hot Piping:
  - 1. Includes domestic hot water supply and recirculation, and hydronic heating.
  - 2. Insulate with sectional fiberglass. Provide insulation thickness per Insulation Thickness Table.
  - 3. Insulate valves, unions, flanges, fittings, tanks, vessels, air separators, heat exchangers, and similar components, except where indicated otherwise.
- C. Buried Piping. Insulate with flexible foam plastic insulation; glue seams with manufacturers recommended cement.
- D. Jacketing: Provide PVC jacketing for piping below 8 feet above finished floor.
- E. Insulation Thickness Table (units are in inches):



Fluid Design Operating Temperature Range	Less than 1	1 to <1-1/2	1-1/2 to <4	4 to <8	8 and up
Heating Systems (Water and Glycol Solutions) and Domestic (Hot Water and Hot Water Circulation):					
141 °F to 200 °F	1.0	1.0	1.5	2	2
105 °F to 140 °F	1.0	1.0	1.5	2	2
Cooling Systems (Well water, Chilled Water and Glycol Solutions, and Refrigerant):					
40 °F to 60 °F	1.0	1.0	1.5	1.5	1.5
Below 40 °F	1.0	1.0	1.5	1.5	1.5
Domestic Cold Water:					
All	1	1	1.5	1.5	1.5
Rain leaders, Plumbing vents through roof:					
All	1	1	1.5	1.5	1.5

### 3.3 TECHNIQUE FOR APPLICATION TO PIPES

- A. Close longitudinal joints of pipe insulation firmly and butt insulation sections firmly together. Neatly and smoothly adhere laps and butt strips.
- B. Clean the contact area on jacket for adhesive lap strips and butt strips so it is free from fingerprints, oil, construction dust and other contaminants. Clean surfaces with tack rags, methanol, or other suitable agent before attempting to adhere the strip. Apply pressure to adhesive strip with suitable tool immediately after adhering. Remove insulation with inadequately sealed joints and install new sections. Outwardly clinching staples may be used to reinforce joints.
- C. Continuously seal vapor barriers. If staples are used at laps, seal the entire length of stapled lap with adhesive jacket tape applied as specified above for laps and butts. Sectionalize vapor barrier by sealing ends of insulation sections at not more than 25 feet intervals, to prevent moisture migrating lengthwise. Apply butt strips over joint as above.
- D. Provide double insulation thickness on piping in outside walls and within five feet of vehicle doors or other large openings.
- E. Except as indicated, locate pipe hangers and rollers outside insulation. Provide insulation saddles or sheet metal shields around insulation. On pipes two inches and larger, within the area of each insulation shield, use calcium silicate or cellular glass on the lower half of the insulation, equal in thickness to adjacent insulation.

### 3.4 TECHNIQUE FOR APPLICATION TO PIPE FITTINGS, EQUIPMENT, AND VALVES

- A. Insulate fittings, valves, and flanges to the same thickness as the pipe insulation.

- B. Any of the following methods of insulation are acceptable:
1. Blanket Wrap: Wrap the fitting with compressed glass fiber blanket. Wire the blanket securely in place and cover with a smooth layer of insulating/finishing cement. Cover with glass mesh tape, adhering it with an adhesive coating.
  2. Fabricated Segments: Cut mitered segments from pipe insulation that has the same wall thickness as adjacent pipe insulation to form a cover which will fit snugly around the fitting. Wire the segments firmly in place and seal the joints with insulating/finishing cement. Apply adhesive coating and wrap with glass mesh tape, then apply another layer of the same coating over the whole assembly.
  3. Cement: Apply insulating or insulating/finishing cement, molding it to the contour of the fitting. When area is large, apply an under layer of cement, wrap this with glass mesh tape, then apply an outer layer of cement. If the insulation is not concealed the exposed surface of insulating/finishing cement shall have a final glass mesh tape wrap embedded in adhesive.
- C. In each of the listed methods, to protect the insulation against contact damage, apply an adhesive coating when the cement is completely dry and hard, then wrap with glass mesh tape. Apply another coating of adhesive over the whole assembly.
- D. In each of the listed methods, pre-formed fitting covers may be substituted for the tape and adhesive covering specified. Cement and tape fitting covers on cold piping to provide a positive vapor barrier.
- E. Removable insulation blankets of comparable insulation value for valves and where equipment require frequent adjustments or maintenance shall be provided; identify and coordinate during submittal process.
- F. After insulation has been installed adjust hangers for proper fit, maintain pipe grade and support.

### 3.5 DUCT THERMAL INSULATION REQUIREMENTS

- A. Insulate ductwork as follows:
1. Supply air ductwork: AHU-1 supply air ductwork insulation not required.
  2. Insulate combustion air outside air intake ducts from air intake louver connection to equipment connections with 1-1/2-inch flexible insulation with ASJ. Provide vapor tight installation.
  3. Insulate combustion air intake louver plenum with 2" semi rigid or rigid board insulation. Provide vapor tight installation.

3.6 PAINTING

- A. Paint exposed insulation in utility areas, service areas and mechanical rooms in accordance with Division 9 - Finishes.
- B. Color shall be white or light gray.

END OF SECTION 20 0700

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## SECTION 20 4100

## MECHANICAL DEMOLITION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Demolition and removal of selected mechanical systems, equipment and selected components.
- B. See Division 1 for general demolition requirements and disposal of demolished materials.
  - 1. Coordinate the demolition and disposal of materials and equipment with Contracting Agency.
  - 2. Provide Contracting Agency with the first right of refusal for the salvage of demolished equipment and materials.
- C. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 25 5000 - Building Automation System

## 1.2 REFERENCES

- A. International Building Code (IBC).
- B. International Mechanical Code (IMC).
- C. Uniform Plumbing Code (UPC).

## 1.3 DEFINITIONS

- A. Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### 1.4 SUBMITTALS

- A. Submit a demolition and construction plan for review by the Contracting Agency prior to beginning work. Describe procedures that will be used to protect and maintain cleanliness of the adjacent building areas/systems during construction.

#### 1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Standards: Comply with ANSI A10.6 and NFPA 241.
- D. Pre-demolition Meetings: Conduct coordination meetings prior to demolition as required by Division 1.

#### 1.6 PROJECT CONDITIONS

- A. Adjacent portions of the building will remain partially occupied during selective demolition. Conduct demolition such that Owner's operations will not be disrupted.
- B. Drawings and specifications involving existing conditions are based on building record drawings and limited field observation. Provide field verification. Addition building record drawings are available from the Owner with a written request.
- C. Notify Contracting Agency of discrepancies between existing conditions and the Contract Documents before proceeding with demolition.
- D. Hazardous Materials: The existing roof construction, to include the existing mechanical penetrations through the roof is likely to include materials which contain asbestos. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Contracting Agency and coordinate the demolition of such hazardous materials in accordance with the hazardous materials abatement procedures specified in Division 1.
- E. Maintain existing utilities to the maximum extent possible. Coordinate outages, if necessary, in accordance with Division 1.
- F. Maintain fire-protection systems in service during mechanical demolition operations.

- G. Storage or sale of removed items or materials on-site is not permitted.

## 1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Drawings and specifications involving existing conditions are based on building record drawings and limited field observation.
- B. Conduct a site inspection prior to submission of Bid to become thoroughly familiarized with the Scope of Work. Review actual site conditions and compare with the Contract Documents mechanical demolition drawings. Obtain direction from Contracting Agency for identified conflicts.
- C. Inventory and record the condition of items to be removed, removed and reinstalled or removed and salvaged. Provide Contracting Agency with first right of refusal for the salvage of demolished equipment and materials.
- D. Verify field measurements, locations, sizes, and routing arrangements and site conditions.
- E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Contracting Agency for direction.
- F. Commencement of demolition implies Contractor accepts existing conditions.

### 3.2 PREPARATION

- A. Maintain existing utilities in operation to the maximum extent possible during the selective demolition of mechanical systems. When utility outages are necessary, coordinate outages and their duration with Contracting Agency in accordance with Division 1. Arrange to shut off indicated utilities with utility companies.
- B. "Tag" equipment and systems to be demolished. Identify the extent to which each system will be demolished.

- C. Locate, identify, isolate, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
- D. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
- E. Coordinate with the Contracting Agency to provide a central staging area for the temporary storage of demolished equipment and systems.
- F. Identify hazardous materials which will be demolished (i.e. mercury thermostats, etc.). Provide and designate a segregated temporary storage area for demolished hazardous materials organized by hazard type.

### 3.3 DEMOLITION - GENERAL

#### A. General:

1. Demolish and remove existing mechanical equipment and systems only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
2. Terminate ductwork and piping back to branch connections and replace tees and fittings with straight couplings. Terminate electrical circuits back to panel (See Divisions 26, 27 and 28). Remove unused ductwork, piping, conduit and associated hangers and other support devices.
3. Abandonment in place of unused equipment and systems affected by the remodel is not allowed.
4. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
5. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
6. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
7. Promptly transport and dispose of demolished equipment, systems and material at the closed, approved dump site.
8. Heating System: Drain, flush and clean the existing hydronic heating systems throughout the entire building. Dispose of existing circulation solutions in an approved manner.

#### B. Controls:

1. Sequence limited demolition of the controls system.
2. Limited scheduled outages are acceptable for system cross-over.



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3. Coordinate outages with Contracting Authority 24 hours in advance of the scheduled outage.
- C. Indoor Air Quality:
1. Maintain cleanliness and indoor air quality in areas adjacent to construction areas.
  2. Submit a demolition and construction plan for review by the Contracting Agency prior to beginning work.
  3. Reference SMACNA IAQ Guidelines for Occupied Buildings Under Construction - First Edition - November 1995.
- D. Fire Protection: Notify the Contracting Agency and the Fire Department Agencies at least 24 hours before partially or completely disabling Fire Protection Systems.
- E. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Contracting Agency.
  4. Transport items to Contracting Agency designated on-site storage area.
  5. Protect items from damage during transport and storage.
- F. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- G. Existing items to Remain:
1. Protect construction indicated to remain against damage and soiling during selective demolition.
  2. When permitted by Contracting Agency, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.
- 3.4 CLEANING AND REPAIRS
- A. Plug, patch and repair surfaces, adjacent construction, and finishes damaged during demolition and new work. Restore to original condition or better. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish. Repair fire proofing.

- B. Clean construction areas after completion of the project. Wipe down new and existing surfaces including but not limited to walls, floors, ductwork, piping and equipment. Clean adjacent equipment and systems to remain and building surfaces of dust, dirt, and debris caused by demolition operations.
- C. Return adjacent areas to the condition existing before demolition operations began.

END OF SECTION 20 4100

## SECTION 22 1100

## DOMESTIC WATER PIPING AND SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Pipe, fittings, and connections for domestic potable water system.
2. Mechanical coupling systems.
3. Piping accessories.
4. Valves.
5. Trap primer valves.
6. Water Meters.
7. Cross Connection Protection Devices.
8. Access doors.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0556 - Interior Trench Excavation and Backfill
5. 20 0700 - Mechanical Insulation
6. 20 4100 - Mechanical Demolition

## 1.2 REFERENCES

## A. Codes and Standards:

1. International Building Code (IBC).
2. Uniform Plumbing Code (UPC).
3. ASCE 07-05, Minimum Design Loads for Buildings and Other Structures.
4. ANSI A117.1, Accessible and Usable Buildings and Facilities.
5. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
6. 2011 Reduction of Lead in Drinking Water Act.
7. NSF/ANSI 61 - Drinking Water System Components - Health Effects.

## B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the various plumbing systems and equipment.
2. Wetted surfaces of pipes, fittings, valves, and equipment in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

#### B. Performance Requirements:

1. Potable water systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping and equipment that does not perform as intended with properly operating equipment.

### 1.4 PRE-INSTALLATION MEETINGS

- #### A.
- Coordinate and sequence installation of plumbing systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components

### 1.5 SUBMITTALS

- #### A.
- Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

#### B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.
2. Indicate valve data and ratings.
3. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.

#### C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.
2. Show placement of fixtures and plumbing equipment.

- D. Certificates: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of cross contamination protection devices.
- E. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manuals.
- F. Test and Evaluation Reports:
  - 1. Submit hydrostatic pressure test report.
  - 2. Submit sterilization of system report.

#### 1.6 CLOSEOUT SUBMITTALS:

- A. Refer to Section 20 0000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Warranty Documentation.
- C. Record Documentation:
  - 1. Record actual locations of valves, backflow preventers, water hammer arresters, and other components.
  - 2. Record locations of access doors required for access or valves.

#### 1.7 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
  - 2. Installers: Minimum three years' experience in the installation and start-up of plumbing systems and equipment.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
  - 1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
  - 2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.
- B. Storage and Handling Requirements:
  - 1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
  - 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
  - 3. Replace damaged items with same item in new condition.

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1.9 WARRANTY

- A. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical warranty requirements.

## PART 2 - PRODUCTS

## 2.1 WATER SERVICE PIPING (ABOVE GRADE INSIDE BUILDING)

- A. Copper (Hard drawn):
1. Tubing: Type L (ASTM B88).
  2. Fittings:
    - a. Cast copper alloy (ASME B16.18).
    - b. Wrought copper and bronze (ASME B16.22).
  3. Joints: Solder, Grade 95TA (ASTM B32).
- B. Copper Press Fitting System:
1. Limited to tubing sizes 4 inch and smaller.
  2. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
  3. IAPMO UPC listing.
  4. Manufacturer: Viega ProPress only, no substitutions.

## 2.2 UNIONS (STANDARD)

- A. Steel Piping (Threaded):
1. Class 150 malleable iron, ground joint, copper or copper alloy seat. AnvilStar Figure 463. (150 psig steam, 300 wog).
  2. Where indicated: Class 250 malleable iron ground joint, copper or copper alloy seat. AnvilStar Figure 554.
- B. Copper Piping (Sweat and Threaded): Cast bronze, ground joint, copper to copper, or copper to threaded joint. Nibco 733-LF series.

## 2.3 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

- A. Provide dielectric unions for 2 inch pipe and smaller.
- B. Provide dielectric flanges for 2-1/2 inch pipe and larger.
- C. Insulating gaskets, all types, shall be suitable for fluid type, temperature and pressure.

- D. Galvanized pipe to copper: Brass threaded end and sweat copper end.
- E. Black steel to copper: Zinc plated steel threaded end and sweat copper end.
- F. Manufacturers: Capitol, Epco, Control Plastics, Watts, or approved equal.

## 2.4 VALVES

### A. General:

- 1. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig saturated steam or 200 psig W.O.G. Packing material or seals shall not contain asbestos.

### B. Ball Valves:

- 1. Two (2) inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 psig pressure/temperature rating (steam).
- 2. Two and one half (2-1/2) inches through four (4) inch: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, 150 psig pressure/temperature rating (steam). May be substituted for gate valves except where otherwise indicated.

### C. Gate Valves:

- 1. Two (2) inch and smaller: Bronze body and trim, rising stem, solid wedge. Use only where shown on drawings.
- 2. Two and one half (2-1/2) inch through four (4) inch: Iron-body, bronze trim, flanged threaded or sweat fitting. Non-rising stem: Inside screw. Rising stem: OS&Y. Bronze valves optional for 2-1/2 inch and three-inch.

### D. Globe Valves:

- 1. Two (2) inch and smaller: Bronze body, renewable disc suitable for service.
- 2. Two and one half (2-1/2) inch and larger: Iron body, bronze trim, flanged, bronze disc. Bronze valves optional for 2-1/2 inch and three-inch.

### E. Swing Check Valves:

- 1. Two (2) inch and smaller: Bronze body, horizontal swing, Y-pattern, Buna-N-disc for water, oil and gas. TFE disc for steam.
- 2. Two and one half (2-1/2) inch and larger: Iron body, horizontal swing, bolted bonnet, renewable bronze seat and disc, flanged.
  - a. Bronze valves optional for 2-1/2 inch and three (3) inch.

### F. Drain Valves:

- 1. Full port ball valve with threaded hose adapter with bronze end cap.
- 2. Do not use sillcocks or butterfly valves as drain valves.

## 2.5 TRAP PRIMER VALVES

- A. Manufacturers:
  - 1. Precision Plumbing Products.
  - 2. Mifab.
  - 3. ProFlo.
- B. Electronic Type:
  - 1. Description: Electronic solenoid valve designed to deliver a metered amount of water to floor drain traps upon pre-set timer once every 24 hours.
  - 2. Performance: Factory set for proper operation with water pressure of 20 to 70 psi.
  - 3. Materials:
    - a. Lead-free brass body.
    - b. Stainless steel mesh screen
- C. Non-Electronic Type:
  - 1. Description: Valve designed to deliver a metered amount of water to floor drain traps upon pressure drop of 10 psi in the cold water line.
  - 2. Performance: Factory set for proper operation with water pressure of 20 to 80 PSI.
  - 3. Materials:
    - a. Lead-free brass body.
    - b. EPDM o-rings.
    - c. Stainless steel mesh screen.
    - d. Stainless steel screen.
- D. Accessories: Distribution unit to serve multiple floor drains from a single trap primer.

## 2.6 PRESSURE GAUGES Provide where shown on drawings, specified in Part 3, or as required.

- B. Bourdon tube type with 4-1/2-inch dial (minimum) accuracy plus or minus one-percent span, recalibratable. Normal operating pressure near midpoint of range. Industrial quality and lead free.
- C. Gauge cock on gauges and pulsation damper (snubber).

## 2.7 THERMOMETERS

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Digital self-powered type.
- C. Weiss DVU or equal.



2.8 HYDRONIC SYSTEM MAKEUP WATER METER Nutating disc meter, certified and labeled to NSF/ANSI 61 for potable water application.

- B. Lead free bronze construction.
- C. Coordinate meter BAS monitoring requirements.
- D. Badger, Neptune or equal.

## 2.9 REDUCED PRESSURE PRINCIPLE BACKFLOW DEVICE

- A. The reduced pressure backflow preventer shall consist of two independently operating, spring loaded cam-check valves with a hydraulically operated differential pressure relief valve located between and below the cam-checks, required test cocks, and inlet and outlet resilient seat shut off valves.
- B. Modes of Operation:
  - 1. When normal flow exists, both check valves are open and the pressure in the area between the checks, called the zone, is at least two PSI lower than the inlet pressure. The differential pressure relief valve is closed during normal flow.
  - 2. If cessation of normal flow occurs, the differential pressure relief valve will automatically open and discharge to maintain the zone at least two PSI lower than the inlet pressure. This action will prevent a backflow or back siphonage condition. After the required differential is established, the differential pressure relief valve again closes.
- C. The cam-checks include a stainless steel spring and cam-arm, rubber faced disc, and a replaceable seat. The body shall be manufactured from 300 series stainless steel, lead free, with a single two-bolt grooved style access cover. No special tools shall be required for servicing. The relief valve shall be compact with a rolling diaphragm and no sliding seals. The relief valve shall discharge in a 360 degree radius.
- D. Provide installation that meets access requirements of local code amendments.
- E. Water pressure drop through the assembly including shutoff valves shall not exceed 14 PSIG at 50 GPM.
- F. Manufacturer: AMES model 4000SS series, Watts Regulator LF909QT-S, Febco, or equal.

## 2.10 ACCESS DOORS

- A. Provide access doors for mechanical systems.
- B. Provide UL labeled access doors and panels when required for fire resistance of surrounding construction.
- C. Provide key locks on access doors located in public areas below eight feet above finished floor.

- D. Prime coat steel.
- E. Coordinate location and size of access doors in walls, partitions, floors, and ceilings to correspond with valves, trap primers, cleanouts, and other devices requiring service or adjustment. Maintain any fire rating of the surrounding construction.
- F. Manufacturers: Elmdor, KARP, Milcor, MIFAB.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- B. Surface Preparation:
  - 1. Verify that excavations are to required grade, dry, and not over-excavated.
  - 2. Refer to Section 20 0556 - Interior Trench Excavation and Backfill.

### 3.2 INSTALLATION

- A. Interface with Other Work:
  - 1. Review architectural drawings. Coordinate locations of access panels prior to piping installation.
  - 2. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
  - 3. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related work shall be completed at no additional expense to the Owner.
  - 4. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 for instructions on painting and coordination.
- B. Water Service Piping:
  - 1. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.
  - 2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- C. Valves:
  - 1. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at all terminal devices.

2. Install balancing valves for hot water recirculation system to be accessible and adjustable.
- D. Provide finished products with protective covers during balance of construction.
- E. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

### 3.3 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

### 3.4 SITE QUALITY CONTROL

- A. Site Tests:
  1. Test water piping hydrostatically at 100 psig or 150 percent of working pressure, whichever is greater, for a period of four hours. Observe piping during this period and repair leaks and retest.
  2. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.
- B. Inspection:
  1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.

### 3.5 CLEANING

- A. Sterilization of Domestic Water Systems:
  1. Sterilize each unit of completed supply line and distribution system with chlorine before acceptance for domestic operation.
  2. Sterilization as described below or by the system prescribed by the American Water Works Association Standard C-651. Apply the amount of chlorine to provide a dosage of not less than 50 parts per million. Provide chlorine manufactured in conformance to the following standards:
    - a. Liquid Chlorine: Federal Specification BB-C-120.
    - b. Hypochlorite: General Specification O-C-114a, type 11, Grade B or Federal Specification O-X-602.

3. Introduce the chlorinating material to the water lines and distribution system after piping system has been thoroughly flushed. Maintain a contact period of not less than 24 hours. Flush the system with clean water until the residual chlorine content is not greater than 1.0 part per million.
  4. Open and close valves in the lines being sterilized several times during above chlorination.
  5. Certify in writing that sterilization has been completed in accordance with these requirements.
- B. After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

END OF SECTION 22 1100

## SECTION 22 1300

## SANITARY WASTE AND VENT PIPING AND SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Sanitary waste and vent pipe and fittings.
2. Cleanouts.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0556 - Interior Trench Excavation and Backfill
5. 20 0700 - Mechanical Insulation
6. 20 4100 - Mechanical Demolition

## 1.2 SYSTEM DESCRIPTION

## A. Design Requirements: This section describes specific requirements, products and methods of execution for sanitary waste systems and equipment.

## B. Performance Requirements:

1. Sanitary waste systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping that does not perform as intended with properly operating equipment.
3. Provide products with performance, output or salient features indicated or scheduled on the drawings.

## 1.3 SUBMITTALS

## A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

## B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Clearly annotate literature to indicate specified salient features and performance criteria.
2. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Record Documentation:
  1. Record actual dimensioned locations for buried or inaccessible piping.
  2. Show actual cleanout locations and types.

#### 1.5 QUALITY ASSURANCE

- A. Qualifications:
  1. Installers: Work shall be performed by workmen usually employed and experienced with the trade.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
  1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
  2. Remove damaged or otherwise unacceptable products from the project site when directed by the Contracting Agency.
- B. Storage and Handling Requirements:
  1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
  2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
  3. Replace damaged items with same item in new condition.

## PART 2 - PRODUCTS

## 2.1 DRAINAGE PIPING, BURIED BENEATH AND WITHIN FIVE FEET OF BUILDING

## A. Hub-less Cast Iron Pipe and Fittings:

1. Manufacturers:
  - a. Charlotte Pipe and Foundry.
  - b. Tyler Pipe and Coupling.
  - c. AB&I Foundry.
  - d. Equal.
2. Pipe: CISPI 301, ASA group 022.
3. Fittings: Cast iron.
4. Couplings:
  - a. Manufacturers:
    - 1). Husky Series 4000.
    - 2). Approved equal.
  - b. Materials:
    - 1). Heavy-duty 304-type stainless steel couplings and screws.
    - 2). Minimum shield thickness: 0.015 inch.
    - 3). Gaskets conforming to ASTM C564.

## 2.2 DRAINAGE PIPING, ABOVE GRADE

## A. Hub-less Cast Iron Pipe and Fittings:

1. Manufacturers:
  - a. Charlotte Pipe and Foundry.
  - b. Tyler Pipe and Coupling.
  - c. AB&I Foundry.
  - d. Equal.
2. Pipe: CISPI 301, ASA group 022.
3. Fittings: Cast iron.
4. Couplings:
  - a. Manufacturers:
    - 1). Husky Series 2000
    - 2). MG Coupling
    - 3). Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.
  - b. Description: No-hub cast iron pipe couplings conforming to standard CISPI 310.
  - c. Materials:

- 1). Gaskets conforming to ASTM C564.
- 2). Stainless steel clamp-and-shield assemblies.

- B. Copper Pipe: ASTM B306, DWV, ASTM B75, ASTM B88, ASTM B251 Type L.
1. Fittings: ASME B16.23 cast bronze, or ASME B16.29 wrought copper.
  2. Joints: ASTM B32, solder, Grade 50B.

## 2.3 ADAPTERS

- A. Manufacturers:
1. Romac.
  2. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.
- B. Use to connect pipes of same nominal size but different outside diameter or pipes of different material (cast iron to ductile iron, etc.).
- C. Rigid sleeve type coupling, ductile iron center ring and end rings, elastomeric gaskets, corrosion resistant bolts or polyethylene encasement.

## 2.4 CLEANOUTS

- A. Manufacturers:
1. Zurn.
  2. Mifab.
  3. J.R. Smith.
  4. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.
- B. Floor Cleanouts:
1. Cast iron body, bronze plug with neoprene gasket.
  2. Adjustable head to match finished floor elevation.
  3. Round, scoriated bronze top.
  4. Where indicated, provide cleanout tops with tile-terrazzo insert or carpet insert to match surrounding floor finish.
- C. Wall Cleanouts:
1. Cast iron body, recessed bronze plug.
  2. Wall access panel or access cover with center screw.

## PART 3 - EXECUTION



### 3.1 PREPARATION

- A. Interface with Other Work:
  - 1. Review architectural and millwork shop drawings. Confirm location of cleanouts and access panels prior to installation.
  - 2. Coordinate and sequence installation of piping with trades responsible for portions of this and other related sections of the Project Manual.
- B. Protection: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- C. Surface Preparation:
  - 1. Verify that excavations are to required grade, dry, and not over-excavated.
  - 2. See Section 20 0556 - Interior Trench Excavation and Backfill.

### 3.2 INSTALLATION

- A. Install plumbing systems in accordance with manufacturer's instructions and listing.
- B. Provide finished products with protective covers during balance of construction.
- C. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.
- D. Piping:
  - 1. Grading: Minimum 1/4 inch per foot unless indicated otherwise on drawings and approved by AHJ for shallower slopes.
  - 2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 4. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  - 5. Where pipe support members are welded to structural building framing; scrape, brush clean, and apply one coat of zinc rich primer to welding.
- E. Vents:
  - 1. Install vents as indicated and as required by plumbing code. Add vents when field conditions increase the length of a trap arm or cause other changes in venting requirements.
  - 2. Unless otherwise indicated, the portion of the vent extending through roof shall be increased in size from one foot below roof assembly to termination as defined below. Increase as follows:
    - a. Vent size two-inch and under; vent thru roof three-inch.
    - b. Vent size three-inch; vent thru roof four-inch.
    - c. Vent size four-inch; vent thru roof six-inch.

- d. Vent size six inch & larger; vent thru roof same size.
- 3. Termination of Vent: As required by the Uniform Plumbing Code.
- F. Cleanouts:
  - 1. Provide as indicated on drawings.
  - 2. If field conditions create additional offsets or increase length of piping shown, provide additional cleanouts as required by the Uniform Plumbing Code and AHJ.

### 3.3 REPAIR/RESTORATION

- A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.
- B. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- C. Substitute replacement parts from other manufacturers are not acceptable.

### 3.4 RE-INSTALLATION

### 3.5 FIELD QUALITY CONTROL

- A. Inspections: Arrange for inspections and provide notice to the Contracting Agency when the entire Work, or logical portions thereof, is ready for inspection.
- B. Maintain current as-built drawings on-site recording including invert elevations, connections to fixtures, cleanouts, slopes, pipe sizes, and routing of pipes. Annotate sections of lines with dates when pressure tests have been approved by AHJ.
- C. Pressure Tests:
  - 1. Water Test: Test waste and vent system with water in accordance with the Uniform Plumbing Code.
- D. Verify all penetrations are installed to maintain assembly integrity.

### 3.6 CLEANING

- A. Flush drain piping to remove dirt and foreign debris from all systems.
- B. Clean all exposed pipes, fittings, and materials.

END OF SECTION 22 1300

## SECTION 23 0593

## TESTING, ADJUSTING AND BALANCING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: General requirements and methods of execution relating to the testing and balancing of the mechanical systems provided on this project.
- B. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 23 2113 - Hydronic Piping and Specialties
  - 3. 23 2115 - Well Water Cooling Piping and Specialties
  - 4. 23 2123 - Hydronic Pumps
  - 5. 23 5216 - Condensing Boilers and Accessories
  - 6. 25 9000 - Sequence of Operations

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. National Environmental Balancing Bureau - Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - 2. National Environmental Balancing Bureau - Testing, Adjusting, Balancing Manual for Technicians.
  - 3. SMACNA - HVAC SYSTEMS Testing, Adjusting, and Balancing.
- B. Abbreviations and Acronyms:
  - 1. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
  - 2. TAB: Testing, Adjusting, and Balancing.
  - 3. NEBB: National Environmental Balancing Bureau
- C. Definitions:
  - 1. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
  - 2. Accuracy: Capability of an instrument to indicate the true value of a measured quantity.

3. Adjusting: Varying of system flows by partially closing balancing devices, such as dampers, and valves, and varying fan speeds to achieve optimum system operating conditions within design and installation limitations.
4. Balancing: Methodical proportioning of air and hydronic flows through the system main, branches, and terminal devices using acceptable procedures to achieve the specified air or hydronic flow with testing and design limitations.
5. Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.
6. NEBB Certified TAB Firm: A Firm that has met and maintains all the requirements of the NEBB for Firm certification in TAB and is currently certified by NEBB. A NEBB Certified Firm shall employ at least one NEBB Qualified TAB Supervisor in the full time management position.
7. NEBB Certified TAB Report: Data presented in a NEBB Certified TAB Report accurately represents system measurements obtained in accordance with the current edition of the *NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems*. Variances from design quantities that exceed NEBB or contract document tolerances are to be noted in the TAB report project summary.
8. NEBB Qualified TAB Supervisor: Full time employee of the TAB Firm in a management position who has successfully passed the supervisor level written and practical qualification examinations and maintains the Supervisor re-qualification requirements of NEBB.
9. NEBB Qualified Technician: Full time employee of the TAB Firm who has met the technician level experience requirements of NEBB and has successfully passed the technician level written and practical qualification examinations. A NEBB Qualified TAB Technician shall be supervised by a NEBB Qualified TAB Supervisor. Supervision does not infer constant oversight; a NEBB Qualified Technician is capable of performing assigned tasks with periodic supervision.
10. Precision: Ability of an instrument to produce repeatable readings of the same quantity, or a tightly grouped set of values, under the same conditions.
11. Range: Upper and lower limits on an instrument's ability to measure the value of a quantity for which the instrument is calibrated.
12. Resolution: Smallest change in a measured variable that an instrument can detect.
13. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and hydronic quantities for an evaluation of flow conditions.
14. Testing and Balancing: As used in these specifications, testing and balancing refers to testing, adjusting, and balancing (TAB) as described in the above references.
15. TAB: A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in this document.

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1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements, products and methods of execution for the testing, adjusting and balancing of the project.
- B. Performance Requirements: Furnish the services of a qualified and approved TAB Firm to perform the work of this specification section.
- C. The work of this section includes but is not necessarily limited to:
  - 1. Test and balance supply air outlets in the Boiler Room.
  - 2. Test and balance new portions of the hydronic heating, including the glycol system. Measure main circ pump flowrate(s) and operating conditions.
  - 3. Test and balance the well water cooling systems.
  - 4. Work directly with the control subcontractor to obtain proper system adjustments and to assist in calibrating the hydronic heating and well water cooling flowmeters.
  - 5. Provide a final report.
- D. The work of this section does not include:
  - 1. Adjusting burners for proper combustion operation.
  - 2. Liquid waste transfer system adjustment.
  - 3. Refrigeration work.

## 1.4 SUBMITTALS

- A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Sample report forms and outlines indicating adjusting, balancing, and equipment data required prior to commencing work.
- C. Certificates:
  - 1. Submit the name and qualifications of TAB Firm for approval with general product submittals. Submit copy of TAB Firm's NEBB certification.
  - 2. Submit the names and certifications of the Firm's NEBB Qualified TAB Supervisor and NEBB Certified Technician.
- D. Balancing Report:
  - 1. Submit a complete report of the testing and balancing of all devices in a format equivalent to that shown in the SMACNA HVAC Systems Testing, Adjusting and Balancing manual. Compile the test data and submit eight copies of the complete test data for acceptance and/or analysis and recommendations.
  - 2. Provide report in soft cover, letter size, comb bound binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include drawings within report.
  - 3. Report Cover Sheet. Include the following data:

- a. Project Name.
  - b. Project Address.
  - c. Names of Architect and Engineer.
  - d. Names of General Contractor and HVAC Contractor.
  - e. Report date.
  - f. Names of TAB technicians responsible for the measurements and report.
4. System Review Sheet:
    - a. List air and hydronic systems balanced, with systems highlighted that were found to be performing outside design tolerances.
    - b. Include a summary of problems encountered, deviations from design, deficiencies in performance, remaining problems, recommendations, and comments.
  5. Instrument Calibration Report:
    - a. Include a complete list of test equipment used, including apparatus manufacturer's name, model number, serial number, and date last calibrated.
    - b. List the instruments used on the project during the balancing work, on an NEBB "Instrument Calibration Report" form, or equivalent form. This includes flow measuring hoods and other related devices.
  6. Air Systems Report. Prepare a report for each air system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
    - a. System Diagram: Include locations of air terminal units and pitot tube traverses. Include appropriate notes, static pressure reading locations, etc., taken during testing and balancing.
    - b. Air Apparatus or Fan Test Report: Include pertinent data on the test report forms. If test data could not be measured, or is not applicable, indicate such on report forms. List how each actual cfm measurement was obtained (duct traverse, total of outlet airflows, or a combination).
    - c. Duct Pitot Tube Traverse Reports: Include actual temperature and pressure readings recorded at the time of testing and balancing.
    - d. Air Outlet Test Reports: Include applicable  $A_k$  factors and terminal device sizes. If flow measuring hoods are used, indicate their use in the remarks column.
    - e. Include complete identification of elements. Identify by box number, room name and number, air outlet symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.
  7. Hydronic Heating and Cooling System Reports. Prepare a report for each hydronic system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
    - a. Schematic Diagram: Include heat exchange equipment and locations of flow measuring devices.
    - b. Pump Test Report: Confirm test data was recorded and properly entered on form. Attach manufacturer's pump capacity curves, with the actual pump

operating point plotted, to the test report form. List how the actual pump flow rate was determined (flow meter, pump curve, etc.).

- c. Primary Heat Exchange Equipment: Confirm that appropriate test data has been recorded for the boilers, heat exchangers, chillers, and other primary heat exchange equipment. List how the actual flow rate(s) of each item was determined.
- d. Terminal Heat Exchange Equipment: Confirm that heating coil and terminal unit temperatures and pressures were recorded and properly entered on form. List how each terminal unit flow rate was determined.
- e. Include complete identification of elements. Identify by equipment tag number, room name and number, baseboard symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.

## 1.5 QUALITY ASSURANCE

### A. Qualifications:

- 1. The work described in this section shall be performed by a Firm certified by the National Environmental Balancing Bureau for air and hydronic balancing.
- 2. The Firm shall have a record of operation within Alaska for at least three years prior to bid date of this project and shall have demonstrated satisfactory completion of five projects of similar size and scope in the State of Alaska. Provide references if requested.
- 3. The Firm's Technician and Supervisor for this project shall be NEBB certified for their respective positions.
- 4. Bids by suppliers, contractors or any Firm whose principal business is not that of testing, adjusting, and balancing HVAC systems are not acceptable.

### B. Balancing Standards:

- 1. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- 2. Maintain one (1) copy of balancing procedural document on site.
- 3. Use standard NEBB forms.

### C. Timing of Work:

- 1. Sequence work to commence after completion of systems. Do not begin balancing and testing until the systems are complete and in full working order.
- 2. Schedule the testing and balancing work in cooperation with other trades.
- 3. Schedule completion of testing and balancing before Substantial Completion of Project.



## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verify systems are complete and operable before commencing work.
- B. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- C. Report defects and deficiencies that may preclude proper TAB of systems and equipment.

## 3.2 PREPARATION

- A. Schedule work under the provisions of Section 20 0000 - Mechanical General Conditions.
- B. Provide calibrated instruments required for testing, adjusting, and balancing operations.
- C. Prior to starting work, review drawings and actual field conditions for additional balancing devices or components required for correct balance. Coordinate provision of additional balancing devices as required elsewhere in these specifications. Refer to Related Sections above.
- D. Preliminarily adjust grille, register, and diffuser blades or pattern controllers per drawings. If airflow blow patterns are not shown on drawings, adjust for uniform diffusion pattern(s) or diffusion into long dimension of room.

## 3.3 SPECIAL TECHNIQUES:

- A. Use instrumentation in accordance with NEBB requirements, calibrated to the accuracy standards specified by this organization.
- B. Flow measuring hoods are acceptable for measurement of ceiling diffuser performance if used in a manner as recommended by the manufacturer and calibration and accuracy data is provided with the balancing report.



### 3.4 ACCEPTABLE CRITERIA

- A. Systems will be considered balanced in accordance with NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* when the following conditions are satisfied:
1. Air Handling Systems:
    - a. Measured airflow quantities are within plus or minus 10 percent of design quantities. Deficiencies shall be noted in the TAB report.
    - b. There is at least one direct path with fully open dampers from the fan or terminal unit device to an air inlet or outlet. Additionally, if a system contains branch dampers, there will be at least one wide open path downstream of every adjusted branch damper.
  2. Air Outlets and Inlets:
    - a. Measured airflow quantities total to within plus or minus 10 percent of design to space and individual outlets and inlets in space to within plus or minus 10 percent of design.
    - b. Grilles, registers, and diffusers blades or pattern controllers are adjusted for uniform diffusion in the space.
  3. Hydronic Systems:
    - a. Manually balanced systems:
      - 1). Measured fluid flow quantities are within plus or minus 10 percent of design.
      - 2). There is at least one direct path with fully open balancing valves from the pump discharge balancing valve (if present) to a terminal device. Additionally, if a system contains branch balancing valves, there will be at least one wide open path downstream of every adjusted branch balancing valve.
    - b. Automatically balanced systems: Pressure drops across a sample of system's automatic balance valves are within the manufacturer's recommended operating range for the device.
- B. If systems or components cannot be adjusted to within specified tolerances:
1. Coordinate the replacement of sheaves, belts, or other components or devices needed for correct balance as required elsewhere in these specifications.
  2. Note deficiencies in the TAB report.

### 3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on equipment sheaves, belts, dampers, valves, air outlets and inlets and each system according to the procedures contained in the current edition of the NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* and this section.
- B. Ensure recorded data represents actual measured or observed conditions.

- C. Permanently mark final settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Contracting Agency.
- G. Schedule and provide assistance in final adjustment and test of fire alarm system with Authority Having Jurisdiction.

### 3.6 SITE QUALITY CONTROL

- A. Make calibrated test instruments available to Contracting Agency to facilitate spot checks during testing and commissioning as appropriate.
- B. Re-balance components or systems found to be out of tolerance at no additional expense to the Owner.

END OF SECTION 23 0593

## SECTION 23 1123

## FUEL GAS PIPING AND SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Specific requirements, products, and methods of execution relating to the provision of fuel gas systems for the project.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 23 5216 - Condensing Boilers and Accessories

## 1.2 REFERENCES

## A. Codes and Standards:

1. International Fuel Gas Code (IFGC).
2. Uniform Plumbing Code (UPC).
3. NFPA 54 - National Fuel Gas Code.

## 1.3 SYSTEM DESCRIPTION

## A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the distribution of natural gas within the building.
2. Provide products including above and below ground piping, connections to gas burning apparatus, and work at the gas source to provide complete fuel gas systems where required. Provide gas equipment pressure regulator vents to outside the building at fuel gas trains.

## B. Performance Requirements:

1. Underground gas service piping to the meter location, and the meter itself, is supplied by others. Divisions 20, 22, 23, 25 work begins at the outlet of the meter, and is limited to a nominal distance of five feet from the building perimeter. Coordinate the meter connection requirements and the exact meter location, and

- properly integrate the gas service line and meter Work with the other Work of the project.
2. Provide the connection at the gas meter-regulator outlet using appropriate materials, compatible joints, supports, and other products for proper interface. Verify that the gas meter, service line and related Work has been inspected, tested and approved by the proper authority before connecting to the outlet of the meter-regulator assembly.
  3. Provide natural gas service volume and pressure to the building as shown on drawings.

#### 1.4 PREINSTALLATION MEETINGS

- A. Coordinate installation of gas piping and equipment with trades responsible for portions of this and any other related specification sections prior to installation of any components.

#### 1.5 SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Provide manufacturers' product literature for items specified in Part 2 and those products required by the performance standards of this section, clearly annotated to indicate specified salient features and performance criteria.
- C. Shop Drawings: Submit dimensioned shop drawings of gas piping size and routing as part of the plumbing shop drawings, with callouts indicating deviations from layout shown.
- D. Test and Evaluation Reports:
  1. Obtain a certificate of final inspection from the Contracting Agency.
  2. Submit a letter of certification with copy of certificate of final inspection, indicating that the gas piping has been completed, tested, and inspected.
- E. Quality Control Submittals: Provide a certified test report showing the system has been tested in accordance with Code requirements and is in compliance.

#### 1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance (IO&M) Manuals:
  1. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
  2. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating

instructions, installation instructions, maintenance and repair data, parts listings, and spare parts list.

B. Record Documentation: Record actual locations of equipment, piping, and components, and areas required for maintenance access.

C. Qualifications:

1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
2. Installers: Minimum three years' experience in the installation of gas piping and equipment.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

## 1.8 WARRANTY

A. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.

# PART 2 - PRODUCTS

## 2.1 PIPING

A. Above ground, pressure less than 14 inches water column:

1. Schedule 40 black steel pipe.
2. Welded or threaded black malleable iron fittings.
3. Corrugated Stainless Steel Tubing (CSST):
  - a. CSST complying with ASTM A 240, 125 PSIG maximum operating pressure and 200 degrees F maximum operating temperature.
  - b. Fittings and appurtenances by same manufacturer as CSST product.
  - c. Manufacturer: OmegaFlex TracPipe PS-II, or approved equal.

B. Above ground, pressure greater than or equal to 14 inches water column:

1. Welded schedule 40 black steel pipe.
2. Welded schedule 40 steel fittings.

## 2.2 GAS METERS

A. Gas meters to be provided by others at the locations shown.

### 2.3 SEISMIC LOOP/EXPANSION COMPENSATORS

- A. Provide seismic loop/expansion loops where shown on the Drawings sized to match adjoining pipe or as shown.
- B. Loop assembly shall be AGA Certified to meet standards of UL 536 for gas use.
- C. Loop shall be designed to impart no thrust loads on adjacent pipe anchors. Loop shall consist of two flexible sections of braided hose, two 90 degree elbows and a 180 degree return.
- D. Hose and braid materials shall be Type 304 stainless steel with schedule 40 carbon steel fittings. Drain plug at low point of 180 degree return fitting. Maximum rated working pressure 150 psi at 70 degrees Fahrenheit. Provide dielectric isolation where dissimilar metals are connected.
- E. Manufacturer: Metraflex Model ML Series, or equal.

## PART 3 - EXECUTION

### 3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel under the supervision of a qualified installation supervisor.

### 3.2 PREPARATION

- A. Protection of In-Place Conditions: Plug piping connections for protection from construction dirt and debris.
- B. Surface Preparation: Prior to installation of stacks, verify that shop drawings are approved and stack locations and routing have been coordinated with other trades.

### 3.3 INSTALLATION

- A. Special Techniques:
  - 1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
  - 2. Arrange products to be readily accessible for inspection, testing, and shutting off gas supply.
  - 3. Install pipe and fittings clean and free from cuttings, burrs, and defects in structure of threading, and thoroughly brushed and scale blown.
  - 4. Do not install any piping in concrete, in masonry, or below grade inside the building.
  - 5. Provide connection to gas consuming appliances. Connect gas appliances and fixtures with flexible connectors in accordance with the requirements of the appliance listing and manufacturer's instructions.

- B. Interface with Other Work: Coordinate and sequence installation of gas piping and equipment with trades responsible for portions of this and other related sections of the Project Manual.

### 3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

### 3.5 RE-INSTALLATION

- A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

### 3.6 SITE QUALITY CONTROL

- A. Site Test and Inspections:
  - 1. Test gas piping before connection to the gas source. Do not enclose or conceal any untested portion of the gas system.
  - 2. Test piping in accordance with IFGC requirements.
- B. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

### 3.7 CLEANING

- A. Clean gas piping, fittings, valves, etc., of grease, rust, dust and dirt.
- B. Paint interior piping with one coat of a suitable rust-inhibiting primer and one final coat of heat-resistant enamel paint to provide a uniform appearance. Color: black.
- C. Paint exterior piping with one coat of a suitable rust-inhibiting primer and one final coat of enamel paint to provide a uniform appearance. Color: black.

END OF SECTION 23 1123

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## SECTION 23 2113

## HYDRONIC PIPING AND SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Pipe and fittings for:
  - a. Hydronic heating piping.
  - b. Equipment drains and overflows.
2. Piping accessories.
3. Hydronic Specialties:
  - a. Expansion tanks.
  - b. Air vents.
  - c. Strainers.
  - d. Plate & frame heat exchangers.
  - e. Flushing agents.
  - f. Water treatment chemicals.
  - g. Glycol specialties.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0700 - Mechanical Insulation
5. 20 4100 - Mechanical Demolition
6. 23 0593 - Testing, Adjusting and Balancing
7. 23 2123 - Hydronic Pumps
8. 23 5216 - Condensing Boilers and Accessories

## 1.2 REFERENCES

## A. Codes and Standards:

1. International Mechanical Code (IMC).
2. International Fuel Gas Code (IFGC).
3. Uniform Plumbing Code (UPC).

4. NFPA 54 - National Fuel Gas Code.
5. NFPA 31 - Installation of Oil-Burning Equipment.
6. ASME Boilers and Pressure Vessel Code (1998), Sections IV & VI.
7. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

A. Summary:

1. This section describes specific requirements, products, and methods of execution for the system of liquid heat transfer throughout the project. The system of heat generation is specified elsewhere.
2. The existing hydronic heating system for the NSB building utilizes a 50% PG solution. Approximate system volume is estimated at 500 gallons. This project will convert the NSB building primary hydronic system to a corrosion inhibited water solution. A secondary 50% PG loop will be provided for the existing AHU-1 preheat coil.
3. Draining, flushing and filling the entire NSB building hydronic system is required.
4. Disposal of the old glycol from the primary system is required.

B. Performance Requirements:

1. Provide performance and output shown or scheduled on drawings.
2. Provide loops, pipe offsets, and swing joints, or expansion joints where required or indicated.
3. Pipes shall be capable of thermal expansion movement without disengagement of supports or forces on equipment connections.
4. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

### 1.4 PRE-INSTALLATION MEETINGS

- A. Coordinate installation of hydronic systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any hydronic components.

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1.5 SUBMITTALS

- A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
  - 1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.
- C. Shop Drawings:
  - 1. Submit shop drawings for performance-specified products and systems.
  - 2. Submit shop drawings for piping systems to demonstrate proper layout and coordination.
  - 3. Drawings of boiler room, fan rooms, and other areas with high-density piping, shall be shown at 1/4-inch scale or larger.
  - 4. Indicate elevation of piping above finish floor.
  - 5. Indicate dimensions and weights of equipment, and placement of openings and holes.
  - 6. Include reference to ductwork and other equipment where space coordination is necessary to avoid conflicts.
  - 7. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer Reports:
  - 1. Certificates, Manufacturer's Instructions, and Manufacturer's Field Reports:
    - a. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
    - b. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:
      - 1). Printed names and signatures of the installers.
      - 2). Documentation from Manufacturer's representative and Contracting Agency that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
- E. Test reports:
  - 1. Provide certificate that cleaning of hydronic systems has been accomplished.
  - 2. Provide certificate listing satisfactory results for the hydrostatic pressure tests.
  - 3. Provide hydronic fluid water chemistry test reports.

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1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance (IO&M) Manuals:
  - 1. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
  - 2. Include the following:
    - a. Copies of approved submittal information.
    - b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
    - c. Completed start-up and operational test report as required to validate equipment warranty.
    - d. Start-up and operational test reports for each piece of equipment. Report shall include printed names and signatures of the installers and documentation that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.
- C. Record Documentation: Record actual locations of equipment, valves, strainers, air vents, flexible pipe connectors, expansion joints, other components, and locations of access doors required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

## 1.7 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
  - 2. Installers: Minimum 3 years' experience in the installation and start-up of hydronic systems and equipment.
  - 3. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at Site:
  - 1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
  - 2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

3. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

B. Storage and Protection:

1. Store products outside the general construction zone in covered storage area protected from the elements, until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

## 1.9 SITE CONDITIONS

- A. Existing Conditions: Field verify existing conditions.

## 1.10 WARRANTY

A. Manufacturer Warranty:

1. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide 1 year manufacturer's warranty.
3. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.
4. Provide to the Contracting Agency 1 copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

## PART 2 - GENERAL

### 2.1 PIPE AND FITTINGS

A. Water Systems:

1. Copper pipe three inches and smaller:
  - a. Type L copper, wrought copper fittings.
  - b. Fit joints using 430 silver solder, 95-5 tin-antimony or other approved lead-free solder. Solder type must be compatible with pipe and fittings. Solder containing lead shall not be allowed on the job site.
  - c. Soldering flux: Water flushable, low corrosivity type meeting the requirements of ASTM B813. Flux shall have label indicating it meets these requirements.
  - d. Extracted branch joints (T-Drill) may be approved when Contractor can demonstrate satisfactory experience with this method. Joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-Cup series filler metal.
2. Steel pipe four inches and larger: Welded pipe and fittings.

- a. Grade B, seamless, ASTM A53 or A106.
    - b. Schedule 40 black with ANSI B16 butt weld fittings of type and wall thickness to suit pipe.
  3. Galvanized piping is not permitted.
- B. Glycol Systems (Copper or Steel Option):
  1. Copper pipe three inches and smaller:
    - a. Type L copper, wrought copper fittings.
    - b. Fit joints using 430 silver solder, 95-5 tin-antimony or other approved lead-free solder. Solder type must be compatible with pipe and fittings. Solder containing lead shall not be allowed on the job site.
    - c. Soldering flux: Water flushable, low corrosivity type meeting the requirements of ASTM B813. Flux shall have label indicating it meets these requirements.
    - d. Extracted branch joints (T-Drill) may be approved when Contractor can demonstrate satisfactory experience with this method. All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-Cup series filler metal.
  2. Steel pipe four inches and larger: Welded pipe and fittings. No threaded pipe allowed.
    - a. Grade B, seamless, ASTM A53 or A106.
    - b. Schedule 40 black with ANSI B16 butt weld fittings of type and wall thickness to suit pipe.
  3. Viega ProPress copper press-fit joint-type pipe systems are not permitted.
  4. Victaulic mechanical joint-type pipe systems are not permitted.
  5. Galvanized piping is not permitted.
- C. Copper Press Fitting System:
  1. Limited to tubing sizes 4 inch and smaller.
  2. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
  3. IAPMO UPC listing.
  4. Manufacturer: Viega ProPress only, no substitutions.
- D. Equipment drains and overflows: Type L copper pipe, wrought copper fittings.

## 2.2 VALVES

- A. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig saturated steam or 200 psig W.O.G. Packing material or seals shall not contain asbestos. Select linings and seals appropriate for the fluid used.

- B. Manufacturers: Crane, Nibco, Hammond, Jenkins, Grinnell, Milwaukee, Stockham,
- C. Ball Valves 2 inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 psig pressure/temperature rating (steam).
- D. Ball Valves, 2-1/2 inch through 12 inch: Two piece type, full port, carbon steel or stainless steel body and ball, TFE seats, 150 psig pressure/temperature rating (steam). May be substituted for gate valves except where otherwise indicated.
- E. Gate Valves, two inch and smaller: Bronze body and trim, rising stem, solid wedge. Use only where shown on drawings.
- F. Gate Valves, 2-1/2 inch through four inch: Iron-body, bronze trim, flanged threaded or sweat fitting. Non-rising stem: Inside screw. Rising stem: OS&Y. Bronze valves optional for 2-1/2 inch and three-inch.
- G. Gate valves, six inch and larger: Iron body bronze trim, flanged. Rising stem: OS&Y, or non-rising stem with solid wedge.
- H. Globe Valve two inch and smaller: Bronze body, renewable disc suitable for service.
- I. Globe or Angle Valve 2-1/2 inch and larger: Iron body, bronze trim, flanged, bronze disc. Bronze valves optional for 2-1/2 inch and three-inch.
- J. Swing Check Valves two inch and smaller: Bronze body, horizontal swing, Y-pattern, Buna-N-disc for water, oil and gas. TFE disc for steam.
- K. Swing Check Valves 2-1/2 inch and larger: Iron body, horizontal swing, bolted bonnet, renewable bronze seat and disc, flanged or grooved. Bronze valves optional for 2-1/2 inch and three-inch.
- L. Butterfly Valves two inch and smaller: 150 psig bubble tight shutoff, suitable for 220 degrees F. operation, viton seal, lever handle, full flow low Cv type, bronze body and stainless steel trim, recommended by manufacturer for system intended. Manufacturer: Milwaukee "Butterball".
- M. Butterfly Valves four inch and smaller: Lug type ductile iron body, EPT O-ring and seat, disc for 150 psig shutoff, valve rated for 220 degrees F. on heating systems and other 200 degrees F. systems. All others, lever handle. Manufacturers: Dezurik, Nibco, Demco, Keystone, Milwaukee, Norris
- N. Drain Valves: Full port ball valve with threaded hose adapter with bronze end cap. Do not use sillcocks or butterfly valves as drain valves.
- O. Valves Specified Elsewhere: Provide special valves such as motor-operated valves, relief valves, temperature regulating valves, etc., as specified under the individual system or as indicated on the drawings.

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2.3 UNIONS (STANDARD)

- A. Steel Piping (Threaded):
  - 1. Class 150 malleable iron, ground joint, copper or copper alloy seat. Grinnell No. 463. (150 psig steam, 300 wog).
  - 2. Where indicated: Class 250 malleable iron ground joint, copper or copper alloy seat. Grinnell No. 554.
- B. Copper Piping (Sweat and Threaded): Cast brass, ground joint, copper to copper, or copper to threaded joint. Grinnell No. 9730 - 9739.

## 2.4 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

- A. Provide dielectric unions for two inch pipe and smaller.
- B. Provide dielectric flanges for 2-1/2 inch pipe and larger.
- C. Insulating gaskets shall be suitable for fluid type, temperature and pressure.
- D. Galvanized pipe to copper: Brass threaded end and sweat copper end.
- E. Black steel to copper: Zinc plated steel threaded end and sweat copper end.
- F. Manufacturers: Capitol, Epco, Control Plastics, Watts, or approved equal.

## 2.5 PRESSURE GAUGES

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Bourdon tube type with 4-1/2-inch dial (minimum) accuracy plus or minus one-percent span, recalibratable. Normal operating pressure near midpoint of range. Industrial quality.
- C. Gauge cock on gauges and pulsation damper (snubber). Steam gauges shall have siphon to isolate gauge from steam, except where remotely mounted and connected by looped tubing.
- D. Differential pressure gauges shall be piston or diaphragm type with range suitable for application and static pressure capability suitable for system pressure. Orange Research.

## 2.6 THERMOMETERS

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Provide where shown on drawings, specified in Part 3, or as required.
- C. Digital self-powered type.



- D. Weiss DVU or equal.

## 2.7 PRESSURE AND TEMPERATURE TEST PLUGS

- A. Provide where shown on drawings, specified in Part 3 or as required.
- B. Standard type for 1/8-inch diameter pressure or temperature probes. Self seal when probe removed and complete with threaded cap. Minimum continuous rating 125 PSIG and 220 degrees F coincident. Sealing element suitable for fluid in pipe.
- C. Provide one thermometer and one pressure gauge for each range required by system parameters.
- D. Manufacturers: Sisco, Peterson Equipment, or approved equal.

## 2.8 EXPANSION TANKS

- A. General:
  - 1. Performance as scheduled.
  - 2. Full acceptance flexible heavy duty butyl removable bladder or flexible heavy duty butyl diaphragm sealed into tank, as scheduled.
- B. Construction:
  - 1. Designed, tested and stamped in accordance with ASME SEC 8-D standards; supplied with National Board Form U-1.
  - 2. Welded steel shell and base.
  - 3. Forged steel system connections.
  - 4. Steel support stand.
- C. Ratings:
  - 1. Working pressure: 125 PSIG.
  - 2. Working Temperature: 240 degrees F.
  - 3. Precharge: As Scheduled.
- D. Accessories:
  - 1. Pressure gage.
  - 2. Air charging fitting.
  - 3. Tank drain isolation valve.
  - 4. System connection isolation valve.
- E. Model and size: As scheduled.
- F. Manufacturers: Amtrol, Armstrong, Bell & Gossett, Taco, or equal.

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2.9 AIR VENTS

- A. High Capacity Float Type:
  - 1. Forged brass body, non-ferrous internals suitable for system operating temperature and pressure; with isolating valve.
  - 2. Maximum operating pressure 150 psig and maximum operating temperature 250 deg F. Provide ball type isolation valves for air vents that do not have integral rated shut off valves.
  - 3. Manufacturers: Spirotherm VTP or equal.

## 2.10 STRAINERS

- A. Size two inch and under:
  - 1. Screwed brass or iron body for 175 PSIG working pressure.
  - 2. Y pattern with 1/32-inch stainless steel perforated screen.
- B. Size 2-1/2 inches to four inches:
  - 1. Flanged or grooved iron body for 175 PSIG working pressure.
  - 2. Y pattern with 1/32-inch stainless steel perforated screen.
- C. Manufacturers: Metraflex, Armstrong, Crane, Hayward, Watts Regulator, Hoffman, Sarco.

## 2.11 AUTOMATIC FLOW LIMITING VALVES

- A. Body material: Steel pipe schedule 40.
- B. Flanged connections.
- C. 230 psig and 300 deg F pressure and temperature rating.
- D. 250 GPM flowrate. Hi-flow model with 3-18 psig nominal control range. 5.8 ft head loss.
- E. Flow Control Cartridge: Stainless steel one piece cartridge with segmented port design and full travel linear coil spring.
- F. Manufacturer: Griswold Controls or equal.

## 2.12 BALANCING VALVES

- A. Provide calibrated plug or ball valve type balancing valves with self-sealing quick connect pressure taps, scale and locking device. Include schedule with submittal.
- B. Manufacturers: Bell & Gossett, Taco or equal.

**2.13 PLATE HEAT EXCHANGERS**

- A. Provide plate type heat exchanger(s) with the heat transfer and hydraulic performance characteristics as scheduled.
- B. Heat exchangers to include the following:
  - 1. Frame and pressure plates: Carbon steel with baked epoxy coating.
  - 2. Channel plates: Type 304 stainless steel.
  - 3. Tightening bolts: Steel.
  - 4. Gasket material: Nitrile (glycol compatible).
  - 5. Nozzles: 2" NPT carbon steel.
  - 6. Frame: Carbon steel with baked epoxy paint, side-bolts and plate shroud.
- C. Manufacturers: Bell & Gossett, Trantor, Mueller, or equal.

**2.14 FLUSHING AGENT**

- A. Synthetic organic dispersant manufacturer: CH2O, Product 6149 or approved equal.

**2.15 WATER TREATMENT**

- A. Hydronic loop treatment manufacturer: CH2O, Product 6439 or approved equal.

**2.16 GLYCOL SYSTEMS**

- A. Provide equipment and products specifically designed and approved for continuous operation with the glycol solution specified.
- B. Glycol Solution:
  - 1. Inhibited propylene glycol solution premixed to 50 percent by volume for use with hydronic heating systems.
  - 2. Fluid analysis test kit.
  - 3. Manufacturer: Dow Chemical Company Dowfrost. No substitutes.

**PART 3 - PRODUCTS****3.1 INSTALLERS**

- A. Installer: Perform work by experienced personnel previously engaged in hydronic system construction and under the supervision of a qualified installation supervisor.

### 3.2 PREPARATION

- A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- B. Surface Preparation:
  - 1. Prior to installation of equipment, verify concrete housekeeping pads are complete and properly sized for equipment mounting.
  - 2. Prior to installation of piping and equipment, verify that shop drawings are approved and locations and routing have been coordinated with the work of other trades.

### 3.3 INSTALLATION

- A. Special Techniques:
  - 1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
  - 2. Provide finished products with protective covers during balance of construction.
  - 3. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at terminal devices. Provide drains and manual vents at main line and branch line valves to facilitate draining and filling piping sections. Provide caps on drain outlets.
  - 4. Access Doors: Provide appropriate size and install such that hydronic system features are readily accessible and maintainable.
  - 5. Install balancing valves and automatic flow limiting valves to be accessible and adjustable.
  - 6. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 7. Use of bullhead tee with opposed flow, double inlet configuration not allowed.
  - 8. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  - 9. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
  - 10. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes.
  - 11. Thermal Expansion:
    - a. Install piping to allow for normal thermal expansion and contraction without stressing pipe, joints, or connected equipment.
    - b. Provide anchors where necessary and as shown.
    - c. Provide support and expansion loops, expansion compensators, and alignment guides to suit conditions and as shown on drawings.
    - d. Piping shall be guided and restrained as recommended by the manufacturer.

12. Provide test plugs on both inlet and outlet sides of heat transfer elements to allow measurement of both fluid pressure drop and differential temperature.
13. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
14. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
15. Provide pipe anchors offsets, loops and expansion compensators as required to control the expansion of pipelines.
16. Flushing:
  - a. The removal of the existing glycol solution for the entire building system is required. Flushing of the entire system is required. Provide provision for cleaning and flushing as required. Approximate volume of the primary system is 500 gallons.
  - b. Clean internal surfaces of the completed heating system as follows:
    - 1). Flush hydronic piping to remove black magnetic iron oxide and mill scale from the system.
    - 2). Flush system piping with synthetic organic dispersant to remove grease. Circulate solution through system at 150 degrees F. or greater for 12 to 24 hours.
    - 3). Repeat process until the system is clean to the satisfaction of the Contracting Agency.
    - 4). Flush system with fresh water as necessary to remove residual cleaning agent.
    - 5). Exercise proper care during flushing and cleaning of systems to make sure no damage is done to equipment, valves, fittings, or Work of other trades. Restore damaged system components or Work of other trades to new or original condition at no additional cost to Owner.

- B. Interface with Other Work: Coordinate and sequence installation of hydronic products with trades responsible for portions of this and other related sections of the Project Manual.

### 3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.
- C. Touch-up finished surfaces with touch-up paint provided by the equipment manufacturer.

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3.5 SITE QUALITY CONTROL

- A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.
- B. Manufacturer Services:
  - 1. Verify units are installed and operational in accordance with the manufacturer's written installation instructions.
  - 2. Both the Contractor and Manufacturer's Representative(s) shall sign start-up and operational checklist to confirm proper unit installation and operation.
  - 3. Provide samples of the inhibited propylene glycol solution to the manufacturer for testing using the fluid analysis test kit provided.
  - 4. The manufacturer of the inhibited propylene glycol solution shall provide free testing of the solution 24 hours after system startup and again 90 days later to verify proper fluid performance for both tests.
  - 5. Provide one copy of manufacturer's test reports to the Owner. Adjust fluid concentration and/or correct deficiencies as addressed in the report.
- C. Hydronic System Cleaning and Treatment Coordination Meeting:
  - 1. Conduct a meeting prior to flush cleaning and treatment of the hydronic heating system to discuss cleaning agents, treatment chemicals and procedures to be used. Discuss system fill procedures with inhibited water and propylene glycol solution.
  - 2. Participants shall include the Contractor, Subcontractor directly performing the work and the Owner's Maintenance Staff personnel.
  - 3. Provide one week notice prior to the meeting.
  - 4. Cleaning, filling and treatment of the hydronic heating system is not permitted until this coordination meeting has been conducted and the Contracting Agency's concerns have been adequately addressed.
- D. System fill:
  - 1. After flush cleaning the entire building hydronic heating system and flushing the strainers at all terminal units, fill the primary system with water and add treatment chemicals to the concentration recommended by the manufacturer. Fill the secondary loop system with inhibited propylene glycol solution as specified.
  - 2. Provide fluid testing to document the fluid chemistry for both the primary water system and the secondary glycol system.
  - 3. Thoroughly vent the systems to include piping high points and equipment vents (pump casings, air separators, etc.).
- E. Site Tests:
  - 1. Hydrostatic Pressure Test:
    - a. Make sure hydronic heating system is filled with clean operating fluid. Hydrostatically test system to 100 psig. System must hold test pressure for a two hour period with no pressure drop to pass test.

- b. Inspect system during test and repair leaks.
    - c. Provide written report indicating that the pressure test has been satisfactorily completed.
  - 2. Operational Test:
    - a. Inspect system for proper fluid circulation, sufficient clearance for expansion and contraction of piping and proper system pressure control.
    - b. Note and correct discrepancies and deficiencies.
    - c. Provide written report indicating that the operational test has been satisfactorily completed.
  - 3. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.
- F. Inspection:
- 1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.
- G. Verify penetrations are installed to maintain assembly integrity.

### 3.6 SYSTEM STARTUP

- A. Start-up and operate hydronic heating systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.
- B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

### 3.7 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.
- B. Coordinate and work directly with the Balancing and Testing Agency and the requirements of Section 23 0593 - Testing, Adjusting and Balancing, to provide systems in proper operating order.
- C. Make corrections and adjustments as required by the Testing, Adjusting and Balancing (TAB) Agency in a timely manner.

### 3.8 CLEANING

- A. Waste Management: After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

3.9 CLOSEOUT ACTIVITIES

- A. Training: Provide 2 hours of operational instruction conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

END OF SECTION 23 2113



## SECTION 23 2115

## WELL WATER COOLING PIPING AND SPECIALTIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Pipe and fittings for: Well water cooling piping.
2. Valves.
3. Well water cooling specialties:
  - a. Air vents.
  - b. Balancing valves.
  - c. Back Pressure (Pressure Sustaining) Valves
  - d. Air/Vacuum Valves
4. Access doors.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 20 0700 - Mechanical Insulation
5. 23 0593 - Testing, Adjusting and Balancing
6. 25 9000 - Sequence of Operations

## 1.2 REFERENCES

## A. Codes and Standards:

1. International Mechanical Code (IMC).

## B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for the system of well water cooling throughout the project.
2. Design expansion compensation system to adequately protect piping and structure from thermal expansion and contraction forces.
3. See Division 33 for well pump information.

#### B. Performance Requirements:

1. Provide performance and output shown or scheduled on drawings.
2. Operate well water cooling system in accordance with Section 25 9000 - Sequence of Operations.

### 1.4 PREINSTALLATION MEETINGS

- #### A.
- Coordinate installation of well water cooling systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any well water cooling components.

### 1.5 SUBMITTALS

- #### A.
- Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

#### B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section.
2. Literature clearly annotated to indicate specified salient features and performance criteria.

#### C. Shop Drawings:

1. Submit shop drawings for performance-specified products and systems.
2. Submit shop drawings for piping systems to demonstrate proper layout and coordination.
3. Drawings of mechanical rooms and other areas with high-density piping shall be shown at 1/4-inch scale or larger.
4. Indicate elevation of piping above finish floor.
5. Indicate dimensions and weights of equipment, and placement of openings and holes.
6. Include reference to ductwork and other equipment where space coordination is necessary to avoid conflicts.
7. Indicate mechanical and electrical service locations and requirements.

## D. Quality Control Submittals:

1. Design Data: Submit calculations for performance specified products and systems.
2. Certificates, Manufacturer's Instructions, and Manufacturer's Field Reports:
  - a. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment. Clearly annotate the manual to indicate applicable information for the specific equipment model(s) installed.
  - b. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:
    - 1). Printed names and signatures of the installers.
    - 2). Documentation from Manufacturer's representative and Contracting Agency that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
3. Provide test reports - Provide certificate:
  - a. That cleaning of well water cooling system has been accomplished.
  - b. Listing satisfactory results for the hydrostatic tests.
  - c. Listing satisfactory results for the operational tests.

## E. Manufacturer Reports:

1. Test reports:
  - a. Provide certificate listing satisfactory results for the hydrostatic pressure tests.
  - b. Provide certificate listing satisfactory results for the operational tests.
2. Submit start-up report and operational checklist to confirm proper system installation and operation.

## 1.6 CLOSEOUT SUBMITTALS:

## A. Operation and Maintenance Data:

1. Refer to Section 20 0000 - Mechanical General Requirements, for Operation and Maintenance (IO&M) Manual formatting requirements and number of copies required.
2. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, parts listings, and spare parts list.

## B. Record Documentation: Record actual locations of valves, water meter, other components, and locations of access doors required for access or valves.

## 1.7 QUALITY ASSURANCE

### A. Qualifications

1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
2. Installers: Minimum three years' experience in the installation and start-up of well water cooling systems.
3. Testing Agencies: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

### A. Delivery and Acceptance Requirements:

1. Verify products are new and delivered in original factory packaging/crating and are free from damage and corrosion.
2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.

### B. Storage and Handling Requirements:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

## 1.9 WARRANTY

### A. Manufacturer Warranty:

1. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide 1 year manufacturer's warranty.

## PART 2 - PRODUCTS

## 2.1 PIPE AND FITTINGS

### A. Steel pipe four inches and larger: Welded pipe and fittings.

1. Grade B, seamless, ASTM A53 or A106.
2. Schedule 40 black with ANSI B16 butt weld fittings of type and wall thickness to suit pipe.

### B. Copper Pipe: Type L copper, wrought copper fittings.

1. Joints: Brazed.
- C. Galvanized piping is not permitted.

## 2.2 VALVES

- A. See Section 23 2113 - Hydronic Piping and Specialties.
- B. Combination Air/Vacuum Valve (well water cooling):
1. Provide sizes as shown on drawings.
  2. Combination Air/Vacuum Valve sizes one inch through six inch, (single body, double orifice) allows large volumes of air to escape out the large orifice when filling a pipeline and closes when liquid enters the valve. The valve shall re-open during draining or if a negative pressure occurs allow large volumes of air to enter during pipeline drainage to break the vacuum.
  3. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512. Valves manufacturer shall have a quality management system certified to ISO 9001 by an accredited, certifying body.
  4. Valves 3 inches and smaller shall have full size NPT inlets and outlets equal to the nominal valve size.
  5. Design:
    - a. Valve body shall provide a through flow area equal to the valve size. A bolted cover and gasket shall be provided for maintenance and repair.
    - b. Floats to be unconditionally guaranteed against pressure surge failures and shall be protected against direct water impact by an internal baffle.
  6. Materials:
    - a. Valve body, cover, and baffle shall be ASTM A126 Class B cast iron for Class 125 and Class 250 valves.
    - b. The float, guide shafts, and bushing shall be constructed of Type 315 stainless steel; no exceptions. Resilient seats shall be Buna-N.
  7. Options:
    - a. Provide a stainless-steel inlet/outlet screen.
  8. Paint valve exterior with universal alkyd primer.
  9. Manufacturer:
    - a. Val-Matic Valve and Manufacturing Corporation, Series 100.
    - b. Approved equal.

## 2.3 BACK PRESSURE (PRESSURE SUSTAINING) VALVE

- A. Description: A self contained, adjustable valve that modulates to prevent the pressure upstream the valve from falling below a predetermined, adjustable minimum.
- B. Design: The pressure sustaining valve shall be a single-seated, line pressure operated, diaphragm actuated, pilot controlled globe valve. The valve shall seal by means of a

corrosion-resistant seat and a resilient, rectangular seat disc. These, and other parts, shall be replaceable without removing the valve from the line. The stem of the main valve shall be guided top and bottom by integral bushings. Alignment of the body, bonnet and diaphragm assembly shall be by precision dowel pins. The diaphragm shall not be used as a seating surface, nor shall the pistons be used as an operating means. The pilot system shall be furnished complete and installed on the main valve. It shall include a closing speed control, Y-strainer and isolation ball valves. The pressure sustaining valve shall be operationally and hydrostatically tested prior to shipment.

- C. **Materials and Construction:** The main valve body and bonnet shall be ductile iron per ASTM A536, Grade 65-45-12. End connections shall be ANSI B16.42 Class 150# flange. All ferrous surfaces shall be coated with a minimum of 4 mils of an NSF-61 approved epoxy. The main valve seat ring shall be bronze. Elastomers (diaphragms, resilient seats and O-rings) shall be Buna-N. The control pilot shall be bronze. The closing speed control and isolation ball valves shall be brass, and control line tubing shall be copper.
- D. **Operating Conditions:** The pressure sustaining valve shall be suitable for controlling the inlet pressure to a minimum of 2 psi at flow rates ranging from 60 to 200 gpm.
- E. **Valve Sizes:**
  - 1. As shown on drawings.
- F. **Manufacturers:**
  - 1. **Basis of Design:**
    - a. OCV Control Valves, Model 108-2.
  - 2. Approved Equal.

## 2.4 BALANCING VALVES

- A. Provide calibrated plug or ball valve type balancing valves with self-sealing quick connect pressure taps, scale and locking device. Include schedule with submittal.
- B. **Manufacturers:** Bell & Gossett, Taco, or equal.

## PART 3 - EXECUTION

### 3.1 INSTALLERS

- A. **Installer:** Perform work by experienced personnel under the supervision of a qualified installation supervisor.

### 3.2 PREPARATION

- A. **Protection of In-Place Conditions:** Cover equipment and plug piping connections to protect components from construction dirt and debris.

### 3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Special Techniques:
  - 1. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at all terminal devices. Provide drains and manual vents at main line and branch line valves to facility draining and filling piping sections.
  - 2. Install balancing valves to be accessible and adjustable.
  - 3. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 5. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  - 6. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one (1) coat of zinc rich primer to welding.
  - 7. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes..
  - 8. Thermal Expansion:
    - a. Install piping to allow for normal thermal expansion and contraction.
    - b. Provide anchors where necessary and as shown.
    - c. Piping shall be guided and restrained as recommended by the manufacturer.
  - 9. Provide test plugs on both inlet and outlet sides of heat transfer elements to allow measurement of both fluid pressure drop and differential temperature.
- C. Interface with Other Work:
  - 1. Coordinate and sequence installation of well water cooling products with trades responsible for portions of this and other related sections of the Project Manual.
  - 2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related work shall be completed at no additional expense to the Owner.

### 3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

### 3.5 SITE QUALITY CONTROL

- A. System fill:
  - 1. At system start up time, flush out the well water cooling system.
  - 2. Thoroughly vent the system at piping high points.
- B. Site Tests and Inspections:
  - 1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.
  - 2. Hydrostatic Pressure Test:
    - a. Make sure well water cooling system is filled with clean well water. Hydrostatically test system to 100 psi. System must hold test pressure for a 2-hour period with no pressure drop to pass test.
    - b. Inspect system during test and repair leaks.
    - c. Provide written report indicating that the pressure test has been satisfactorily completed.
  - 3. Operational Test:
    - a. Inspect system for proper fluid circulation, sufficient clearance for expansion and contraction of piping and proper system pressure control.
    - b. Note and correct discrepancies and deficiencies.
    - c. Provide written report indicating that the operational test has been satisfactorily completed.
  - 4. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.
- C. Manufacturer Services:
  - 1. Verify units are installed and operational in accordance with the manufacturer's written installation instructions.
  - 2. Both the Contractor and Manufacturer's Representative(s) shall sign start-up and operational checklist to confirm proper system installation and operation.

### 3.6 SYSTEM STARTUP

- A. Start-up and operate well water cooling systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.

### 3.7 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturers' recommendations, or as otherwise directed.
- B. Coordinate and work directly with the requirements of Section 23 0593 - Testing, Adjusting and Balancing, to provide systems in proper operating order.



- C. Make corrections and adjustments as required by the Testing, Adjusting and Balancing (TAB) Agency in a timely manner.

### 3.8 CLEANING

- A. Clean internal surfaces of the completed well water cooling system as follows:
  - 1. Flush well water cooling piping with fresh water as necessary to remove black magnetic iron oxide and mill scale from the system.
  - 2. Repeat process until the system is clean to the satisfaction of the Contracting Agency.
  - 3. Exercise proper care during flushing of systems to make sure no damage is done to equipment, valves, fittings, or Work of other trades. Restore damaged system components or Work of other trades to new or original condition at no additional cost to Owner.
- B. Clean the exterior of apparatus and piping at the completion of the Work.

### 3.9 CLOSEOUT ACTIVITIES

- A. Training: Provide 1 hour of operational instruction conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

### 3.10 PROTECTION

- A. Provide finished products with protective covers during balance of construction.

END OF SECTION 23 2115

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## SECTION 23 2123

## HYDRONIC PUMPS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. System lubricated circulators.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0513 - Common Motor Requirements
3. 20 0529 - Mechanical Hangers and Supports
4. 20 0553 - Mechanical Identification
5. 23 0593 - Testing, Adjusting and Balancing
6. 25 9000 - Sequence of Operations

## 1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

## 1.3 SYSTEM DESCRIPTION

## A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the pumping of heating fluid, which will be distributed to the locations shown.
2. The method of generation of, and distribution of, this heat is specified elsewhere.

## B. Performance Requirements:

1. Select pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
2. Provide performance and output shown or scheduled on drawings.

#### 1.4 SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements.
- B. Product Data:
  - 1. Provide manufacturers' product literature, clearly annotated to indicate specified salient features and performance criteria.
  - 2. Include the following:
    - a. Catalog data sheets for each pump scheduled. Indicate which model is being submitted.
    - b. Pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
    - c. Dimensional data.
    - d. Features and appurtenances being provided.
    - e. Electrical characteristics and connection requirements.
- C. Closeout Submittals:
  - 1. Project Record Documents: Record actual locations of pumps and associated valves, and areas required for maintenance access.
  - 2. Operation and Maintenance (IO&M) Manuals:
    - a. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
    - b. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, assembly views, lubrication instructions, maintenance and repair data, parts listings, and spare parts list.

#### 1.5 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
  - 2. Acceptable Installers: Minimum three years experience in the installation and start-up of pumps.
- B. Pre-Installation Meetings: Coordinate installation of pumps and associated piping and valves with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.
- C. Regulatory Requirements: Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

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1.6 DELIVERY, STORAGE, AND HANDLING

## A. Acceptance at Site:

1. Verify that products are delivered in original factory packaging and are free from damage and corrosion:
2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

## B. Storage and Protection:

1. Outside the general construction zone, store products in covered storage area protected from the elements until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

## 1.7 WARRANTY

- A. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
- B. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.
- C. Provide to the Contracting Agency one copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

## PART 2 - PRODUCTS

## 2.1 SYSTEM LUBRICATED CIRCULATORS

- A. Type: Horizontal shaft, single-stage, direct connected, with resiliently mounted motor for in-line mounting.
- B. Materials:
  1. Pump: Cast iron, with flanged pump connections.
  2. Impeller: Replaceable stainless steel cartridge.
  3. Mechanical Seal Assembly: None.
- C. Performance:
  1. As scheduled.
  2. Maximum working temperature: 230 degrees F.
  3. Maximum working pressure: 140 psig.
- D. Electrical Characteristics:

1. As scheduled.
  2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- E. Manufacturers: Grundfos UP Series (Basis of Design), Armstrong, Bell and Gossett, Taco.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection: Cover pumps and plug piping connections to protect pumps from construction dirt and debris.
- B. Preparation: Prior to installation of pumps, verify that electrical power is available and of the same voltage and phase characteristics as the pump being installed.

### 3.2 INSTALLATION

- A. Install pumps, pump supports, suction guides, mechanical seal piping, pressure gauges and other pump appurtenances in accordance with the manufacturer's written installation instructions.
- B. Provide access space around pumps for service. Provide no less than the minimum as recommended by manufacturer.
- C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.
- D. Provide line sized shut-off valve on pump suction, and line sized soft seat check valve.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Provide gauges with connections to suction and discharge.
- H. Check, align, and certify alignment of base mounted pumps prior to start-up.
- I. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.
- J. Lubricate pumps before start-up.

### 3.3 CONSTRUCTION

- A. Interface with Other Work:
  - 1. Coordinate and sequence installation of pumps and appurtenances with trades responsible for portions of this and other related sections of the Project Manual.
  - 2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

### 3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

### 3.5 ADJUSTING

- A. Coordinate and work directly with the Testing, Adjusting and Balancing Agency to provide systems in proper operating order. Make corrections and adjustments as required by the Balancing and Testing Agency in a timely manner.

### 3.6 CLEANING

- A. After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.
- B. Touch up marred or scratched factory finished surfaces using finish materials furnished by manufacturer.

### 3.7 DEMONSTRATION & START-UP

- A. Start-up and operate hydronic pumps in accordance with the manufacturer's written installation and operation manual checklist.
- B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

END OF SECTION 23 2123

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## SECTION 23 3100

## DUCTS AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Metal Ductwork and Fittings.
  - 2. Flexible Ductwork.
  - 3. Smoke dampers
  - 4. Access Panels and Doors.
- B. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 20 0529 - Mechanical Hangers and Supports
  - 3. 23 0593 - Testing, Adjusting and Balancing
  - 4. 23 3600 - Air Terminal Units
  - 5. 23 3700 - Air Outlets and Inlets

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. International Building Code (IBC).
  - 2. International Mechanical Code (IMC).
  - 3. ASHRAE Standard 90.1-2010 Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - 4. SMACNA HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005.
  - 5. SMACNA HVAC Air Duct Leakage Test Manual, Second Edition 2012.
  - 6. SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, Fifth Edition 2002.
  - 7. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
  - 8. ACR the National Air Duct Cleaners Association (NADCA) Standard for Assessment, Cleaning and Restoration of HVAC Systems, 2013.

### 1.3 SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Include manufacturer's detailed fire, smoke, and combination fire/smoke damper installation instructions for each specific wall, ceiling, and floor construction type(s) for the project.

### 1.4 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.
- C. Record Documentation: Record actual locations of ductwork and areas required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

### 1.5 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturers: Minimum five (5) years of documented experience manufacturing commercial HVAC duct work and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - 2. Installers: Minimum five (5) years of experience in the installation of commercial HVAC ductwork and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

### 1.7 WARRANTY

- A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

## PART 2 - PRODUCTS

## 2.1 METAL DUCTWORK AND FITTINGS

- A. General: Provide metal ductwork and fittings fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, G90 zinc coated unless otherwise noted.
- B. Medium Pressure/Velocity Ductwork:
1. Duct Pressure Class: 4 inches WC.
  2. Seal Class: A.
  3. Maximum Velocity: 2,200 FPM.
- C. Low Pressure/Velocity Ductwork:
1. Duct Pressure Class: 2 inches WC.
  2. Seal Class: A.
  3. Maximum Velocity: 1,500 FPM.

## 2.2 FLEXIBLE DUCTWORK

- A. Manufacturers:
1. Thermaflex, Model M-KE.
  2. Hart & Cooley.
  3. JPL.
  4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.
- B. Description: UL listed, Class 1 flexible ductwork in compliance with NFPA 90A and 90B.
- C. Performance/Design Criteria:
1. Positive Pressure Rating:
 

Ten inches WC	(4"-12" ID).
Six inches WC	(14"-16" ID).
Four inches WC	(18"-20" ID).
  2. Negative Pressure Rating:
 

One inch WC	(4"-12" ID).
One half inch WC	(14"-20" ID).
  3. Maximum Velocity: 5000 FPM.
  4. Operating Temperature Range:
    - a. 0 degrees F to 140 degrees F (continuous).
    - b. Minus 20 degrees F to 250 degrees F (intermittent).
  5. Insulating Value: R-4.2.

6. Acoustical Net Insertion Loss (Based on 8 inch duct, 10 feet long, 1,000 fpm airflow):

<b>band</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
<b>dB</b>	34	30	22	(16)	(17)	(18)	(18)

D. Materials:

1. Acoustically rated black polyester core permanently bonded to coated spring steel wire helix.
2. Fiberglass insulation.
3. Tear resistant, reinforced metalized vapor barrier.

## 2.3 SMOKE AND COMBINATION FIRE / SMOKE DAMPERS

A. Manufacturers:

1. Ruskin (Basis of Design).
2. Greenheck.
3. Pottorff.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Regulatory Requirements:

1. Smoke dampers UL listed and labeled in accordance with UL Standard 555S.
2. Combination fire/smoke dampers also listed in accordance with UL Standard 555.

C. Performance/Design Criteria:

1. Fire rating suitable for the applicable wall construction rating in accordance with IBC.
2. Rated for use in dynamic system with maximum velocity of 2,000 fpm and maximum 4" w.g. static pressure.
3. Elevated temperature rating: Minimum 250 degrees F.
4. Leakage classification: Class II.
5. Supply damper actuators as part of the listed damper assembly. If the damper actuators must be provided separately, actuators must be UL listed for a temperature rating greater than or equal to that of the damper.
6. Provide damper actuators powered by 120 VAC, energized in the normal open position and spring driven closed on loss of power. See Section 28 3100 - Addressable Fire Alarm System for sequences of operation.
7. Provide thermal actuation of combination fire/smoke dampers by a UL listed electric temperature-sensing device (165 degrees F electric fuse link) with manual remote reset capability from the fire alarm system.

---

2.4 ACCESS PANELS AND DOORS FOR DUCTS AND PLENUMS

## A. Manufacturers:

1. Air Balance Inc. model FSA-100 (Basis of Design).
2. Ruskin.
3. Ductmate.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

## B. Material:

1. Frame and Door: Minimum 24 gauge galvanized steel.
2. Reinforced doors with cross-bracing and/or otherwise stiffened to prevent rattling and vibration.
3. Seals: Rubber gaskets, secured to door or frame.
4. Where ductwork is insulated or lined, provide double-walled access door panels with one (1) inch of internal insulation to match duct or plenum insulating and/or sound attenuating characteristics.
5. Walk Through Doors:
  - a. Construct in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
  - b. Provide insulation and inner liner to match plenum or casing.

## C. Hinges and Latches:

1. Low velocity system access panels:
  - a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.
  - b. Continuous steel hinge mechanically fastened to frame and quarter turn cam latches.
2. Medium velocity system access panels:
  - a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.
  - b. Continuous steel hinge mechanically fastened to frame.
  - c. Provide a minimum of two latches for rolled plate doors.
  - d. Cement sheet rubber gasket to door.
3. Walk through doors (any dimension over 24 inches):
  - a. Provide three hinges.
  - b. Provide two latches with inside and outside handles.

---

PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Verify location, size and type (i.e. fire resistive construction) of wall, floor and ceiling/roof penetrations.

### 3.2 PREPARATION

- A. Protection on In-Place Conditions: During construction, install temporary closures of sheet metal, cardboard or polyethylene taped over ductwork openings to prevent construction dust and debris from entering duct systems.

### 3.3 INSTALLATION

A. Metal Ductwork and Fittings:

1. Install, seal and support ductwork and fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible for the duct pressure class and seal class specified. The use of "duct tape" as a duct seal method is prohibited.
2. Provide medium pressure/velocity ductwork at the following locations: VAV ventilation systems from air handler cabinet discharge plenum connection to VAV terminal unit inlet neck connection.
3. Provide low pressure/velocity ductwork at the following locations:
  - a. VAV terminal unit discharge connections to air outlet connections.
  - b. Outside air intake ductwork.
4. Proprietary or other joint systems may be substituted for SMACNA details when submitted and approved in writing before starting work.
5. Where ducts penetrate through walls exposed in occupied spaces, provide sheet metal escutcheons at each penetration to provide a clean, finished appearance.
6. Duct penetrations: See Section 20 0529 – Mechanical Hangers and Supports.
7. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoffs, use 90-degree conical tee or low-loss tee connections.
8. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream of equipment.
9. Provide orifice plates or balance dampers at branch connections as required for proper ventilation system balancing. Select balancing device and installation method to limit noise from mechanical vibration or air bypass.
10. Do not use turning vanes in medium velocity duct systems.
11. Support duct mounted equipment equal to or greater than 40 pounds, such as heating coils, independently from ductwork.
12. Support duct mounted equipment less than 40 pounds using standard duct supports and sway bracing located within 12 inches of equipment.
13. Where offsetting ductwork is not possible, ducts may be reduced a maximum of 20 percent to clear obstacles with Contracting Agency's permission.
14. Where steel ductwork is visible through air outlets or inlets, paint visible interior ductwork flat black.

B. Flexible Ductwork:

1. Install, connect and support flexible ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

2. Connection to air outlets in suspended grid ceiling systems: Provide a flexible duct length of 8 to 10 feet with one 90-degree bend or large radius 180-degree curve in addition to outlet connection. Support flexible duct at connections to air outlets to maintain minimum recommended bend radius.
  3. Seal flexible duct connections to rigid ductwork with draw bands to the pressure class of the rigid duct system.
  4. Flexible duct connections between medium pressure ductwork and air terminal units are prohibited.
  5. Flexible ductwork is prohibited in inaccessible locations, such as above "hard" ceilings.
  6. Flexible ductwork is prohibited at penetrations through walls.
- C. Fire, Smoke and Combination Fire/Smoke Dampers:
1. Before starting work, verify the location and types of fire resistive construction as indicated by the Contract Drawings. Typical fire rated separations include:
    - a. Area separation walls, vertical only.
    - b. Occupancy separation walls, or partitions and floors. Vertical or horizontal.
    - c. Fire resistive egress corridors, halls and vestibules.
    - d. Fire resistive enclosures of hazardous spaces within an occupancy, including rooms for fuel-fired or electric heating equipment.
    - e. Fire resistive floor/ceiling assemblies associated with any of the above.
  2. Verify locations and types of dampers indicated on drawings. If dampers appear to be incorrectly located or missing, obtain clarification from Contracting Agency.
  3. Install dampers at locations indicated on the Drawings and in accordance with manufacturer's UL approved installation instructions.
  4. Install round dampers plumb and free from racking. Install rectangular dampers square and free from racking.
  5. Do not compress or stretch damper sleeve into duct or opening.
  6. Handle damper using frame/sleeve. Do not lift damper using blade, actuator, or jackshaft.
- D. Penetrations:
1. Coordinate mechanical penetrations with architectural and structural construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
  2. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
  3. Penetrations through roof, exterior walls and floors to be weather and water tight.
  4. Penetrations through fire rated assemblies to be UL listed.
  5. Penetrations through smoke partitions and barriers to resist passage of smoke.
  6. Other penetrations to have acoustical seals.
- E. Access Panels and Doors:

1. Locate access doors to enable in-duct equipment to be easily inspected, cleaned, maintained and tested and/or reset.
2. Provide access doors at the following locations:
  - a. Fire, smoke and combination fire/smoke dampers.
  - b. Motor operated dampers.
  - c. Each side of duct mounted coils.
  - d. Each side of duct mounted humidification dispersion panels.
  - e. As necessary for duct cleaning in accordance with NADCA Industry Standard for Mechanical Cleaning of Non-Porous Air Conveyance System Components.
  - f. As necessary for maintenance access to serviceable instrumentation and control equipment.
3. Coordinate location and size of access doors in walls, partitions and ceilings to correspond with duct access doors, dampers and automatic control devices and instruments.
4. Coordinate with supplier of component air handlers, package units and similar equipment to ensure that access doors and panels will not be obstructed when the equipment is installed.

F. Interface with Other Work:

1. Assist electrical and controls trades in mounting instrumentation devices and safety controls in ductwork and air handling units.
2. Make penetrations through exterior building walls watertight. Detail ductwork connections to prevent condensation or leakage from entering into surrounding building construction. Provide sleeves, special connections and sealant as required to accomplish this performance requirement.

### 3.4 SITE QUALITY CONTROL

A. Site Tests and Inspections:

1. Smoke and Combination Fire/Smoke Dampers: Test automatic closure and reset of smoke and combination fire/smoke dampers in accordance with Section 28 3100 - Addressable Fire Alarm System sequences of operation.

B. Verify accessibility to ventilation system components for maintenance, adjustment and cleaning.

### 3.5 ADJUSTING

A. Adjust and balance dampers in accordance with Section 23 0593 - Testing. Adjusting and Balancing.



## 3.6 CLEANING

- A. Prior to building occupancy and after ventilating systems are complete and functional, verify cleanliness of ventilating system ductwork. Verification shall comply with the inspection method(s) outlined in the National Air Duct Cleaners Association (NADCA) Standard for Assessment, Cleaning, and Restoration of HVAC Systems 2013. Conduct inspection in the presence of a Contracting Agency representative.
- B. If the ductwork does not comply with the standard for cleanliness, clean the affected ductwork as follows:
  - 1. Small systems: Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient airflow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
  - 2. Large systems: Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION 23 3100

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## SECTION 23 3600

## AIR TERMINAL UNITS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Single duct variable air volume terminal units.
- B. Products Installed But Not Supplied Under This Section: Coordinate installation of damper control actuators and application specific controllers, furnished under Section 25 5000 - Building Automation System. Control enclosure shall be factory mounted by the air terminal unit manufacturer.
- C. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 20 0529 - Mechanical Hangers and Supports
  - 3. 20 0553 - Mechanical Identification
  - 4. 23 0593 - Testing, Adjusting and Balancing
  - 5. 23 3100 - Ducts and Accessories
  - 6. 23 3700 - Air Outlets and Inlets
  - 7. 25 9000 - Sequence of Operations
  - 8. Divisions 26, and 27 - Electrical

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. SMACNA - HVAC Duct Construction Standards, Metal and Flexible, Third Edition 2005.
  - 2. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
  - 3. ANSI/AHRI 880-2011 - Performance Rating of Air Terminals.
- B. Abbreviations, Acronyms and Definitions:
  - 1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
  - 2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
  - 3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for the single duct, variable air volume, direct digital control terminal units.
2. The method of distribution of air is specified elsewhere.

#### B. Performance Requirements:

1. Provide product performance characteristics as specified or scheduled on drawings.
2. Operate ventilation system in accordance with Section 25 9000 - Sequence of Operations.

### 1.4 SUBMITTALS

- A. See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data.
- C. Installation, Operation and Maintenance (IO&M) Manuals.

### 1.5 CLOSEOUT SUBMITTALS:

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.

### 1.6 QUALITY ASSURANCE:

#### A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing the products specified.
2. Installers: Minimum five (5) years of experience in the installation of products specified.

- B. Certifications: Air terminal units shall be certified under AHRI Standard 880 Certification Program and carry the AHRI seal.

**1.7 DELIVERY, STORAGE AND HANDLING**

- A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

**1.8 WARRANTY**

- A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

**PART 2 - PRODUCTS****2.1 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL UNITS**

- A. Manufacturers:
  - 1. Titus, Model: DESV.
  - 2. Price.
  - 3. Nailor Industries.
  - 4. Substitution request required.
- B. Performance/Design Criteria:
  - 1. Capacities: Provide terminal units of the sizes and performance capacities as scheduled.
  - 2. Sound Rating:
    - a. Sound data certified by AHRI.
    - b. Radiated and discharge sound power levels at maximum air flow operating conditions shall be submitted with product information.
  - 3. Casing Leakage: Less than 2 percent of nominal CFM at 1.5 inches WC differential pressure.
- C. Operation:
  - 1. Control Actuator and Application Specific Controller: NEMA 1 control enclosures/digital control packages furnished by Section 25 5000 - Building Automation System to the air terminal unit manufacturer for factory mounting on side of casing.
- D. Materials:
  - 1. Casing:
    - a. Minimum 22 gauge galvanized steel.
    - b. Mechanically sealed and gasketed, leak resistant construction.
    - c. Beaded inlet for low leakage construction, sized to fit standard round duct.
    - d. Rectangular discharge opening designed for slip and drive cleat connection to low pressure ductwork or reheat coil.

- e. Multi-port, center averaging inlet velocity sensor with sensor tubing. Flow measurement taps provided for connection to application specific controller.
  - f. Internally line casing with sound liner specified below.
- 2. Control Damper:
  - a. Heavy gauge galvanized steel, butterfly type damper.
  - b. One-piece, 1/2-inch diameter damper shaft with self-lubricating Delrin® or bronze oilite bearings. Notched shaft end, to indicate damper position.
  - c. Synthetic damper seal to limit close-off leakage to less than 1% of terminal rated airflow at 3.0 inches water column differential pressure.
  - d. Mechanical stop to prevent damper over-stroking.
- 3. Duct Transitions:
  - a. Provide rectangular discharge plenum:
    - 1). Minimum length 36 inches or longer to accommodate branch ducts as indicated on drawings

## PART 3 - EXECUTION

### 3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel previously engaged in ventilation system construction and under the supervision of a qualified installation supervisor.

### 3.2 PREPARATION

- A. Protection of In-Place Conditions: Cover air terminal unit inlet and discharge openings to protect components from construction dirt and debris.

### 3.3 INSTALLATION

- A. General:
  - 1. Install air terminal units in strict compliance with the manufacturer's written installation instructions.
  - 2. Do not locate any part of the terminal unit assembly, including reheat coil and associated low pressure sound lined plenums, such that it passes over a partition wall or through a full height wall penetration.
  - 3. Locate terminal unit controller, coil hydronic piping/valves, and coil access doors on same side of unit. Locate on side that maximizes accessibility (i.e. above accessible ceiling tiles, away from full height walls and main duct runs).
  - 4. Support air terminal units independent of duct system. Provide sway bracing within 12 inches of support attachment.
  - 5. Connect air terminal unit inlets to ductwork using straight sections of unrestricted rigid duct of the same inlet diameter as terminal unit inlet. Provide a minimum

straight duct length of 4 duct diameters at each terminal unit inlet. Medium pressure flexible duct connections to terminal units is not allowed except where specifically shown.

6. Close-coupling of a terminal inlet to the side of a main supply duct is not acceptable without written permission from the Contracting Agency. When this method is approved, provide an inlet flow straightening device.
7. Install low pressure ductwork branches vertically centered along the sides of the low pressure sounded lined plenum. A minimum of two (2) inches of sheet metal is required between the spin-in (or similar connection) and top and bottom external edge of the metal plenum.
8. Secure control enclosure cover in place as intended by the manufacturer.
9. Verify mechanical connections, electrical and control wiring and sensor tubing are properly secured.

B. Interface with Other Work:

1. Coordinate and sequence the installation of air terminal units with trades responsible for portions of this and other related sections of the Project Manual.
2. Coordinate ceiling and/or wall access panel locations to provide convenient maintenance and cleaning access for each air terminal unit.
3. Coordinate air terminal unit locations with ceiling grids, lighting troffers, air outlets and return grilles to maximize accessibility and minimize interference.
4. Rework required as a result of failure to follow the manufacturer's written installation instructions, properly coordinate the installation with related work, or provide adequate access (as determined by the Contracting Agency) shall be completed at no additional cost to the Owner.

### 3.4 REPAIR/RESTORATION

- A. Refer to Section 20 0000 - Mechanical General Requirements for general repair/restoration requirements.

### 3.5 SYSTEM START-UP

- A. With the applicable central ventilation system air balancing completed and the ventilation system operating under automatic control utilizing the BAS, cycle each air terminal unit control damper between minimum and maximum scheduled air flow settings to demonstrate proper operation and capacity in accordance with 25 9000 - Sequence of Operations for verification by the Contracting Agency.
- B. Verify reheat coil and auxiliary heating unit (as applicable) hydronic control valves properly cycle with terminal unit control damper, in accordance with Section 25 9000 - Sequence of Operations.

## 3.6 ADJUSTING

- A. Adjust velocity sensor bias adjustment as necessary to provide accurate air flow measurement.

## 3.7 CLEANING

- A. Upon completion of installation and prior to initial operation, vacuum clean and wipe down air terminal units and control enclosures.
- B. Remove any debris from control enclosure.

END OF SECTION 23 3600



## SECTION 23 3700

## AIR OUTLETS AND INLETS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Air Diffusers and Registers.
2. Stationary Louvers.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 23 0593 - Testing, Adjusting and Balancing
4. 23 3100 - Ducts and Accessories

## 1.2 REFERENCES

## A. Codes and Standards:

1. SMACNA HVAC Duct Construction Standards - Metal and Flexible Third Edition 2005.
2. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
3. ARI Standard 890-2001 - Air Diffusers and Air Diffuser Assemblies.
4. MOA Handout A.04 - Suspended Ceilings Industry Standard Construction, May 1, 2008.

## 1.3 PREINSTALLATION MEETINGS

- A. Coordinate and sequence installation of air diffusers, registers, and louvers with trades responsible for portions of this and other related sections of the Project Manual prior to installation of air outlets and inlets.

## 1.4 SUBMITTALS:

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

## B. Product Data:

1. Air outlets and inlets performance data at operating conditions.
2. Submit color selections for air outlets and inlets from manufacturer's color selection chart.
3. Submit color selections for louvers which match exterior architectural wall panels.

## C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 20 0000 - Mechanical General Requirements.
2. Include the following information on scaled ventilation system shop drawings:
  - a. Air diffuser, register and grille locations, duct connection sizes and throw directions.
  - b. Louver locations with plenum dimensions.
  - c. Louver penetration detail which clearly shows wall type, louver frame type, duct connection method, sealant and or gasket locations and drainage path.

## D. Test and Evaluation Reports:

1. Louver plenum water tightness test: Submit written certification that louver plenums have been satisfactorily tested and have been verified water-tight prior to insulating plenums. Refer to louver test under Part 3 below.

## E. Installation, Operation and Maintenance (IO&amp;M) Manuals.

## 1.5 CLOSEOUT SUBMITTALS:

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.
- C. Record Documentation.

## 1.6 QUALITY ASSURANCE:

## A. Qualifications:

1. Manufacturers: Minimum five (5) years of documented experience manufacturing the products specified.
2. Installers: Minimum five (5) years of experience in the installation of products specified.

**1.7 DELIVERY, STORAGE AND HANDLING**

- A. Refer to Section 20 0000 - Mechanical General Requirements for general delivery, storage and handling requirements.

**1.8 WARRANTY**

- A. Refer to Section 20 0000 - Mechanical General Requirements for general warranty requirements.

**PART 2 - PRODUCTS****2.1 AIR DIFFUSERS AND REGISTERS**

- A. Manufacturers:
  - 1. Titus (Basis of Design).
  - 2. Price.
  - 3. Nailor Industries Inc.
  - 4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.
- B. Performance/Design Criteria: As scheduled.
- C. Finishes: Standard white, baked enamel or powder coated finish suitable for field application of custom finish color as required.
- D. Accessories:
  - 1. Equalizing grids.
  - 2. Earthquake tabs.
- E. Correlate diffuser style, dimension, and fit with ceiling. Provide diffusers with modules of the proper size to match the suspended ceiling layout or with appropriate factory provided frame for surface mounting.

**2.2 WALL LOUVERS**

- A. Manufacturers:
  - 1. Ruskin.
  - 2. Greenheck.
  - 3. Pottorff.
  - 4. Substitution request required.
- B. Description:
  - 1. General:

- a. Six inch deep, stationary wall louvers.
  - b. Horizontal drainable blades (37.5 degree blade angle) with integral downspouts incorporated into frame jamb and mullion design.
  - c. Frame style designed for installation into wall penetration construction type indicated. See Architectural penetration details to coordinate style types.
  - d. Louver frame with surfaces designed to accept exterior caulking.
- 2. Regulatory Requirements:
  - a. Louvers shall bear the AMCA Certified Ratings label for Water and Air Performance.
  - b. Manufacturer's ratings based on testing in accordance with AMCA Publication 511.
- C. Performance/Design Criteria:
  - 1. Size and performance as scheduled.
  - 2. Water penetration: 0.01 ounces of water per square foot of free area at 1000 FPM free area velocity.
- D. Materials: Heavy gauge extruded aluminum.
- E. Finishes:
  - 1. As scheduled on the drawings.
- F. Accessories:
  - 1. Bird Screens: Flattened, expanded aluminum with 1/2 inch mesh pattern. Located on internal side of louver assembly.
  - 2. Extended Sills: Extruded aluminum. Coordinate with installation method as indicated on Architectural.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Removal: Remove existing air diffusers, registers and grilles designated for relocation and reuse after repair and cleaning.

### 3.2 INSTALLATION

- A. General:
  - 1. Install products in compliance with the manufacturer's written installation instructions.
  - 2. Connect air outlets, registers, grilles and louvers to ventilation duct systems in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

## B. Air Diffusers, Registers and Grilles:

1. Install air diffusers, registers and return/exhaust grilles at the locations shown.
2. Orient and adjust diffusers to provide the throw directions indicated.
3. Provide appropriate borders for the ceiling, wall or floor construction type.

## C. Wall Louvers:

1. Install wall louvers at the locations shown and in accordance with manufacturer's written installation instructions and details for the specific wall type.
2. Coordinate louver locations, borders and mullion spacing with architectural panels.
3. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
4. Seal louver penetrations watertight. Install, seal and insulate louver ductwork (intake or exhaust/relief plenums) to interior louver frame to prevent condensation or entrained water that enters ductwork from leaking into building. Provide sleeves, special connections and sealant as required to accomplish this requirement.
5. Slope plenum ductwork such that any entrained water drains out through base frame of wall louver. If drain holes are not provided by the manufacturer, drill 1/2-inch (minimum diameter) weep holes at twelve (12) inch intervals on center through base of louver as required for drain water to escape. Touch-up holes with factory supplied touch-up paint.

### 3.3 REPAIR/RESTORATION

- A. Refer to Section 20 0000 - Mechanical General Requirements for general repair/restoration requirements.
- B. Clean and repair existing air outlets and inlets to function as originally intended prior to reinstallation. Air outlets and inlets which require major repair may be replaced at the Contractor's option.

### 3.4 SITE QUALITY CONTROL

- A. Site Tests and Inspections: Prior to insulating louver intake and exhaust/relief plenums, with applicable fans shutdown, lightly spray water into louver from building exterior such that water enters plenums. Verify that the water readily drains out of louver drain holes without pooling and that no visible leakage is present. Repair and retest as necessary until performance requirements are met.

### 3.5 CLEANING

- A. Clean exposed surfaces of air outlets and inlets, with water and mild soap or detergent not harmful to finish, in order to remove fingerprints and dirt.

END OF SECTION 23 3700

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## SECTION 23 5216

## CONDENSING BOILERS AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section includes:

1. Packaged condensing gas fired boilers and appurtenances.
2. Packaged boiler management system.
3. Boiler sealed combustion air system.
4. Boiler venting system.
5. Emergency Boiler Shut off

## B. Related sections:

1. 20 0000 - Mechanical General Requirements
2. 20 0529 - Mechanical Hangers and Supports
3. 20 0553 - Mechanical Identification
4. 23 0593 - Testing, Adjusting and Balancing
5. 23 1123 - Fuel Gas Piping and Specialties
6. 25 5000 - Building Automation System
7. 25 9000 - Sequence of Operations
8. Divisions 26 and 27 – Electrical

## 1.2 REFERENCES

## A. Codes and Standards:

1. International Mechanical Code (IMC).
2. International Fuel Gas Code (IFGC).
3. Uniform Plumbing Code (UPC).
4. NFPA 54 - National Fuel Gas Code.
5. ASME Boilers and Pressure Vessel Code (1998), Sections IV & VI.
6. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

## B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.

3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for the generation of heat, which will be distributed to the locations shown.
2. The method of distribution of this heat is specified elsewhere.

#### B. Performance Requirements:

1. Provide product performance characteristics as specified or scheduled on drawings.
2. Operate central heating system in accordance with Section 25 9000 - Sequence of Operations.

### 1.4 PRE-INSTALLATION MEETINGS

- #### A.
- Coordinate installation of boilers and associated piping and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

### 1.5 SUBMITTALS

- #### A.
- See Section 20 0000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

#### B. Product Data:

1. Provide manufacturers' product literature, clearly annotated to indicate specified salient features and performance criteria to include:
  - a. Product model and selected optional equipment, appurtenances and special features.
  - b. Boiler physical and performance characteristics as scheduled.
  - c. Total equipment weight (filled with water). Boilers weighing 20 percent more than the scheduled equipment will be disapproved unless it is determined by the Owner's Representative that the structure as designed is capable of bearing the additional load with an adequate safety margin.
  - d. Dimensional data.
  - e. Anchoring method.
2. Regulatory Requirements: Provide automatic boiler controls listed in the IMC and ASME CSD-1, latest edition, together with most current addenda and interpretations.

#### C. Shop Drawings:



1. Submit fully dimensioned shop drawings of boiler room(s) showing the following:
  - a. Major equipment and housekeeping pads, with clear callouts indicating deviations from layout shown:
    - 1). Submitted boiler shall be dimensionally equal to scheduled product within 6 inches in each dimension. Maintain clearances shown on drawings. Submit fully dimensioned shop drawings of boiler room(s) at drawing scale of 1/4-inch equals 1 foot 0 inches or larger, showing entire boiler room, equipment and deviations. Provide boiler room modifications required due to dimensional and technical deviation at no additional cost to the Owner. Submit shop drawings of proposed equipment layout and base or pad for each piece of equipment.
    - 2). If equipment to be provided exceeds the weight of the specified equipment by more than 20 percent, or if the location is to be altered, submit shop drawings and calculations of proposed revised structural design, noting location of pertinent loads, stamped by a registered professional engineer.
  - b. Service area boundaries as required by manufacturer's installation.
  - c. Boiler piping and vent stack locations with dimensions. Coordinate stack roof penetrations with roof structure.
  - d. Indicate mechanical and electrical service locations and requirements.
  - e. Boiler management system location.
2. Engineering Calculations:
  - a. Provide manufacturer's engineering calculations for boiler venting and combustion air ducting as indicated in Articles 2.3 and 2.4 below.

D. Manufacturer Reports:

1. Provide start-up and operational test reports for each boiler. Refer to Article on Site Quality Control.
2. Provide start-up report for boiler control system with selected presets annotated.
3. Submit a letter to document that the training was conducted. Include in the letter the date, start/stop times for the training, list of attendees and signature/title of the person(s) providing the training.

## 1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance (IO&M) Manuals:

1. Refer to Section 20 0000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
2. Include the following:
  - a. Copies of approved submittal information.
  - b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.

- c. Computer software manuals and applicable licenses.
  - d. Completed start-up and operational test report as required to validate equipment warranty.
  - e. Start-up and operational test reports for each boiler. Report shall include printed names and signatures of the installers and documentation that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
  - f. Start-up report for boiler management system with selected presets annotated.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 0000.
- C. Record Documentation: Record actual locations of equipment, piping, and components and areas required for maintenance access in accordance with Section 20 0000 - Mechanical General Requirements.

## 1.7 QUALITY ASSURANCE

- A. Qualifications:
- 1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
  - 2. Installers:
    - a. Minimum 3 years' experience in the installation and start-up of boilers.
    - b. A factory-authorized technician shall perform boiler startup service.
    - c. The manufacturer's authorized technician shall supervise the installation, startup, programming, and adjustment of the Energy Management System.
  - 3. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
- 1. Verify products are new and delivered in original factory packaging/crating and are free from damage and corrosion.
  - 2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.
- B. Storage and Handling Requirements:
- 1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
  - 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.

3. Replace damaged items with same item in new condition.

## 1.9 WARRANTY

### A. Manufacturer Warranty:

1. See Section 20 0000 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide prorated 10 year warranty on pressure vessel/heat exchanger against failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
3. Provide 2 year warranty on control circuit boards.
4. Submit necessary documentation to the Manufacturer's Representative to validate manufacturer's warranty.
5. Provide to the Contracting Agency 1 copy of warranty documentation and confirmation receipt from the Manufacturer's Representative.

## PART 2 - PRODUCTS

### 2.1 CONDENSING GAS FIRED BOILERS

#### A. Manufacturer:

1. Aerco Benchmark series
2. Approved equal.

#### B. Description:

1. Gas fired, condensing fire tube design with modulating power burner and positive pressure discharge.
2. UL Listed, CSD-1 approved, ASME coded and stamped.
3. UL/FM gas train.

#### C. Performance/Design Criteria: Manufacturer must publish known partial load efficiencies, and the thermal efficiency must increase as the firing rate decreases.

#### D. Assembly/Fabrication:

1. Size and clearances:
  - a. Minimum 28 inches wide, 44.5 inches long and 79 inches high.
  - b. Listed for 0 wall clearance.
  - c. Max weight 1533 lbs dry.
2. Air/Fuel Supply/Burner:
  - a. Turndown capacity: 20:1 without loss of combustion efficiency or staging of gas valves.
  - b. Burner shall produces less than 16 PPM of NOx corrected.

- c. Burner shall be metal fiber mesh covering a stainless steel body, with spark ignition and flame rectification.
  - d. All material exposed to combustion shall be stainless steel.
  - e. Modulating air/fuel valve with single linkage that does not require field adjustment. VFD pre-mix blower for optimum air/gas mixture.
  - f. Gas train safety shut-off valve with proof of closure switch.
  - g. Minimum 4.2 inch W.C. gas input at rated capacity.
3. Pressure Vessel/Heat Exchanger:
- a. Boiler capable of sustained operation with return water temperature down to 40 Degree F without failure due to thermal shock or fireside condensation.
  - b. ASME steel construction for working pressure: 160 PSIG.
  - c. Pressure vessel of SA53 carbon steel, 1/4 inch wall and upper head.
  - d. Heat exchanger of 316L stainless steel fire tube and 3/8 inch tube sheets, one-pass combusting gas flow.
  - e. 4 inch steel flange water connection.
  - f. Maximum water pressure drop through boiler: 3.0 psig at 170 GPM.
  - g. Working temperature: 200 Degrees F.
  - h. ASME approved relief valve: 50 PSIG.
4. Exhaust Flue and Condensate Drain:
- a. Corrosion resistant stainless with 6 inch diameter steel flue connection.
  - b. Gravity condensate drain with collecting reservoir.
5. Packaged Boiler Controls:
- a. UL approved.
  - b. Control panel consisting of multiple circuit boards for separate control functions that are individually field replaceable. Boards provide display functions, low water cutoff, power supply, ignition control, a connector board, and a control function board.
  - c. The control panel hardware shall support both RS-232 and RS-485 remote communications.
  - d. The controls shall annunciate boiler & sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of 8 separate status messages and 34 separate fault messages.
  - e. Integrated control panel with operating sequence, system fault and outlet temperature display, operating mode selector switch.
  - f. Self-governing features to take over controlled as set up by user in the event of over temperature, improper control signal, or loss of signal.
  - g. Combustion safeguard/flame control and monitoring system with spark ignition and rectification type flame sensor.
  - h. Electric low water cutoff with test and manual reset functions.
  - i. Each boiler shall utilize an electric single seated combination safety shutoff valve/regulator with proof of closure switch in its gas train and incorporate

- dual over-temperature protection with manual reset in accordance with ASME Section IV and CSD-1.
- j. Self-diagnostic capabilities.
- k. Adjustable high and low setpoint limits.
- l. Temperature control modes:
  - 1). Internal setpoint.
  - 2). Indoor/outdoor Reset.
  - 3). 4ma to 20ma Temperature Setpoint.
  - 4). Network Temperature Setpoint.
  - 5). 4 mA to 20 mA Direct Drive.
  - 6). Network Direct Drive.
  - 7). Boiler management system (ACS) with Combination Control System (CCP).
- m. Additional control system features to include:
  - 1). Ambient temperature system start/stop.
  - 2). Circulator pump delay timer.
  - 3). Auxiliary start delay timer.
  - 4). Auxiliary temperature sensor.
  - 5). Analog output (mA) monitoring of temperature setpoint, supply temperature, or boiler fire rate.
  - 6). Remote interlock circuit.
  - 7). Delayed interlock circuit.
  - 8). Remote alarm fault relay.
- 6. Electrical Power: 120 VAC/1 PH/60 Hz.

## 2.2 BOILER MANAGEMENT SYSTEM

- A. Manufacturers:
  - 1. Aerco Boiler Control System (ACS)
  - 2. Aerco Integrated C-More Controller with Boiler Sequencing Technology (BST).
  - 3. Approved equal.
- B. Description: Boiler manufacturer's boiler management system controls the integrated operation of the boilers on the project, and to provide a communication gateway to the building automation system. The boiler management system shall control operation and sequencing of multi-boiler central heating system.
- C. Operation:
  - 1. Control all operation and energy input of the multiple boiler heating plant.
  - 2. Utilize MODBUS open protocol to communicate with the boilers via a RS-485 port.
  - 3. Controller shall have the following capabilities:

- a. Vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize condensing capability and thermal efficiency.
  - b. Maintain boiler header temperature setpoint within 2 degrees F. Control will be PID.
  - c. Provide contact closure for auxiliary equipment such as pumps and combustion air inlets dampers.
  - d. Operational modes.
    - 1). Internal setpoint.
    - 2). Outdoor temperature reset control.
    - 3). 4 mA to 20 mA setpoint control.
    - 4). Network temperature setpoint control.
- D. Assembly/Fabrication:
- 1. Other features shall include:
    - a. UL approved.
    - b. Microprocessor based PID type control.
    - c. LCD display monitoring of sensors and interlocks.
    - d. Non-volatile backup of control setpoints.
    - e. Automatic rotation of lead boiler to balance operating time.
    - f. Provision for setback and remote alarm contacts.
    - g. Adjustable seasonal start/stop ambient temperature.
    - h. Contact closure control for auxiliary equipment (i.e. circulator pumps).
    - i. Supply header temperature control utilizing external inputs:
      - 1). System header temperature setpoint is reset by the Building Automation System (BAS) via BACnet IP through a MODBUS gateway.
        - a) Open Protocol Interface: When the building automation system does not have MODBUS protocol capability and interoperability is required, provide MODBUS Gateway to act as interface/translator between the BAS and the boiler management system. Coordinate requirements with the Control subcontractor.

## 2.3 BOILER SEALED COMBUSTION AIR SYSTEM

- A. Description:
- 1. Complete, engineered sealed combustion air system for each boiler to include straight duct, fittings, connections, adapters, and support brackets.
    - a. Provide manufacturer's engineering calculations customized to model actual installation of venting and combustion air ducting as intended by Contractor. Calculations to include venting and combustion air duct sizes, fittings, terminations, performances at minimum and maximum boiler firing rates.

- B. Performance/Design Criteria: Provide supports and seismic restraints in accordance with the manufacturer's and IBC requirements.
- C. Materials:
  - 1. Sheetmetal: See specification Section 23 3100 - Ducts.
- D. Assembly/Fabrication:
  - 1. Insulate sealed combustion air ducts as required for outside air ducts.
- E. Finishes:
  - 1. Sheetmetal: Galvanized.
- F. Insulation: See 20 0700 Mechanical Insulation.

## 2.4 BOILER VENTING SYSTEMS

- A. Manufacturers:
  - 1. Schebler.
  - 2. Heat-Fab.
  - 3. Approved equal.
- B. Description:
  - 1. Provide complete, engineered venting system for flue gas exhaust for each boiler to include straight duct, fittings, connections, adapters, thimbles, terminations and support brackets.
    - a. Provide manufacturer's engineering calculations customized to model Contractor's proposed installation configuration for venting and combustion air ducting. Calculations to include venting and combustion air duct sizes, fittings, terminations, performances at minimum and maximum boiler firing rates.
    - b. Venting and combustion air system performance data shall be reviewed by the boiler manufacturer and deemed to be acceptable for the performance of their boilers before product approval. Changes in size or configuration of venting or combustion air systems required for the proper performance of the boilers shall be at no additional cost to the Owner.
  - 2. Provide supports and seismic restraints in accordance with the manufacturer's UL listing, Section 20 05 29 - Mechanical Hangers and Supports.
- C. Performance/Design Criteria:
  - 1. UL 1738 listed for use with Category IV appliances (operating temperatures up to 600 Degrees F, positive pressure, condensing flue gas service).
- D. Materials:
  - 1. Inner wall shall be 24-gauge AL29-4C stainless steel.
  - 2. Outer wall shall be 22-gauge type 430 stainless steel.



## E. Assembly/Fabrication:

1. Double walled venting system with 1 inch air space between walls.
2. Vent flanged sections sealed with factory applied gasket designed specifically for leak-free condensing boiler exhaust systems for temperatures up to 550 degrees F with a UL tested pressure rating of 4.0 inches WC. Silicone sealant is not acceptable.
3. Inner liner seams shall be fully welded. Riveted, tack or spot welded seams are not permitted. Outer shells connected to inner shell with metal clips allowing each section to be installed as one piece.
4. Sections connected with a pressure tight, Rapid-Lock connection system.
5. Supports and seismic restraints in accordance with the manufacturer's UL listing.

## F. Leak Guarantee:

1. Manufacturer shall guarantee the system will not leak for a period of three (3) years when installed per manufacturer's drawings and installation instructions.

## 2.5 EMERGENCY BOILER SHUTOFF

- A. Provide an emergency boiler shutoff switch. See Division 26.

## PART 3 - EXECUTION

## 3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel previously engaged in boiler plant construction and under the supervision of a qualified installation supervisor.

## 3.2 PREPARATION

- A. Protection of In-Place Conditions: Cover products and plug piping connections to protect equipment from construction dirt and debris.
- B. Surface Preparation:
  1. Prior to installation of boilers, verify concrete housekeeping pads are complete and properly sized for boiler mounting.
  2. Prior to installation of stacks, verify that shop drawings are approved and stack locations and routing have been coordinated with required roof penetrations and the work of other trades.



### 3.3 INSTALLATION

#### A. Special Techniques:

1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
2. Install Boiler management system (BMS) in accordance with manufacture's installation instructions. Connect each of the boilers to the BMS. Program BMS to maintain boiler water temperature control as described in Sequence of Operation below.
3. Connect to the building automation system through the open protocol communication port in the BMS.
4. Setting of equipment:
  - a. Set equipment on concrete housekeeping pads compatible with the building structural system.
  - b. Level equipment to within recommended tolerances.
5. Anchoring:
  - a. Anchor boilers to housekeeping pads as recommended by the manufacturer and to allow for normal expansion and contraction.
  - b. Coordinate seismic restraint and anchoring requirements with Section 20 0529 –Mechanical Hangers and Supports.
6. Install components that were removed from equipment for shipping purposes.
7. Install components that were furnished loose with equipment for field installation.
8. Provide interconnecting electrical control and power wiring.
9. Provide fuel gas vent and service piping.
10. Provide piping for boiler pipe connections.
11. Program, adjust and operationally test boiler operation and sequencing in accordance with the manufacturer's written installation and testing instructions and Section 25 9000 - Sequence of Operations.
12. Touch up marred or scratched factory finished surfaces using finish materials furnished by manufacturer.
13. Install emergency boiler shutoff switch inside the boiler room at each exit at 48 inches above finished floor.

#### B. Interface with Other Work: Coordinate and sequence installation of boilers and stacks with trades responsible for portions of this and other related sections of the Project Manual.

#### C. Systems Integration: Coordinate location and operation of boiler emergency shutoff switches with Divisions 26, 27 and 28.

### 3.4 REPAIR/RESTORATION

#### A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.

- B. Substitute replacement parts from other manufacturers are not acceptable.

### 3.5 SITE QUALITY CONTROL

- A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.
- B. Manufacturer Services:
  - 1. Provide manufacturer's representative start-up and instruction of each complete boiler system including all components assembled and furnished by the manufacturer whether or not of his own manufacture.
  - 2. Start-up shall be conducted by experienced and factory authorized technician in the regular employment of the authorized service organization.
  - 3. Start-up and adjust the system to within the tolerances as specified by the equipment manufacturer.
  - 4. Operationally test safety devices and record settings. Test and record oxygen, carbon dioxide, stack temperature, and calculate excess air and steady state efficiency. Make final lead/lag setpoint adjustments. List setpoints in report. Submit final data for review.
  - 5. Test boiler operation and sequencing in accordance with the manufacturer's written installation and testing instructions and Section 25 9000 - Sequence of Operations.
  - 6. Provide a start-up report that includes final control settings, and a performance chart of the control system furnished.
  - 7. Submit a letter of certification with copy of start-up report, indicating that the boiler start-up has been completed, that the boilers are properly adjusted and operating within the tolerances as specified by the manufacturer, and that the sequence of operation is fulfilled.

### 3.6 ADJUSTING

- A. Coordinate and work directly with the requirements of Section 23 0593 - Testing, Adjusting and Balancing, to provide systems in proper operating order.
- B. Make corrections and adjustments as required by the Balancing and Testing Agency in a timely manner.

### 3.7 CLEANING

- A. Waste Management: After construction is completed, clean and wipe down exposed surfaces of boilers and burners.

3.8 CLOSEOUT ACTIVITIES

- A. Training: Provide 2 hours of operational instruction conducted by authorized factory start-up personnel to the Contracting Agencies authorized maintenance personnel.

END OF SECTION 23 5216

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## SECTION 25 3000

## BUILDING AUTOMATION SYSTEM FIELD DEVICES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Requirements, products, procedures, performance requirements, and methods of execution relating to the Building Automation System (BAS) terminal devices and field hardware.
2. Refer to related sections for other technical requirements, products, and methods of execution relating to the controls system for monitoring and control of mechanical systems.

## B. Related Sections: Refer to Section 25 5000 - Building Automation System

## 1.2 SUBMITTALS

- A. Submit in accordance with Section 25 5000 - Building Automation System and in accordance with Division 1.

## 1.3 CLOSEOUT SUBMITTALS

- A. Submit in accordance with Section 25 5000 - Building Automation System and in accordance with Division 1.

## 1.4 WARRANTY

- A. Refer to Section 25 5000 - Building Automation System.

## PART 2 - PRODUCTS

## 2.1 TEMPERATURE SENSOR

## A. Digital room sensors:

1. Temperature monitoring range: 55/95 degrees F.
2. Network jack.
3. Output signal: Changing resistance.

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4. Accuracy at Calibration point: Plus or minus 0.5 degrees F.
  5. Wall Mounted unit with finished cover:
    - a. Private offices and rooms:
      - 1). LCD display, day/night override button, and setpoint slide adjustment override options. The setpoint slide adjustment can be software limited by the automation system to limit the amount of room adjustment.
      - 2). Set Point and Display Range: 55 degrees to 95 degrees F.
    - b. Public Spaces: Blank Cover.
- B. Liquid immersion temperature:
1. Temperature monitoring range: Minus 40/240 degrees F.
  2. Output signal: Changing resistance.
  3. Accuracy at Calibration point: Plus or minus 0.5 degree F.
  4. Provide immersion sensor assembly as specified. Immersion sensors shall include a separate thermowell for sensor installation. Annular space between well and sensor shall be filled with heat conductive compound.
- C. Outside air temperature:
1. Temperature monitoring range: Minus 58/122 degrees F.
  2. Output signal: 4-20 mA DC.
  3. Accuracy at Calibration point: Plus or minus 0.5 degrees F.
  4. Provide NEMA3R rated mounting assembly (rain tight).
- 2.2 WALL MOUNTED SENSOR GUARD
- A. Heavy-duty wire cage type with mounting plate.
  - B. Cast Aluminum Guard and mounting bracket.
  - C. Clear or opaque butyrate plastic guard, key lock, mounting plate.
- 2.3 DIGITAL STATUS POINTS
- A. Digital status shall be monitored by sensing normally closed contacts (contact closed in alarm conditions). The addition of the monitoring relay shall not affect the operation of the systems involved.
- 2.4 DIGITAL COMMAND POINTS
- A. Command relays shall be momentary, automatic, maintained, or magnetic latch fail/safe as required. Maintained contacts located in occupied spaces or plenum spaces shall be mechanically latched. Relays shall be plug in and field replaceable. Contact ratings shall be in accordance with service.

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2.5 FLUID PRESSURE SENSOR

- A. Provide integral pressure transducer and transmitter with 4-20 mA output signal proportional to the input pressure span.
- B. Provide watertight enclosure.
- C. Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter. Transmitter range shall be unidirectional.
- D. The range for the sensor serving the hydronic heating system is 0-50 psig.
- E. Temperature operating range: Minus 40 to 200 degrees F.
- F. Each transmitter shall have field adjustable span and zero adjustments for field calibration. Accuracy plus or minus 1.0 percent of full scale.

## 2.6 CURRENT SENSOR

- A. Provide current sensors that convert AC current to a proportional (4-20 mA) DC current.
- B. Provide reverse voltage and high over current capacity.
- C. Provide red LED light to indicated relay status and power.
- D. Temperature operating range: 5 to 140 degrees F.
- E. Provide UL Listed device.

## 2.7 CURRENT SENSING RELAY

- A. Provide solid-state, self-calibrating, current operated relay suitable for equipment status monitoring. Provide a relay that changes switch contact state in response to an adjustable set point value of current in the monitored A/C circuit.
- B. Provide red LED light to indicated relay activation.
- C. Temperature operating range: minus 30 to 140 degrees F.
- D. Provide UL Listed device that is rated for plenum installation.

## 2.8 RELAYS

- A. Applications: Relays external to the controls shall include (but not be limited to) the following:
  - 1. Control relays for start/stop or open/close control of equipment.
  - 2. Monitoring relays for electrical circuit on/off or open/closed status detection.

3. Interposing relays to provide interface between solid state circuitry and ac-driven control relays.
- B. Requirements: Relays shall be housed in dust-tight cases conveniently located for wiring and inspection:
1. Control Relay: Control relays shall be suitable for continuous operation of 120 VAC and be able to interrupt the control circuits of various HVAC equipment. The number of contacts required for the relay shall be determined from the number of independent equipment to be controlled. The number of control relays required for the motor start/stop circuit shall be determined from examination of the equipment to be controlled.
  2. Monitoring Relay: Monitoring relays shall be suitable for continuous operation at the voltages of the circuits to be monitored. The monitoring relays shall be connected in such a way that the operation of the relay contact shall represent the change of status of the monitored circuit (i.e. ON/OFF, etc.) or duplicate the operation of the existing alarm circuit (i.e. high/low, etc.). The addition of the monitoring relay shall not affect the operation of the systems involved.
  3. Interposing Relay: Interposing relays shall be DC driven and be utilized to provide interface between solid state circuitry and ac-driven control relays as required.

## 2.9 CONTROL VALVE

- A. Control Valve: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Globe Valve 2 inch and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and sweat ends.
- C. Globe Valve 2-1/2 inch and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
- D. Hydronic system globe valve shall have the following characteristics:
1. Rating: ANSI Class 125 for service at 125 psig and 32/250 degrees F. operating conditions.
  2. Internal Construction:
    - a. Replaceable plugs and seats of stainless steel or brass.
    - b. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
    - c. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
  3. Sizing: 3 psig maximum pressure drop at design flow rate.
  4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
  5. Select heating valves shall fail to a Normally Open to heat position, unless otherwise indicated. Select cooling valves to normally closed to cooling position.



6. Three-way valves: Mixing type, unless otherwise indicated.

## 2.10 VALVE AND DAMPER ACTUATORS

### A. General:

1. Provide electronic direct-coupled actuation for control valves and dampers.
2. Proportional actuators shall accept a 0-10 VDC or 0-20 mA control input and provide a 2-10 VDC or 4-20 mA operating range. Damper actuators and control valve actuators serving valves larger than 3/4" shall provide a 2-10 VDC position feedback signal. The feedback signal shall be independent of the input signal.
3. Actuators indicated by Normally Closed or Normally Open designation on drawings or in sequence of operation shall be spring return type.
4. The actuator shall have electronic overload circuitry to prevent damage to the actuator.
5. Provide actuators listed by Underwriters Laboratories Standard 873 Standard for Safety Temperature-Indicating and -Regulating Equipment.

### B. Damper Actuator:

1. Provide damper actuator shall be direct-coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage.
2. Spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation.
3. Non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb torque capacity shall have a manual crank for this purpose.
4. Provide actuators in sufficient size, quantity and type to match application. Provide a minimum of one damper actuator for each 24 square feet of damper area. Damper areas shall not exceed manufacturer's ratings.
5. Outside air and return air dampers on mixing boxes shall be linked such that one opens while the other closes. It shall not be possible to close both dampers simultaneously.
6. Dampers: Size for minimum running torque calculated as follows:
  - a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
  - b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
  - c. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. of damper.
  - d. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.
  - e. Dampers with 2 to 3 Inches w.g. of Pressure Drop or Face Velocities of 1000 to 2500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
  - f. Dampers with 3 to 4 Inches w.g. of Pressure Drop or Face Velocities of 2500 to 3000 FPM: Multiply the minimum full-stroke cycles above by 2.0.
  - g. Values noted above do not include normally open or normally closed open spring return dampers. Provide additional torque as required.

7. Size operators with ample power to overcome friction of damper linkage and air pressure acting on the damper blades.
- C. Valve Actuator:
1. Provide actuators with enough torque and force required for proper valve close-off against the system pressure.
  2. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential.

## 2.11 INSTRUMENT ENCLOSURE

- A. Steel construction with hinged and lockable doors.
- B. NEMA 12 construction only in areas where panels are subject to moisture damage.
- C. Wiring connections including I/O and power shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion.
- D. Provide labeling and color coding for wiring. Wiring shall follow a common format typical for the entire facility. Terminal strip color coding and numbering shall follow a common format. Wiring shall be neatly installed in plastic trays or tie-wrapped.
- E. Line voltage wiring shall be segregated from I/O wiring and shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
- F. Provide a convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers. Provide convenience receptacle for enclosures containing equipment that can be configured or adjusted with a portable computer.

## 2.12 POWER SUPPLY

- A. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75 percent of the rated capacity of the power supply.
- B. Input: 120 VAC plus 10 percent, 60Hz.
- C. Output: 24 VDC.
- D. Line Regulation: Plus 0.05 percent for 10 percent line change.
- E. Load Regulation: Plus 0.05 percent for 50 percent load change.
- F. Provide an appropriately sized fuse and fuse block shall be provided and located next to the power supply.
- G. Provide a power disconnect switch shall be provided next to the power supply.

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PART 3 - EXECUTION

## 3.1 INSTALLATION

## A. Special Techniques:

## 1. Wiring:

- a. The HVAC Control Contractor shall provide conduit, wiring, accessories, and wiring connections required for the installation of the control system, as herein specified, unless specifically shown in Divisions 26, 27 and 28.
- b. Conduit and wiring shall comply with the requirements of applicable portions of Divisions 26, 27 and 28 and local and national electric codes, unless specified otherwise in this section.
- c. System input wiring shall be twisted shielded pair, minimum 20 gauge wire. System analog output wiring shall be twisted shielded pair/3-wire as required, minimum 20 gauge wire. Preconfigured cables between Terminal Unit Controllers and Thermostats are acceptable, minimum 24 gauge.
- d. Internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.
- e. Provide separate conduit for control system power wiring including but not limited to 120 VAC and greater. I/O sensor wiring and data communication cabling shall be segregated from 120 VAC control system power wiring.
- f. Wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size 3/4 inch. One half inch conduit may be used for thermostats and valve stub-ups where conduit contains only a single pair.

## 2. Temperature Sensors:

- a. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application in such manner as to allow for quick, easy replacement and servicing without special tools or skills.
- b. Outdoor installations shall be of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. Protective shield shall be stainless steel.
- c. Wall Mounted Sensor and Thermostats:
  - 1). Install wall mounted room sensors at a height of four feet six inches above finish floor level.
  - 2). Locate sensors as shown on the Drawings.
  - 3). Provide insulated base for sensors mounted on sheet metal, steel columns or exterior walls. Wire penetrations shall be caulked airtight to prevent thermal convection.
  - 4). Provide heavy-duty guards for sensors and thermostats in public areas and as shown on the Drawings.
- d. Fluid Temperature Sensor: The sensor shall have a separable well suitable for insertion in a pipeline or vessel. Cable connections shall be suitable for the highest temperature expected and low temperature sensors shall be sealed to exclude condensation of atmospheric moisture.

- e. Fluid Temperature Sensors: Provide sensors with thermal wells fabricated and installed for the intended service. Wells shall be non-corrosive to the medium being measured and shall have sufficient physical strength to withstand all pressures, (including test pressures) and velocities to which they are subjected. Well shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area. Where piping is smaller than the length of the well or exceeds the area requirements, the well shall be installed at an elbow and installed to effect uniform flow across the well. Sensors installed in wells shall be installed in horizontal piping below the pipe centerline.
- 3. Fluid Pressure Sensor:
  - a. Locate sensors as shown on the Drawings. Mount in accessible location.
  - b. Controls subcontractor to furnish fluid pressure sensor snubbers. Installation of snubbers by plumbing subcontractor.
- 4. Current Sensors:
  - a. Provide flow proof for constant volume fans and pumps with a current sensor connected to the motor wiring at the starter. Set upper alarm limit to the maximum rated current of the motor, or as advised by the TAB Agency. Set lower alarm limit at 1/2 the motor running amps.
  - b. Provide flow proof for variable speed control system through utilization of the variable speed drive serial communication option. Drive will communicate directly with BAS system.
- 5. Digital Status, Digital Command Points, Lighting Controls:
  - a. Provide relays in a separate instrument enclosure or control panel adjacent to the monitored or controlled equipment. The relays shall mounted and connected in a manner that does not violate controlled equipment listing or code requirements.
  - b. Provide relays that operate in conjunction with the motor control system. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
  - c. Coordinate motor control requirements with Divisions 26, 27 and 28.
- 6. Identification:
  - a. Panel and Instrument Enclosure Identification: Panels and instrument enclosures shall be identified by a plastic engraved nameplate securely fastened to the outside of the controller enclosure.
  - b. Field Devices: Field devices shall be identified by a typed (not handwritten) securely attached tag label.
  - c. Panel or Instrument Enclosure Devices: Devices shall be identified by a typed label securely fastened to the backplane of the local control panel or instrument enclosure.
  - d. Wall Mounted Temperature Sensors: Device covers shall be identified by a typed label securely fastened to the front cover. The label shall indicate the terminal unit zone identification tag.
  - e. Raceway Identification: The covers to junction and pull boxes of the control system raceways shall be painted blue or have identification labels

stating "Control System" affixed to the covers. This requirement includes control system tubing. Labels shall be typed, not hand written.

- f. Wire Identification: Low and line voltage control wiring shall be identified by a number, as referenced to the associated control diagram, at each end of the conductor or cable. Identification number shall be permanently secured to the conductor or cable and shall be typed.

### 3.2 MAINTENANCE

- A. Arrange work so that wherever possible serviceable or operable products are located within mechanical or electrical spaces and are accessible.

END OF SECTION 25 3000

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## SECTION 25 4000

## VARIABLE SPEED DRIVES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This specification is to cover a complete Variable Speed motor Drive (VSD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. It is required that the drive manufacturer has an existing:
  - 1. Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
  - 2. An independent service organization.
- B. Related Sections:
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 20 0513 - Common Motor Requirements
  - 3. 20 0553 - Mechanical Identification
  - 4. 23 0593 - Testing, Adjusting and Balancing
  - 5. 25 5000 - Building Automation System
  - 6. 25 9000 - Sequence of Operations
  - 7. 33 1113 - Water Supply Well

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. ANSI/NFPA 70 - National Electrical Code (NEC).
  - 2. Institute of Electrical and Electronic Engineers (IEEE): Standard 519, IEEE Guide for Harmonic Content and Control.
  - 3. UL 508 - UL Standard for Safety Industrial Control Equipment.
  - 4. UL 508C - UL Standard for Safety Power Conversion Equipment.
  - 5. NEMA ICS 7.1 - AC Adjustable Speed Drive Systems.
- B. Abbreviations, Acronyms and Definitions:
  - 1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
  - 2. Refer to Section 20 0000 - Mechanical General Requirements for general mechanical related definitions.
  - 3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements, products and methods of execution for variable speed drives.
- B. Performance Requirements:
  - 1. Provide product performance characteristics as specified or scheduled on drawings.
  - 2. Operate variable speed drives in accordance with Section 25 9000 - Sequence of Operations.

### 1.4 PRE-INSTALLATION MEETINGS

- A. Coordinate installation of variable speed drives with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

### 1.5 SUBMITTALS

- A. Product Submittals: Submittals shall include the following information:
  - 1. Outline dimensions, conduit entry locations and weight.
  - 2. Customer connection and power wiring diagrams.
  - 3. Complete technical product description include a complete list of options provided.
  - 4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
    - a. The VSD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5 percent.
    - b. Input line filters shall be sized and provided as required by the VSD manufacturer to ensure compliance with IEEE standard 519. VSDs shall include a minimum of 5 percent impedance reactors, **no exceptions**.
    - c. Output load reactors or filters shall be sized for the distance between the VSD and motor.
- B. Quality Assurance:
  - 1. Submit startup reports.
  - 2. Submit syllabus of training for review and approval.
- C. O&M Manuals:
  - 1. Submit Operation and Maintenance Manuals to include all information necessary for the operation and maintenance of the system.
  - 2. Furnish a minimum two (2) complete sets to owner, or more as otherwise noted in Division 1.



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1.6 QUALITY ASSURANCE

- A. The manufacturer of the AC Drive shall be a certified ISO 9001 facility.
- B. The AC Drive and associated optional equipment shall be UL Listed according to UL 508 C - Power Conversion Equipment. As verification, a UL label shall be attached on the inside of the combination enclosure. A UL508A panel builders label does not meet specification.
- C. The AC Drive shall be designed, constructed and tested in accordance with UL, CSA, NEMA, and NEC standards.
- D. Every power converter shall be tested with an AC induction motor while loaded and temperature cycled within an environment chamber at 40 degrees C (104 degrees F).
- E. VSDs and options shall be UL listed as a complete assembly. VSDs that require the customer to supply external fuses for the VSD to be UL listed are not acceptable. The base VSD shall be UL listed for 100 KAIC without the need for input fuses.
- F. The AC Drive supplier shall furnish, field test, adjust and certify installed AC Drives for satisfactory operation.
- G. Any exceptions/deviations to this specification shall be indicated in writing and included with the submittal.

## 1.7 TRAINING

- A. Provide two (2) hours of Owner operator training on operation and service diagnostics at the time of the equipment commissioning.
- B. Training shall be conducted by the manufacturer's start-up and commissioning agents.
- C. Training shall utilize Operation and Maintenance Manuals submitted and approved for this specific project.
- D. Coordinate with the Contracting Agency to schedule training sessions with Owner's personnel.
- E. Submit training syllabus that describes topics to be addressed.

## 1.8 WARRANTY

- A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include parts, labor, travel time and expenses. There shall be 24/7/365 support available via a toll-free phone number.

## PART 2 - PRODUCTS

### 2.1 BASIS OF DESIGN

- A. Acceptable Manufacturers:
  - 1. ABB ACH Series, or preapproved equal.
  - 2. Approval does not relieve supplier of specification requirements.
  - 3. VSDs that are manufactured by a third party and "brand labeled" shall not be acceptable.

### 2.2 GENERAL DESCRIPTION

- A. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage.
- B. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage.
- C. The output power section shall change fixed DC voltage to adjustable frequency AC voltage.
- D. The adjustable frequency drive package shall consist of a line reactor, EMI/RFI filter, control circuit terminal board for digital and analog field wiring. The base VSD shall be UL listed for 100 KAIC without the need for input fuses.
- E. The drive door shall have mounted and wired electrical disconnect, and Hand-Off-Auto switch.
- F. The entire drive package shall be UL508C listed and coordinated with NEMA ICS 7.1. A UL508A panel builders label does not meet specification.
- G. A line reactor or dv/dt filter shall be provided to compensate for motor feeder length. Submit reactor/filter data from manufacturer stating maximum cable length allowed.

### 2.3 CONSTRUCTION

- A. The AC Drive power converter shall be enclosed in a NEMA Type 12 enclosure. The enclosure shall provide dedicated user terminals for power and control device connection.
- B. Include provisions to lock the disconnect in the OFF position with a padlock.
- C. Enclosure and heat sink fans shall be accessible from the front and shall not require the removal of the AC drive power converter for fan replacement.

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2.4 APPLICATION DATA

- A. The AC Drive shall be sized to operate a variable torque load.
- B. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 72 Hz.

## 2.5 ENVIRONMENTAL RATINGS

- A. The AC Drive shall meet IEC 60664-1 Annex A and NEMA ICS 1, UL, and CSA standards.
- B. The AC Drive shall be designed to operate in an ambient temperature from -10 to 40 degrees C (14 to 104 degrees F).
- C. The maximum relative humidity shall be 95 percent, non-condensing.
- D. The AC Drive shall be rated to operate at altitudes less than or equal to 3300 feet (1000 meters). For altitudes above 3300 feet (1000 meters), the AC Drive shall be de-rated per drive specifications.
- E. The AC Drive shall meet the IEC 60721-3-3-3M3 operational vibration specification.
- F. The AC Drive shall be Seismic Qualified to 2000 IBC Level 3 "Extreme" rating with an Importance Factor  $I_p=1.5$ .

## 2.6 RATINGS

- A. The AC Drive shall be designed to operate at the input line voltage indicated on the equipment schedule.
- B. The AC Drive shall operate from an input frequency range of 60 Hz ( $\pm$ ) 5 percent.
- C. The displacement power factor shall not be less than 0.98 lagging under any speed or load condition.
- D. The efficiency of the AC Drive at 100 percent speed and load shall not be less than 97 percent.
- E. The variable torque rated AC Drive over current capacity shall be not less than 110 percent for 1 minute.
- F. The output carrier frequency of the AC Drive shall be programmable at 0.5, 1, 2, 4 or 8 kHz. In addition, the output carrier frequency shall be randomly modulated about the selected frequency.

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2.7 PROTECTION

- A. Upon power-up, the AC Drive shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, DC-to-DC power supply, control power and pre-charge circuit.
- B. The enclosure shall provide a fully coordinated 100,000 AIC current rating marked on the enclosure nameplate. Short circuit coordination to UL 508C Power Conversion Equipment and NEMA ICS 7.1.
- C. The AC Drive shall be protected against short circuits, between output phases and to ground.
- D. The AC Drive shall have a minimum AC under-voltage power loss ride-through of 200 milliseconds (12 cycles).
- E. The AC drive shall have a programmable ride-through function, which shall allow the logic to maintain control for a minimum of one-second (60 cycles) without faulting.
- F. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to 6 programmable restart attempts. The time delay before restart attempts will be 30 seconds.
- G. Upon loss of the analog process follower reference signal, the AC Drive shall be programmable to display a fault.
- H. The AC Drive shall have a solid-state UL 508C listed overload protective device and meet IEC 60947.
- I. The output frequency shall be software enabled to fold back when the motor is overloaded.
- J. There shall be three skip frequency ranges that can be programmed to a bandwidth of  $\pm 2.5\text{Hz}$ .

## 2.8 ADJUSTMENTS &amp; CONFIGURATIONS

- A. The AC Drive will be factory programmed to operate specified optional devices.
- B. The acceleration and deceleration ramp times shall be adjustable from 0.05 to 999.9 seconds.
- C. The memory shall retain and record run status and fault type of the past eight faults.
- D. The software shall have an energy economy function that, when selected, reduces the voltage to the motor when selected for variable torque loads. A constant volts/Hz ratio shall be maintained during acceleration. The output voltage shall then automatically adjust to meet the torque requirement of the load. Selectable volts/Hz ratio patterns do not meet specification; the function shall be automatically optimized.

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2.9 KEYPAD DISPLAY INTERFACE

- A. A keypad display interface shall offer the modification of AC Drive adjustments through a touch keypad. Electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, and adjustment storage, and diagnostics shall be accessible.
- B. The AC Drive model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall be listed on the drive identification portion of the LCD display.
- C. The keypad display shall have a hardware selector switch that allows the keypad to be locked out from unauthorized personnel.

## 2.10 OPERATOR CONTROLS

- A. The control power for the digital inputs and outputs shall be 24VDC.
- B. The internal power supply shall incorporate automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs shall be current limited and shall not be damaged if shorted.
- C. Pull-apart terminal strips shall be used on logic and analog signal connections in the power converter.
- D. Two voltage-free relay output contacts shall be provided. One of the contacts shall indicate AC Drive fault status. The other contact shall indicate a drive run status.
- E. The combination enclosure shall have the following dedicated operator controls:
  - 1. Hand-Off-Auto switch.
- F. The combination enclosure shall include terminal point connection for fire/freeze state interlock, to prevent drive operation. The interlock shall shut down the motor in the drive modes.

## 2.11 SERIAL COMMUNICATION

- A. The AC Drive shall have BACnet communications capability. The BACnet communications card shall provide data communications with a host computer or other device via the existing BACnet network. Data exchanges shall give access to all drive functions:
  - 1. Control: Start, stop, reset, and setpoint.
  - 2. Monitoring: Status, current, voltage, thermal state, etc.
  - 3. Diagnostics: Alarms.
- B. The AC Drive shall have Apogee FLN P1 communications capability. The Apogee P1 communications card shall provide data communications with a host computer or other

device via the Apogee FLN P1 network. Data exchanges shall give access to all drive functions:

1. Control: Start, stop, reset and setpoint.
  2. Monitoring: Status, current, voltage, thermal state, etc.
- C. The graphic display terminal or the integrated display terminal shall be used to access functions for communication configuration and diagnostics.

## 2.12 HARMONIC MITIGATION

- A. Each drive shall include a minimum 5 percent line reactor mounted inside the drive enclosure to reduce power system harmonics and provide power quality protection for the drive. DC bus chokes do not meet specification and shall not be substituted.
- B. EMI / RFI filters: VSDs shall include EMI/RFI filters. The onboard filters shall allow the VSD assemble to be CE Marked and the VSD shall meet product standard EN 61800-3 for the First Environment restricted level.
- C. VSDs through 50HP shall be protected from input and output power mis-wiring. The VSD shall sense this condition and display an alarm on the keypad.
- D. Additional Features: Furnished and mounted by the drive manufacturer. Additional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label:
1. A MANUAL BYPASS SYSTEM IS NOT DESIRED OR REQUIRED.
  2. Provide a door interlocked, padlockable circuit breaker that will disconnect input power from the drive and internally mounted options.
  3. Provide a fused disconnect (service switch).
  4. The drive shall provide single-phase motor protection.
  5. The following operators shall be provided:
    - a. Hand-Off-Auto.
    - b. Drive mode selector.
  6. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided:
    - a. Power-on (Ready).
    - b. Run enable (safeties) open.
    - c. Drive mode select damper opening.
    - d. Drive running.
    - e. Drive fault.
    - f. Safety open.
    - g. Damper opening.
    - h. Damper end-switch made.
  7. The digital inputs for the system shall accept 24V or 115VAC (selectable).

8. Customer Interlock Terminal Strip: provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. External safety interlocks shall remain fully functional whether the system is in Hand or Auto modes.
9. The VSD shall include a "run permissive circuit" that will provide a normally open contact whenever a run command is provided (local or remote start command in VSD mode). The VSD system shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VSD system safety interlock (fire detector, freezestat, high static pressure switch, etc.) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
10. Class 20 or 30 (selectable) electronic motor overload protection shall be included.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protection: Cover drives to protect components from construction dirt and debris.

#### 3.2 INSTALLATION

- A. Verify that the location is ready to receive work and the dimensions are as indicated.
- B. Do not install VSD until the building environment can be maintained within the service conditions required by the manufacturer. Before and during the installation, the VSD equipment shall be protected from site contaminants.
- C. Details of the installation shall comply with the manufacturer's applicable instructions.
- D. Minimize the length of conductors between the drive and the motor to avoid motor damage from reflected wave phenomenon.
- E. Where the field conditions dictate long lengths of conductors between the VSD and motor, provide necessary measures to protect motors from reflected wave phenomenon. Measures may include coordination with the motor manufacturers to provide higher insulation voltage ratings, protection devices such as output reactors or special terminators, or BJT inverter output.
- F. Mounting of VSD shall be suitable for seismic anchorage and/or restraints as required by International Building Code.
- G. VSDs shall be furnished under Divisions 20, 21, 22, 23, 25 and installed under Divisions 26, 27 and 28. The contractor shall install the drive in accordance with the recommendations of the VSD manufacturer as outlined in the installation manual.
- H. Power wiring shall be provided under Divisions 26, 27 and 28. The contractor shall complete wiring in accordance with the recommendations of the VSD manufacturer, as outlined in the installation manual.

### 3.3 CONTROL WIRING

- A. Control wiring and control devices shall be provided under the specification section in which the controlled equipment is specified. Coordinate related work.
- B. Control wiring shall be routed completely separately from power wiring.

### 3.4 NAMEPLATES

- A. Provide a nameplate for each VSD in accordance with Section 20 0553 Mechanical Identification. Coordinate names with mechanical equipment lists.

### 3.5 FIELD QUALITY CONTROL

- A. Start up: Certified factory startup shall be provided for each drive by a factory authorized service center. A certified startup form shall be filled out for each drive with copies submitted and included in the O&M Manuals, and a copy kept on file by the manufacturer.
- B. Training: Onsite training shall be provided as part of the startup service. The training shall include installation, programming, and operation of the VSD and serial communication.

END OF SECTION 25 4000



## SECTION 25 5000

## BUILDING AUTOMATION SYSTEM

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: This section describes requirements, products, and methods of execution relating to the building automation controls system for the project.
- B. Related Sections: Refer to related sections for other technical requirements, products, and methods of execution relating to the controls system for monitoring and control of mechanical systems.
  - 1. 20 0000 - Mechanical General Requirements
  - 2. 23 0593 - Testing, Adjusting and Balancing
  - 3. 23 2123 - Hydronic Pumps
  - 4. 23 3600 - Air Terminal Units
  - 5. 23 5216 - Condensing Boilers and Accessories
  - 6. 25 3000 - Building Automation System Field Devices
  - 7. 25 4000 - Variable Speed Drives
  - 8. 25 9000 - Sequence of Operations
  - 9. Divisions 26 and 27 - Electrical

## 1.2 NOTIFICATION OF POTENTIAL HAZARDS

- A. Asbestos, lead and other hazardous materials may be present in the building that may impact the work of all trades. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to specification Section 02 2600 Hazardous Materials Summary Report, Section 01 3545 Airborne Contaminate Control; and Division 02 Specifications for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.

## 1.3 REFERENCES

- A. Codes and Standards. Perform work in accordance with applicable national, state and local codes to include:
  - 1. NFPA 70, National Electrical Code - NEC.
  - 2. ANSI-C2, National Electrical Safety Code - NESC.

3. Underwriters Laboratory (UL) or approved equal.
4. Institute of Electrical and Electronics Engineers - IEEE.
5. National Electrical Manufacturers' Association - NEMA.

B. Abbreviations and Acronyms:

1. Building Automation System (BAS).
2. Direct Digital Control (DDC).

C. Definitions:

1. ASHRAE: The American Society of Heating, Refrigerating and Air-Conditioning Engineers.
2. BACnet: A Data Communication Protocol for Building Automation and Control Networks, ANSI/ASHRAE Standard 135-current edition, developed under the auspices of ASHRAE.
3. Bridge: A device that routes messages or isolates message traffic to a particular segment, sub-net or domain of the same physical communication media.
4. Building Automation System (BAS): Collection of sensors, operators, controllers, and interconnecting wiring that control the operation of the building mechanical and electrical systems as described in these specifications.
5. Field device or field control device: A physical component such as a temperature sensor, pressure sensor, contact, motor operated valve, and motor operated damper. Generally considered to bring only one point to a controller.
6. Gateway: A hardware/software package that allows communication between dissimilar ("foreign") systems and different protocols. Gateways are typically custom built, configured, and used only for transmitting and receiving data between different systems. System programming through gateways is not possible within the scope of this definition.
7. LonTalk: An open protocol for communication developed privately by the Echelon Corporation in Palo Alto, California.
8. Operator workstation: The central personal computer for the user to implement day to day operation of the system.
9. Router: A device for connecting different local-area network segments within a network. Routers that are used between networks with different protocols are limited. Point mapping in this type of router is automatic and requires less than one hour to configure. This device is not capable of storing point map information.
10. TCP/IP: (Transmission Control Protocol/Internet Protocol) The communication language or protocol that defines the Internet. TCP/IP can also be used as a communication protocol in private networks.
11. Terminal Unit Controller: A device to control very specific applications such as a VAV box, cabinet unit heater, fan terminal unit and the like. These units may have predefined operating sequences with limited custom programming available. (Also called an "application specific controller").

#### 1.4 SYSTEM DESCRIPTION

##### A. Design Requirements:

1. The HVAC Control System will consist of a flat, open architecture based upon BACNet meeting the requirement of ANSI/EIA 709.1 and ASHRAE Standard 135. Provide necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
2. The system shall operate as a low-voltage multiplexed data system. The controls and instrumentation specified herein shall be integrated and installed as a complete package by the Contractor.
3. The completed system shall be integrated such that graphics, reports, and system interfaces from the Operators work station appears as if there is one system.
4. No BAS system components requiring the use of gateways will be accepted.
5. To provide future flexibility, router domains shall not exceed nominally 75 percent of the maximum number of devices in the domain, unless specified otherwise.

##### B. Performance Requirements:

1. This section specifies the requirements for the BAS to be installed in conjunction with this project.
2. Controls contractor shall furnish and install an integrated building automation system, incorporating DDC for energy management, equipment monitoring and control, and subsystems as herein specified. Controls contractor will complete the temperature control system as specified herein.
3. Materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. Systems and components shall have been thoroughly tested and proven in actual use for at least two years.
4. Controls contractor shall be responsible for BAS and temperature control wiring for a complete and operable system. Wiring shall be done in accordance with Divisions 26, 27 and 28 of this specification and local and national codes.
5. Control and monitoring for mechanical systems installed under this Contract, including:
  - a. Building ventilation systems.
  - b. Building heating systems.
  - c. Boiler monitoring.
  - d. Domestic water heater monitoring.
6. The Work under this Section includes furnishing and installing wiring, conduit, connectors, terminal strips, and any other equipment required to interface each sensor or control point to the control system.
7. Provide control system and subsystem network cabling, routers, and other devices required for the systems shown and specified, except as specifically noted or shown on the drawings.
8. Providing sequences of operation described in Section 25 9000 - Sequence of Operations.

9. Installation of control instrumentation and hardware specified in Section 25 3000 - Building Automation System Field Devices, necessary for a complete system of controls.
10. Integrating the controls under this Contract with the Owner's HVAC Supervisory System.
11. Commissioning support activities as required in 01 9100 - Commissioning, including requirements in development of commissioning checklists, phased commissioning, installation examination and performance test activities, training and IO&M requirements.
12. System functional requirements include, but are not limited to:
  - a. BAS system shall provide all normal and off-normal control functionality without reliance upon PC file server or work station.
  - b. Programming information, graphics, databases, and other information required to restore the entire system in the event of equipment failure or malfunction or human error shall be protected with a centralized back-up system.
  - c. Systems shall be designed to maximize multiple-vendor flexibility to replace or modify any portion of the system.
13. Software upgrades for PC and control network operating systems, the supervisory system, web browser, programming/binding tools, etc., without limitation shall be provided at no additional charge for a period of one year after Substantial Completion of the BAS.
14. A training program shall be provided to include: Data acquisition and report generation on the Operator's work station.
15. The cost of providing power from the building electrical system shall be included in the bid. Power sources are subject to submittal requirements, and review and approval.

#### 1.5 PREINSTALLATION MEETINGS

- A. Coordinate installation of the building automation system with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

#### 1.6 SUBMITTALS

- A. Refer to Section 20 0000 - Mechanical General Requirements for general submittal requirements.
- B. Product Data:
  1. Provide manufacturer's literature that demonstrates compliance with the manufacturing methods, appurtenances and salient features specified.
  2. Equipment tagging method specifically listing each device and the identification tag to be applied.
  3. Sequence of Operations.

4. Riser Diagrams.
5. Control Diagrams.
6. Panel layouts.
7. Valve and Damper schedules.
8. Point Summary Report.
9. Blank (Reserved for Enhanced Alarm Report).
10. Blank (Reserved for Commented PPCL).
11. Blank (Reserved for Trend Logs).
12. Blank (Reserve for Electronic Plans Room file).

C. Shop Drawings:

1. Riser Diagrams.
2. Control Diagrams.
3. Panel layouts.
4. Valve and Damper schedules.

## 1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. The O&M Manuals will consist of the following (Progression from Submittal to O&M Manual takes place using the same binders):

1. Sequence of Operations.
2. Riser Diagrams.
3. Control Diagrams.
4. Panel layouts.
5. Valve and Damper schedules.
6. Point Summary Report.
7. Enhanced Alarm Report.
8. Commented PPCL (Program Code).
9. Trend Logs.
10. Product Data including items reused from existing control system as noted.
11. Electronic Plans Room file.

## 1.8 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Companies specializing in manufacturing the products specified in this section with a minimum of three (3) years documented experience.
2. Installers: Minimum three (3) years' experience in the installation, programming and start-up of building automaton systems.

3. Testing Agencies: Regulatory requirement for products requiring electrical connection – Listed and classified by Underwriters Laboratories Incorporated, or by a testing firm acceptable to the MOA.
4. Licensed Professionals:

B. Sustainable Standards Certifications:

## 1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Verify equipment and associated appurtenances are delivered in original factory packaging/crating and are free from damage and corrosion.
2. Replace equipment delivered to job site that does not comply with above requirements at no expense to the Owner.

B. Storage and Handling Requirements:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

## 1.10 SITE CONDITIONS

- A. Existing Conditions: Coordinate new work with the existing BAS system in the building.

## 1.11 WARRANTY

A. Manufacturer Warranty:

1. Provide in accordance with Section 20 0000 - General Mechanical Requirements.
2. Provide maximum 4 hour response time to service/warranty calls from the Owner during the warranty period.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. Siemens Building Technology (SBT).
- B. No substitutions allowed.
- C. Management Level Network (MLN). Acceptable manufacturers are limited to the following:
  1. Siemens Building Technology.

2. No Alternate Brand Request; no Substitution Request.
- D. Building Level Network (BLN). Acceptable manufacturers are limited to the following:
  1. Siemens Building Technology.
  2. No Alternate Brand Request; no Substitution Request.
- E. Floor Level Network (FLN). Acceptable manufacturers are limited to the following:
  1. Siemens Building Technology.
  2. No Alternate Brand Request; no Substitution Request.

## 2.2 APPLICATION SPECIFIC CONTROLLER (ASC)

- A. General Requirements:
  1. Application Specific Controllers shall be equipped with a minimum of 64K programmable non-volatile (flash) memory for general data processing, power supply, input/output modules, termination blocks, network transceivers.
  2. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.
  3. The ASC unit may be equipped with a dedicated software clock battery. If included, the battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a two-week period. Include an integral calendar with automatic leap year compensation.
  4. ASC packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. Make board terminations by means of plug-in connectors to facilitate troubleshooting, repair and replacement.
- B. ASC Interface Software:
  1. General: ASC shall be configured, not programmed, via PC based interface software. This software shall be a program applet that runs within the network management tool chosen. Intimate knowledge of operation of ASC shall not be required for configuration.
  2. ASC shall provide a selection of control applications performable through configuration of the device. Download of new application should not be required for one of these applications.
- C. ASC Device Software:
  1. General: An ASC shall operate in standalone mode as needed for specified control applications if network communication fails. Software shall include a complete operating system (O.S.), communications handler, point processing, standard control algorithms, and specific control sequences.
  2. Operating system software shall reside in programmable flash memory, operate in real-time, provide prioritized task scheduling, control time programs, monitor and manage network communications, and scan inputs and outputs. The operating system shall also contain built in diagnostics.



## 2.3 APPLICATION GENERIC CONTROLLER (AGC)

### A. General Requirements:

1. Application Generic Controllers shall be equipped with a minimum of 64K programmable non-volatile (flash) memory for general data processing, power supply, input/output modules, termination blocks, network transceivers.
2. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.
3. The AGC unit may be equipped with a dedicated software clock battery. If included, the battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a two-week period. Include an integral calendar with automatic leap year compensation.
4. AGC packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. Make board terminations by means of plug-in connectors to facilitate troubleshooting, repair and replacement. Network and power wiring shall allow for 'pass-thru' of signal when electronic boards are removed.

### B. AGC Interface Software:

1. General: AGC shall be configured, not programmed, via PC based interface software. This software shall be a program applet that runs within the network management tool chosen. Intimate knowledge of operation of AGC shall not be required for configuration.
2. AGC shall provide a selection of control applications performable through configuration of the device. Download of new applications from network management tool shall be possible, but not required.

## 2.4 CUSTOM APPLICATION CONTROLLER (CAC)

### A. General Requirements:

1. Custom Application Controllers shall be equipped with a minimum of 64K programmable non-volatile (flash) memory for general data processing, power supply, input/output modules, termination blocks, network transceivers.
2. Operating system software, custom operating sequence software and application programs shall be stored in programmable, non-volatile memory.
3. CAC unit may be equipped with a dedicated software clock battery. If included, the battery shall be capable of maintaining time of day, day of week, date, month, and year, independent of system power for a two-week period. Include an integral calendar with automatic leap year compensation.
4. CAC packaging shall be such that complete installation and checkout of field wiring can be performed prior to the installation of electronic boards. Make board terminations by means of plug-in connectors to facilitate troubleshooting, repair and replacement. The complete CAC including accessory devices such as relay, transducers, power supplies, etc. shall be factory-mounted, wired and housed in a NEMA 1 enclosure or as required by the location and local code requirements.
5. Equip CAC's with diagnostic indicators for the following:



- a. Transmit.
- b. Receive.
- c. Power up test.
- d. Power up fail.
- e. Power up test okay.
- f. Bus error.

B. CAC Software:

1. General: A CAC shall operate in standalone mode as needed for specified control applications if network communication fails. Software shall include a complete operating system (O.S.), communications handler, point processing, standard control algorithms, and specific control sequences.
2. Operating system software shall reside in programmable flash memory, operate in real-time, provide prioritized task scheduling, control time programs, monitor and manage CAC to OI communications, and scan inputs and outputs. The operating system shall also contain built in diagnostics.
3. Input/Output Point Processing Software shall include:
  - a. Continuous update of input and output values and conditions. Connected points are to be updated at a minimum of one-second intervals.
  - b. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no response or failed sensors, and conversion of values to 32 bit floating point format. Both the maximum and minimum values sensed for each analog input are to be retained in memory. It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-scale 32-bit conversion to achieve high accuracy readout.
  - c. A reasonability check on analog inputs against the previously read value and discard those values falling outside pre-programmed reasonability limits.
  - d. Assignment of proper engineering units and status condition identifiers to analog and digital input and outputs.
  - e. Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input or to assign a set of floating limits (alarm follows a reset schedule or control point) to the input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons shall be made each scan cycle.
  - f. Debounce of digital inputs to prevent nuisance alarms. Debounce timing shall be adjustable from two seconds to two minutes in one second increments.
4. Alarm lockouts:
  - a. Alarm lockout software shall be provided to prevent nuisance alarms. on initial start-up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period is

- to be programmable on a per point basis from 0 to 90 minutes in one minute increments.
- b. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when true alarm is dependent on the condition of an associated point. Hard lockout points and lockout initiators are to be operator programmable.
  - c. Design the power supply to accommodate the power requirements of all components (or nodes) connected, plus 50 percent.
5. Run Time Totalization or Point Trending:
- a. Run time shall be accumulated based on the status of a digital input point. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in non-volatile memory and have CAC resident run time limits assignable through the operator's terminal.
  - b. Totalized run time or trended data shall be batch downloaded using FTP to the SS on a daily or weekly basis. Trended data shall reside on the SS database server. The automatic update of this data shall be determined by the SS and facility management application requirements.
6. Transition Counting:
- a. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off.
  - b. Counter is to be non-volatile and be capable of accumulating 600,000 switching cycles.
  - c. Limits shall be assignable to counts to provide maintenance alarm printouts.
7. Custom Direct Digital Control (DDC) Loops:
- a. Custom DDC programs are to be provided to meet the control strategies as called for in the sequence of operation sections of these specifications.
  - b. Each CAC shall have residential in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences:
    - 1). Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning): The adaptive control algorithm shall be used on control loops, as indicated in I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops). The adaptive control algorithm shall monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero. Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory

control at only one flow rate and will require continued manual fine tuning.

- 2). DDC setpoints, gains and time constants associated with DDC programs shall be available to the operator for display and modification via the SS operator interface.
- 3). The execution interval of each DDC loop shall be adjustable from 2 to 120 seconds in one-second increments.
- 4). DDC control programs shall include an assignment of initialization values to outputs to assure that controlled devices assume a fail-safe position on initial system start-up.

## 2.5 VAV CONTROLLERS

- A. Provide manufacturer's thermostat matched to controller. Refer to Section 25 3000 - Building Automation System Field Devices, for requirements.
- B. Coordinate with Section 23 3600 - Air Terminal Units to have VAV controllers factory mounted on the VAV terminal unit.

## 2.6 ROUTERS, BRIDGES, REPEATERS AND TRANSCEIVERS

- A. Routers, Bridges and Repeaters:
  1. Equip each router and bridge with a network transceiver on each network port (inbound and outbound) as dictated by the network type (Type 1 - FTT, Type 2 - TP, Type 3 - PL, Type 4 - LP, Type 5 - RF).
  2. The network router shall be designed to route messages from a segment, sub-net, or domain in full duplex communication mode.
  3. Routers with TCP/IP capability shall be provided where TCP/IP backbone is used.
  4. Routers, bridges and repeaters shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions.
  5. The routers, bridges, and repeaters shall be capable of DIN rail or panel mounting and be equipped with status LED lights for Network traffic and power.
- B. Transceivers:
  1. Type 1 Network Transceiver, Free Topology, Twisted Pair: Provide a transformer isolated, twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:
    - a. Differential Manchester encoded signaling for polarity insensitive network wiring.
    - b. Transformer isolated for common mode rejection.
    - c. 78 Kbps network bit rate up to distances of 2000m.
    - d. Free topology supports star, home run, multi drop and loop wiring topologies.

- e. Complies with FCC and VDE requirements.
  - f. UL recognized component.
2. Type 2 Network Transceiver, Twisted Pair: Provide a transformer isolated twisted pair transceiver capable of mounting directly on a printed circuit board. The transceiver shall meet the following specifications:
- a. Differential Manchester encoded signaling for polarity insensitive network wiring.
  - b. Transformer isolation for common mode rejection.
  - c. 1.25 Mbps network bit rate up to distances of 1000 meters.
  - d. Unpotted construction.
  - e. Less than 1 mA power consumption with +5VDC input voltage.
  - f. FCC and VDE Level B requirements compliance.
  - g. UL Listed.
3. Type 3 Network Transceiver, Power Line:
- a. Provide a direct sequence, spread spectrum power line transceiver which is equipped with the following signal processing and error correction capabilities to provide robust and error free communications.
    - 1). Forward Error Correction (FEC) to enable the system to read and reconstruct corrupted packets without sacrificing throughput. The FEC shall require only six percent overhead for error correction.
    - 2). Automatic sensitivity adjustment algorithm that dynamically changes the receiver sensitivity based on noise characteristics.
    - 3). Oversampling correlation filter and adaptive data recovery algorithm to synchronize instantaneously to incoming packets.
    - 4). Tri-state power amplifier/filter combination to provide a powerful output signal with a minimum number of components.
  - b. The transceiver shall be able to operate using the controller power supply and coupling circuit. Provide the following general features as a minimum:
    - 1). Packaged in a rugged, potted module.
    - 2). Programmable clock output (1.25, 2.5, 5 or 10 Mhz).
    - 3). 10 Kbps network transmission rate.
    - 4). Packet detect output to drive a status indicator LED.
    - 5). Minus 20 to plus 85 degrees C. operating temperature range.
    - 6). UL Listed.
4. Type 4 Network Transceiver, Link Power: Provide a twisted pair transceiver that utilizes the twisted pair communication media to provide power for Controller(s). The transceiver shall meet the following specifications:
- a. Free single-in-line package (SIP) construction.
  - b. Send both network data and power on a twisted wire pair.
  - c. Differential Manchester encoded signaling for polarity insensitive network wiring.
  - d. 78 Kbps network bit rate up to distances of 320 meters.

- e. Supports star, home run, multidrop, and loop wiring.
  - f. Supplies +5VDC @ 100 mA maximum for node power.
  - g. Compliance with FCC and VDE requirements.
  - h. UL Listed.
5. Type 5 Network Transceiver, Radio Frequency: Provide a direct sequence, spread spectrum RF transceiver that meets the following specifications:
- a. 100 meter open field range.
  - b. Wireless communications extends network between buildings and to vehicles and portable devices.
  - c. FCC type certifiable, 48 MHz.
  - d. Low-cost miniature circuit board, SMT components.
  - e. Carrier detect output to drive a status indicator LED.
  - f. Plus 7 to plus 15VDC input voltage.
  - g. Minus 20 to plus 60 degrees C. operating temperature range.

## 2.7 WORKSTATION OPERATOR INTERFACE

### A. Basic Interface Description:

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, 30-character English language point identification, on-line help, and industry standard PC application software. Interface software shall simultaneously communicate with up to 4 Building Level Networks and share data between any of the 4 networks. The software shall provide, as a minimum, the following functionality:
  - a. Real-time graphical viewing and control of environment.
  - b. Scheduling and override of building operations.
  - c. Collection and analysis of historical data.
  - d. Point database editing, storage and downloading of controller databases.
  - e. Alarm reporting, routing, messaging, and acknowledgment.
  - f. Display dynamic data trend plot.
  - g. Definition and construction of dynamic color graphic displays.
  - h. Program editing.
  - i. Transfer trend data to third party software.
  - j. Scheduling reports.
  - k. Operator Activity Log.
2. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.
3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.

4. Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported).
5. Scheduling and Override: Provide a calendar type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key.
6. Collection and Analysis of Historical Data: Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

B. Dynamic Color Graphic Displays:

1. Create at least one color graphic display for each piece of mechanical equipment, including air handling units, hot water boiler systems, and room level terminal units. Provide floor plans to facilitate navigation. Point information to be displayed on the graphics shall be provided by the BAS contractor to optimize system performance and analysis and to speed alarm recognition.
2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of submittal AutoCAD drawings and scanned pictures for use in the system.
3. Dynamic temperature values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.
4. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
5. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
6. A dynamic display of the site-specific architecture showing status of controllers, PC workstations and networks shall be provided.

C. System Configuration and Definition:

1. Network wide control strategies shall not be restricted to a single DDC Controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.



2. Provide automatic backup and restore of DDC controller databases on the workstation hard disk. In addition, database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller. Changes made at the DDC Controllers shall be automatically uploaded to the workstation, ensuring system continuity.

D. Alarm Management:

1. Alarm Routing shall allow the user to send alarm notification to selected PC locations based on time of day, alarm severity, or point type.
2. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.
3. Alarm messages shall be customizable for each point to display detailed instructions to the user regarding actions to take in the event of an alarm.

## 2.8 NETWORKING COMMUNICATIONS

- A. The design of the BAS shall network an operator workstation(s) and stand-alone DDC Controllers. The network architecture shall consist of three levels; a Management Level Network (MLN) Ethernet network based on TCP/IP protocol, a high performance peer-to-peer building level network (BLN) and DDC Controller floor level local area networks (FLN). Access to the system shall be totally transparent to the user when accessing data or developing control programs.

B. Management Level Network:

1. PCs shall simultaneously direct connect to the Ethernet and Management Level Network without the use of an interposing device.
2. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.
3. Simultaneous user access to network limited to number of sight licenses issued to user.
4. When appropriate, any DDC controller residing on the peer-to-peer building level network shall connect to Ethernet network without the use of a PC.
5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet as well as directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network in addition to being able to download program changes to individual controllers.
6. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
7. Access to the system database shall be available from any client workstation on the Management Level Network.

C. Peer-to-Peer Building Level Network (BLN):

1. The system shall have the ability to support integration of third party systems (fire alarm, security, lighting, variable speed drives, PLCs, condensers, boilers) via a panel mounted open protocol processor. This processor shall exchange data between the two systems for inter-process control. Exchange points shall have full system functionality as specified herein.
2. Data transfer via Ethernet.

D. Floor Level Network (FLN):

1. This level communication shall support a family of application specific controllers and shall communicate with the peer-to-peer network through DDC Controllers for transmission of global data.

## 2.9 CONTROL PANELS

- A. Terminal Equipment Controllers will be mounted in enclosed control panels with screwed, removable covers.
- B. Control devices located in exposed areas subject to outside weather conditions or near circulator pumps (spray due to shaft seal failures) shall be mounted inside weatherproof enclosures. Location of each panel shall be convenient for adjustment service.
- C. Nameplates shall be provided beneath each panel face mounted control device describing the function of each device. Nameplates shall have white letters engraved on blue Lamicoid, or approved equal.
- D. Control panels shall bear a UL label compatible with the application.
- E. Electrical devices within the panel shall be pre-wired to terminal strips, with inter-device wiring within the panel completed prior to installation of the system.
- F. BLN level controllers shall be provided with standby/emergency power to provide power quality and minimum 15 minutes operation.

## 2.10 UNINTERRUPTIBLE POWER SUPPLY

- A. Acceptable manufactures are limited to the following:
  1. Powerware.
  2. Alternate Brand Request or Substitution Request required.



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PART 3 - EXECUTION

## 3.1 INSTALLATION

## A. Special Techniques:

1. Mount damper operators and other control devices secured to insulated ductwork on brackets such that the device is external of the insulation. See Section 20 0529 – Mechanical Hangers and Supports.
2. Do not install control devices in locations where they are subject to damage or malfunction due to normally encountered ambient temperatures.
3. Identification: Permanently tag controllers, switches, relays, thermostats and actuators for identification using the tagging format shown on the BAS control drawings.
4. Sensors and Switches:
  - a. Pump flow or fan flow, etc., shall be sensed using current sensor unless indicated otherwise. Calibrate current sensor to distinguish between loaded or unloaded motor condition due to belt or coupler breakage.
  - b. Protect averaging or capillary tubes where they penetrate duct with rubber grommet and seal with clear silicon. Support with capillary clips and maintain minimum 1 inch tubing bending radius.
5. Wiring:
  - a. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories. Install wiring in exposed or inaccessible areas in EMT conduit. Plenum-rated cable may be used in concealed, accessible areas only.
  - b. Provide wiring between thermostats and unit heater motors, and control and alarm wiring.
  - c. Provide conduit and wiring between the BAS panels and the temperature, humidity, or pressure sensing elements, including low voltage control wiring in conduit or plenum-rated cable.
  - d. Provide conduit and control wiring for devices specified in this Section.
  - e. Provide conduit and signal wiring between motor starters in motor control centers and high and/or low temperature relay contacts and remote relays in BAS panels located in the vicinity of motor control centers.
  - f. Provide conduit and wiring between the PC workstation, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contactors, and BAS panels, as shown on the drawings or as specified.
  - g. Wiring shall be compliant with the Divisions 26, 27 and 28 requirements and the NEC.
  - h. Provide electrical wall boxes and conduit sleeves for wall-mounted devices. Mount thermostats at 54 inches AFF unless otherwise noted.

## B. Interface with Other Work:

1. The Contractor is responsible to furnish and install complete and operational systems. The following breakdown is recommend; carefully coordinate work between subcontractors.
  2. Products furnished by BAS contractor for installation by the mechanical contractor:
    - a. Control valves.
    - b. VAV box controllers.
    - c. Wells for hydronic temperature sensors.
  3. Products furnished and installed by mechanical contractor:
    - a. VAV boxes. BAS contractor shall furnish VAV box controls to the VAV box manufacturer for factory installation at the expense of the box manufacturer.
    - b. VAV box controller enclosures will be provided by box manufacturer.
    - c. Gauges, thermometers and thread-o-lets for BAS contractor furnished control sensor wells.
    - d. Airflow measuring stations.
    - e. Control and balancing dampers.
    - f. Smoke and fire/smoke dampers actuators.
  4. Electrical contractor provides:
    - a. Wiring of power feeds through disconnect starters to electrical motors.
    - b. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by controls contractor.
    - c. Duct smoke detectors including installation and wiring.
    - d. Power wiring of smoke/fire dampers provided by Divisions 20, 21, 22, 23, 25.
    - e. Stand-alone packaged controls and wiring of stand-alone packaged controls to their remote sensors and devices.
    - f. Ethernet drop at or near designated BAS control panel(s).
    - g. Mounting and wiring of Variable Speed Drives (VSDs) furnished by the Mechanical Contractor per Divisions 20, 21, 22, 23, 25.
- C. System Integration. Products to receive integration under this section:
1. Variable Speed Drives:
    - a. Connect directly to the BAS through three twisted pair for Start/Stop, speed control and remote communications.
    - b. Factory-furnished with the appropriate communication hardware and software to allow communication.
    - c. Connections to VSD provided under this section.
  2. Fire Alarm/Life Safety System:
    - a. The BAS shall communicate with the fire alarm/life safety system via an alarmable point in the form of a dry contact.
    - b. The device will be provided and terminated by Divisions 26, 27 and 28. This section will provide wiring to the termination device.

### 3.2 PROGRAMMING

- A. Programming and graphics shall be included to implement the controls sequences specified in Section 25 9000 - Sequence of Operations, and to implement the systems and features included in Facility Services Divisions 20-28. It shall not be necessary for the Contracting Agency to further program the system.
- B. Provide licensed copies of software tools and programming aids used to install, develop and troubleshoot the controls system to the Contracting Agency. Assist the Contracting Agency in registering the software in Contracting Agency's name.
- C. Implement the control sequences for the equipment on this project as contained in Section 25 9000 - Sequence of Operations.
- D. Point identifiers shall be chosen for easy identification of the actual equipment being controlled or monitored. They shall include equipment tag identifiers shown on the drawings, and may include additional characters to identify floor, area, etc. Maintain a listing of identifiers used in this project, with their plain English names. Submit the listing for review and information.

### 3.3 GRAPHICS

- A. Graphical Mechanical Displays: Create graphical displays of major mechanical equipment for this project and install graphics on the existing PC-based workstation. At a minimum, these graphical displays shall include:
  - 1. Boiler System (boilers, pumps, fluid temperatures and flowrate, system pressure).
  - 2. Well water cooling system (well pump, fluid temps, flowrate, valve positions, CC-1 discharge air temperature and setpoint, system pressure).
  - 3. Secondary glycol system (pumps, valve position, PHC-1 discharge air temperature, system pressure).
  - 4. VAV114 system.

### 3.4 SITE QUALITY CONTROL

- A. Document each installation and operational step utilizing the approved PC/FT checklists in accordance with Section 01 9100 - Commissioning.
- B. Programming BAS to provide system operation and monitoring in accordance with Section 25 9000 - Sequence of Operation and other referenced sections.
- C. Trend Logs:
  - 1. Prepare trend logs for all points required to demonstrate BAS calibration, control and stability.
  - 2. Trend logs shall document building operation after applicable PC/FT checklists are completed and building site commissioning is satisfactorily completed.
  - 3. Set points, valve positions, etc. may be temporarily adjusted to artificially induce the intended sequences to occur.

## 3.5 CLOSEOUT ACTIVITIES

## A. Demonstration:

1. Demonstrate the proper operation and control of systems controlled and monitored by the BAS.
2. The demonstration shall include, but not necessarily be limited to, the following:
  - a. Review of the Trend Logs.
  - b. Complete and proper operation of control systems including simulations.
  - c. Access to devices for required maintenance.
  - d. Review of associated graphics on Host.

## B. Training:

1. In addition, provide 4 hours of on-site instruction by BAS contractor to familiarize operating personnel with the control system. Instructions will include:
  - a. A brief description of the controls' sequence of operation.
  - b. A discussion and explanation of alarms, switches and gauges.
  - c. A summary and explanation of steps to be taken in response to specific alarms or control malfunctions.
  - d. Building walk-through to physically locate and examine control devices and demonstrate control setpoint adjustment procedures.
  - e. Instructions regarding adjustment procedures shall emphasize methods for continual building "fine-tuning".

END OF SECTION 25 5000

## SECTION 25 9000

## SEQUENCE OF OPERATIONS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. This section describes the building automation system (BAS) control sequences for the heating, ventilating and air-conditioning (HVAC) systems, electrical systems and plumbing systems provided for this project.

## B. Related Sections:

1. 20 0000 - Mechanical General Requirements
2. 23 0593 - Testing, Adjusting and Balancing
3. 23 2123 - Hydronic Pumps
4. 23 3100 - Ducts and Accessories
5. 23 3600 - Air Terminal Units
6. 23 5216 - Condensing Boilers and Accessories
7. 25 3000 - Building Automation System Field Devices
8. 25 4000 - Variable Speed Drives
9. 25 5000 - Building Automation System

## 1.2 SUBMITTALS

## A. Refer to 20 0000 – Mechanical General Requirements.

## B. Product Data:

1. Provide BAS manufacturers' product literature, clearly annotated to indicate performance criteria to include the following:
  - a. Building level to floor level network controller riser diagrams. Include building locations and equipment controlled by each controller.
  - b. Sequences of operation for HVAC, electrical and plumbing systems.
  - c. Process control diagrams to support each sequence of operation. Show field mounted control device locations and circuit routing.
  - d. Complete electrical and pneumatic BAS points list.

## C. Quality Assurance/Control Submittals:

1. Installation and Functional Performance Test Letter.

- a. Provide a letter certifying that the building automation system hardware is completely installed and sequences of operation have been programmed, operationally tested, with physical verification, to comply with the sequences of operation as specified. The installer(s), sub-contractor(s) and the Contractor must sign the letter.
  - b. Include as an attachment, a list of programming deviations from the specified sequences of operation with justification to support each deviation.
  - c. Include as an attachment, a table of final adjustable setpoint values for each applicable control point.
- D. Installation, Operation and Maintenance Data:
- 1. Refer to Section 20 0000 – Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
  - 2. Provide approved submittal information, revised to reflect the actual installation as addressed in the attachments provided with the Installation and Functional Performance Test Letter, for inclusion within the project IO&M Manual.

### 1.3 QUALITY ASSURANCE

- A. Qualifications of Installers/Programmers: Minimum 3 years' experience in the installation and programming of direct digital control systems.
- B. Pre-Installation Meetings: Conduct coordination meetings, as necessary, to evaluate and coordinate the connection of the BAS to each piece of HVAC, electrical and plumbing equipment. Where the BAS is to be connected to packaged, stand-alone controllers, coordinate BAS remote control and monitoring capabilities with the specific features of the packaged controller to maximize remote operability and monitoring of each packaged controller through the BAS.

## PART 2 - PRODUCTS - NOT USED

## PART 3 - EXECUTION

### 3.1 BOILER ROOM VENTILATION AND COOLING (VAV-114)

- A. Description.
  - 1. Boiler room ventilation and cooling is provided by cooling only VAV-114. Its associated air handler AHU-1 runs 24/7/365.
  - 2. Air is returned to the AHU plenum above through a smoke damper protected grille.
- B. VAV Box Controller.
  - 1. Reuse existing VAV-114 controls for new (larger capacity) VAV-114.
- C. Zone Temperature sensor.

1. Reuse existing zone temperature sensor.
- D. Operation.
  1. Modulate VAV damper from minimum to maximum to maintain room temperature setpoint.
- E. Room Temperature Monitoring.
  1. Monitor the temperature in the Boiler Room and send a "Boiler Room High Temperature" alarm to the BAS if the actual room temperature exceeds setpoint by 7 degrees F for a period of 15 continuous minutes.

### 3.2 AHU-1 WELL WATER COOLING SYSTEM

- A. Description.
  1. AHU-1 utilizes a well water cooling system for mechanical cooling operations. AHU-1 is currently the only water user on the cooling well.
- B. Priming Sequence.
  1. The timed priming sequence is intended to fill the WWS piping between the cooling supply well and the check valve inside the facility mechanical room slowly to:
    - a. Allow air to be vented from WWS piping at a reasonable rate.
      - 1). Air is automatically expelled from the system at the WWS pipe Air/Vacuum vent valve upstream of the system check valve.
    - b. Avoid water hammer due to excessively high water flow rates.
  2. Well pump controller is in "AUTO" position.
  3. Software enable the well water cooling system for automatic operation through the BAS.
  4. Priming sequence is initiated each time AHU-1 calls for mechanical cooling.
    - a. Upon a call for cooling by AHU-1, cooling well supply pump starts and ramps slowly to minimum speed required for well pump motor cooling; initial ramp sequence to be 3 minutes (adjustable), or as recommended by well pump manufacturer.
- C. AHU-1 Supply Air Temperature Control Operating Sequence.
  1. Temperature control operating sequence below is enabled after Priming Sequence above has completed its timed ramp-up plus 1 minute (adjustable).
  2. When AHU-1 well water cooling coil control valve is commanded to modulate open for mechanical cooling operations:
    - a. Open bypass control valve CV-2 to 100% open.
    - b. Start well pump. Ramp well pump speed up slowly to maintain minimum well water flow as indicated on flow meter FM-1 (verify minimum well water flow required for well water pump motor cooling).
    - c. After a 3 minute delay (adjustable), release AHU-1 cooling coil control valve CV-1 for cooling operations. CV-1 modulates to maintain AHU-1



supply air temperature setpoint (existing control sequence). CV-2 modulates to maintain minimum well water flow at FM-1.

- d. If bypass valve CV-2 is fully closed (meaning the minimum flow at FM-1 meets or exceeds its minimum flow setpoint) and cooling coil control valve CV-1 is fully open, increase well pump speed to maintain AHU-1 supply air temperature setpoint.
- e. Reverse above sequence for decreasing cooling load operations. If cooling coil control valve CV-1 has been fully closed for a period of 5 minutes, ramp well water pump speed down slowly and stop.

D. Well Water Rejection (WWR) Temperature Control.

1. The maximum WWR temperature is regulated by UAA's ground water usage permit.
2. During well water cooling operations, if the WWR temperature exceeds its setpoint (as read by the WWR header temperature sensor), bypass control valve CV-2 opens to reduce the WWR temperature. When bypass valve CV-2 is actively modulating to maintain maximum WWR temperature setpoint, display the following on the well water system BAS screen "Well Water Bypass Valve Modulating to Maintain WWR Header Temperature".
  - a. The WWR temperature setpoint shall be equal to the maximum permitted WWR temperature minus one degree F (adjustable). Maximum permit WWR and offset temperatures to be verified with UAA.

E. System Monitoring and Alarms.

1. Monitor the WWS header pressure and send a "High Well Water System Pressure" alarm if header pressure exceeds 20 psi (adjustable) for a period of 1 minute.
2. Excluding startup operations, if the minimum system flow (FM-1) has been 10% low for a period of 3 continuous minutes, send a "Minimum Well Water Flow Alarm" to the BAS and shut down well water cooling operations.
3. Monitor WWR header temperature; record temperature at 15 minute intervals or as directed by UAA. If WWR temperature exceeds its maximum WWR temperature setpoint by 2 degrees F for a period of 10 minutes, send a "Maximum Well Water Rejection Temperature Exceeded" alarm to the BAS.
4. Monitor well water pump Variable Speed Drive. Generate a BAS specific message upon alarm.
5. Connect to and monitor the cooling well water level and water temperature sensors located in the well casing. Coordinate requirements with Section 33 1113 Water Supply Well.
6. Coordinate required trending of water temperatures, level, and flowrate with Civil and UAA. Provide trend information at 15 minute intervals while the well pump is operating.

F. End of Season Drainage (by UAA personnel).

1. Not Applicable. WWS/R piping drains down after each mechanical cooling operation.



**3.3 PRIMARY HYDRONIC HEATING SYSTEM OPERATION****A. General System Description.**

1. The hydronic heating system consists of two identical low mass condensing hydronic heating boilers (BLR-1, BLR-2) each scheduled for 65 percent of the building's design heating load. This project reconfigures the facility's heating system into a variable volume primary only piping arrangement. Existing variable volume secondary pumps PMP-1A and PMP-1B will be reused (without change) as the system's primary pumps.

**B. Coordination with Integral Packaged Boiler Controls.**

1. Both boilers are provided with fully integrated packaged controls utilizing 'C-More Controllers with Boiler Sequencing Technology (BST)', capable of master/slave operations. Configure Boiler BLR-1 to be master and BLR-2 to be slave unless directed otherwise.
2. Coordinate connection of the BAS to both boilers using the facility's existing BACnet LAN; provide BACnet 'IP' protocol; verify with boiler manufacturer.
3. Provide boiler enable/disable and monitoring functions utilizing the BAS.

**C. Full Shutdown Mode (Initial conditions).**

1. All boilers off.
2. Primary circulator pumps off (PMP-1A, PMP-1B).
3. AHU heating coil recirculation pumps off (PMP-4A, PMP-4B).

**D. Operating Mode.**

1. Manual Mode.
  - a. Initiated at the master boiler's control panel.
2. Automatic System Enable and Startup.
  - a. Utilize existing BAS programming for startup and lead/lag control for primary loop circulators PMP-1A and PMP-1B. Alternate lead loop pump monthly (adjustable) during the heating season.
  - b. Start lead loop circulator pump (PMP-1A or PMP-1B).
  - c. After loop flow has been established for 5 minutes (adjustable), enable boiler operations via boiler's controllers.
  - d. Lead/lag, boiler sequencing, and modulation provided by boiler's controllers.
3. Boiler Operation.
  - a. Hydronic heating system supply temperature is reset by the BAS and sent to the boiler's controllers according to the following reset table:

<b>Hydronic System Temperature Reset Schedule</b>	
<b>Outside Air Temperature</b>	<b>Heating Loop Water Temperature Setpoint</b>
60 Degrees F.	120 Degrees F.
-20 Degrees F.	180 Degrees F.

- b. Program the above reset schedule into the boiler's controllers for use in the event of loss of communication with the BAS.
  - c. Boilers fire under the control of the boiler on-board combustion management system to maintain remote header temperature setpoint.
  - d. Sequencing of individual boilers within the boiler plant is controlled by the boiler's controllers.
  - e. Flow through standby boilers is isolated from the system loop via 2-way motorized isolation valves controlled by boiler manufacturer's control system.
  - f. Connect boiler's supply and return header temperature sensors to the boiler's control system.
  - g. Connect BAS heating supply and return header temperature sensors to the BAS.
  - h. Connect boiler controller outside air temperature sensor to the boiler control panel for use in the building hydronic heating supply water temperature reset control in the event of loss of communication with the BAS.
  - i. Establish original boiler reset schedule within the boiler's controllers. This schedule will be used by the boiler's controllers in the event that communication with the BAS is lost.
  - j. Coordinate with boiler manufacturer's representative and adjust setpoints and time constants in accordance with manufacturer's recommendations.
4. System Shutdown.
- a. Initiate Full Shutdown Mode in the following events:
    - 1). Manual "off" mode.
    - 2). Low water cutoff shutdown of either boiler.
- E. Hydronic System Monitoring and Alarm.
- 1. Boiler safeguard alarms (BLR-1 and BLR-2).
    - a. Generate a separate "BLR-X Flame Failure" alarm if any boiler is shutdown by its flame safeguard control system.
  - 2. Primary loop pump trouble alarms (PMP-1A and PMP-1B).
    - a. Utilize existing programming
    - b. Generate a separate alarm if either pump fails to operate when called to run.
  - 3. Hydronic System Low Pressure Alarms.
    - a. Monitor both the primary heating loop system pressure with analog sensor pressure sensors.
      - 1). Generate a separate low-pressure alarm if system pressure falls below ten (10) PSIG (adjustable).
  - 4. BTUH Monitoring.
    - a. Calculate system heat output (Btuh) using primary hydronic heating loop supply and return water differential temperature and simultaneous system flow using the following equation:  
$$\text{Btuh equals } 500 * \text{GPM} * (\text{Supply Temperature} - \text{Return Temperature})$$

### 3.4 AHU PREHEAT COIL GLYCOL HEATING SYSTEM.

#### A. General System Description:

1. System provides heated glycol to the main air handling unit (AHU-1) preheat coil.
2. System consists of one plate and frame heat exchanger (HX-1) and a set of constant speed pumps (PMP-4A/PMP-4B), each sized for 100 percent of system flow through heat exchanger. When the hydronic system control valve modulates open to HX-1 on a call for heat, heating loop lead/standby pumps PMP-1A/PMP-1B circulate heating water supply through hot side of HX-1, and glycol heating system lead/standby pumps PMP-4A/PMP-4B circulate heated glycol through cold side of HX-1 to AHU-1's preheat coil.
3. System operates as a constant volume, variable temperature system (HX-1's cold side glycol temperature varies to meet AHU-1 preheat coil's leaving air temperature setpoint).

#### B. System Shutdown (initial conditions):

1. Glycol system circulator pumps off (PMP-4A/PMP-4B).
2. HX-1 freeze protection. HWR control valve is:
  - a. Closed when OSA temperature is greater than 37 degrees F.
  - b. 5 percent open when OSA temperature is less than 35 degrees F.
  - c. 10 percent open when OSA temperature is less than 20 degrees F.
  - d. 20 percent open when OSA temperature is less than 0 degrees F.

#### C. Operating Mode:

1. When outside air (OSA) temperature is 40 degrees F. (adjustable) and decreasing, and associated AHU preheat coil control valve has been open greater than 5 percent for a period of 3 minutes, start applicable heating coil circulator pump.
  - a. Lead/Standby Control: Provide lead/standby control for the system pumps (PMP-4A/PMP-4B). Alternate lead pump monthly (adjustable) during the heating season. Operate pumps with lead pump in "run" and standby pump in "standby." If lead pump fails to start as determined by analog current sensor, disable lead pump and start standby pump.
2. Modulate HX-1 hot side HGR control valve to maintain AHU-1 preheat coil leaving air temperature (existing) setpoint.

#### D. System Monitoring and Alarms.

1. Monitor AHU-1 PHC-1 leaving air temperature. Generate a 'Low PHC-1 Leaving Air Temperature' alarm if PHC-1'S leaving air temperature is below setpoint minus 5 degrees for a period of 10 minutes.
2. Monitor GHS temperature. Generate a 'Low PHC Glycol Supply Temperature' alarm if GHS temperature falls below setpoint minus 5 degrees for a period of 10 minutes.
3. Monitor system pressure. Generate a 'Low PHC Glycol System Pressure' alarm if pressure falls below setpoint minus 5 psi for a period of 10 minutes.
4. Monitor electrical current for system circulation pumps PMP-4A and PMP-4B. Generate pump specific alarm for improper operation, to include:
  - 1). Both pumps are off when system is in operating mode.
  - 2). Lead pump fails to operate and system switches to standby pump.
  - 3). Both pumps are running.

## 3.5 MISCELLANEOUS MONITORING AND ALARMS

## A. Gas Meter Totalizing.

1. Provide gas meter BTU totalizing input to BAS.
2. Report gas usage to UAA's Energy Monitoring and Controlling Solution (EMC) application. Coordinate requirements with UAA.

END OF SECTION 25 9000

## SECTION 26 0000

## ELECTRICAL GENERAL REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
- B. This section describes specific requirements, products, and methods of execution, which are typical throughout the electrical work of this project. Additional requirements for the specific systems may modify these requirements.
- C. This Section applies to all Divisions 26 and 27 and is part of all other Divisions 26 and 27 Sections.
- D. Index of Electrical Specifications:
  - 1. 26 0000 - Electrical General Requirements
  - 2. 26 0519 - Low Voltage Electrical Power Conductors and Cables
  - 3. 26 0526 - Grounding and Bonding for Electrical Systems
  - 4. 26 0529 - Hangers and Supports for Electrical Systems
  - 5. 26 0533 - Raceway and Boxes for Electrical Systems
  - 6. 26 0553 - Identification for Electrical Systems
  - 7. 26 2726 - Wiring Devices
  - 8. 26 2800 - Low Voltage Circuit Protective Devices
  - 9. 26 2816 - Enclosed Switches and Circuit Breakers
  - 10. 26 2900 - Low Voltage Controllers
  - 11. 26 5000 - Lighting Fixtures

## 1.2 NOTIFICATION OF POTENTIAL HAZARDS

- A. Asbestos, lead and other hazardous materials may be present in the building that may impact the work of all trades. All trades shall coordinate with other trades and conduct their work to prevent worker exposure or site contamination. Refer to specification Section 02 2600 Hazardous Materials Summary Report, Section 01 3545 Airborne Contaminate Control; and Division 02 Specifications for specific information concerning disturbing, removing and disposing of these materials and the installation of new materials or components. This notification is provided in accordance with EPA and OSHA requirements.

### 1.3 REFERENCES

- A. Codes: Perform work in strict accordance with applicable national, state and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:
  - 1. NFPA 70, National Electrical Code - NEC.
  - 2. ANSI-C2, National Electrical Safety Code - NESC.
  - 3. International Building Code - IBC.
  - 4. International Fire Code - IFC.
  - 5. Underwriters Laboratory (UL) or approved equal.
- B. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:
  - 1. American National Standards Institute - ANSI.
  - 2. American Society for Testing and Materials - ASTM.
  - 3. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE.
  - 4. Institute of Electrical and Electronics Engineers - IEEE.
  - 5. Insulated Cable Engineers Association - ICEA.
  - 6. National Electrical Manufacturers' Association - NEMA.
  - 7. National Fire Protection Association - NFPA.

### 1.4 DEFINITIONS

- A. "Accessible" means arranged so that an appropriately dressed man, 6 feet-2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended and may then position himself to properly and safely perform the task to be accomplished, without disassembly or damage to the surrounding installation.
- B. "Authority Having Jurisdiction" is the individual official, board, department, or agency established and authorized by the political subdivision created by law to administer and enforce the provisions of the Code as adopted or amended.
- C. "As Specified" denotes a product, system, or installation that:
  - 1. Includes all of the salient characteristics identified in the Drawings and Specifications;
  - 2. Meets all of the requirements of the "Basis of Design"; and
  - 3. Is produced by a manufacturer listed as acceptable on the Drawings or in the Specifications.
- D. "Basis of Design" refers to products around which the design was prepared. Some or all of the particular characteristics of Basis of Design products may be critical to the fit or performance of the completed installation. Such characteristics are often subtle. Where substitutions are made to products that are the Basis of Design, the Contractor is alerted that nominally acceptable substitutions may produce undesirable side effects such as switchboards that no longer fit the space due to increased product dimensions. The Contractor is responsible for resolving all impacts of substitutions. Approval of a substitution request does not relieve the Contractor of complying with the design intent and all Codes.

- E. "Contracting Agency" is the Owner as defined in the General Conditions of the Contract.
- F. "Demolish" means to permanently remove a component, equipment, or system and its appurtenances with no intent for reuse and to properly dispose of it.
- G. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.
- H. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.
- I. "Product" is a generic term that includes materials, equipment, fixtures and any physical item used on the project.
- J. "Provide" means furnish all products, labor, subcontracts, and appurtenances required and install to a complete and properly operating, finished condition.
- K. "Remove" means to remove a component, equipment, or system and its appurtenances and either store it for re-installation, reuse, or turn it over to the Contracting Agency.
- L. "Rough-in and Connect" means provide an appropriate system connection such as conduit with junction boxes, wiring, switches, disconnects, etc., and wiring connections. Equipment furnished is received, uncrated, assembled, and set in place under the Division in which it is specified.
- M. "Serviceable" means arranged so that the component or product in question may be properly removed, and replaced without disassembly, destruction or damage to the surrounding installation. "Serviceable" components shall be "accessible".
- N. "Shop Drawings" are dimensioned working construction drawings drawn to scale to show an entire area of work in sufficient detail to demonstrate service and maintenance clearances and complete coordination of all trades.
- O. "Substitution" is a product, system or installation that is not by a listed manufacturer or does not conform to all salient characteristics identified in the Contract Documents, but which the Contractor warrants meets all specific requirements listed in the Contract Documents.
- P. "System Drawing" is a diagrammatic engineered drawing that shows the interconnection and relationship between products to demonstrate how the products interact to accomplish the function intended. Examples of system drawings include control and instrumentation diagrams, and wiring diagrams. Some drawings, such as dimensioned and complete Fire Suppression Drawings may be both System Drawings and Shop Drawings.



## 1.5 PERFORMANCE REQUIREMENTS

- A. Provide labor, products and services required for the complete installation, checkout and startup of electrical systems shown and specified. Where the work of several crafts is involved, coordinate related work to provide each system in complete and in proper operating order.
- B. Lay out the work in advance and avoid conflict with other work in progress. Physical dimensions shall be determined from existing conditions. Verify locations for junction boxes; disconnect switches, stub-ups, etc., for connection to equipment furnished by others, or in other Divisions of this Work.
- C. Refer to the "Suggested Coordination Schedule" in Section 20 0000 - Mechanical General Requirements.
- D. Cooperate with others involved in the project, with due regard to their work, to promote rapid completion of the entire project.
- E. Coordinate installation of panels, equipment, system components, and other products to provide proper service areas and access for items requiring periodic maintenance inspection or replacement.
- F. Reference to a specific manufacturer's product (even as "Basis of Design") does not necessarily establish acceptability of that product without regard to compliance with all other provisions of these specifications.
- G. Local Conditions: The Contractor shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climatic conditions and other local conditions which may affect the progress and quality of the work.
- H. Utility Coordination: Coordinate work with the serving utilities (electrical, telephone, cable television, etc.) and provide equipment and installation in accordance with the respective utility requirements. Meet with the serving utilities and coordinate the installation and location of the services. Provide a written statement of approval from each serving utility. Provide trenching from telephone and television stubout locations to property line in accordance with respective utility requirements.
- I. Demolition: Coordinate related demolition in support of the project. Restore circuits and systems, which are to remain, but which are affected in any way by demolition Work. Conduct a site visit prior to bid to determine Scope. Refer to Part 3 of this Section for execution requirements.

## 1.6 SUBMITTALS

- A. Refer to Division 1 for general submittal, closeout submittal and product substitution requirements. In addition, prepare Divisions 26 and 27 submittals in accordance with the following.
- B. Specification section drawings, calculations, and products shall be complete and submitted together in one package.



## C. General:

1. The Contracting Agency's obligation to review submittals and to return them in a timely manner is conditioned upon the prior review and approval of the submittals by the Contractor as required by the Construction Contract.
2. Streamlining: in many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.
3. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.
4. Submittals will not be checked for quantity.
5. Submittals will not be exhaustively checked for dimension or fit, or for proper technical design of manufactured equipment. Provision of a complete and satisfactory working installation is the responsibility of the Contractor.
6. Furnish suppliers with the applicable portions of the Contract Documents and review and verify that the suppliers' submittals clearly represent products which comply with the Contract Documents.

## D. Electronic Submittals:

1. Submittals may be in electronic (PDF) format.
  - a. Electronic submittals shall follow the organization and formatting required for paper submittals.
    - 1). Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
    - 2). If individual PDF files are provided for each product or shop drawing sheet, organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
  - b. If submittal is a scanned document, run the optical character recognition OCR function to ensure the document is searchable and can be copied and pasted.
  - c. Electronic submittals may be transmitted via Email, disc or download from a project or construction Website.

## E. Coordination:

1. Create and maintain a master submittal log. Submit master submittal log with first submittal.
2. Prior to submission for approval hold a meeting of all trades to review all shop drawings and submittals. All trades shall cross-check all shop drawings and submittals for conflicts, clearances, physical space allocation and routing, discrepancies, dimensional errors, omissions, contradictions, departures from the Contract requirements, correct electrical/mechanical services and connections, and provisions for commissioning.
3. Revise, correct, and appropriately annotate submittals prior to submission for approval.
4. A current copy of approved submittals and the submittal log shall be kept at the job site.

## F. Product Submittals

1. General: This section describes in detail the preparation of electrical product submittals. Submittals not provided as described shall be rejected without review. This procedure is designed to accelerate and improve the accuracy of the technical

review process, as well as, simplify the preparation of the Installation, Operation, and Maintenance Manuals (IO&Ms) during project closeout.

2. Submittal Organization:

- a. Organize product submittal information in the same order as the products are specified to simplify the technical review process. Provide a separate tabbed divider for each Divisions 26 and 27 specification section. Provide the typed section number on each tab.
- b. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable specification section. Provide sub-tabs within each section for each separate product article. Provide the typed product article number on each tab.
- c. Provide product submittal information for each product specified in 8-1/2" x 11" format. Fold-out 11" x 17" format is also acceptable.
- d. If a particular specified product is being omitted from the product submittal or will not be used for the project, provide a single sheet within the article tab identifying the product and annotated with a brief reason why the product is not being submitted, for example: "NOT USED," NO SUBMITTAL REQUIRED," "TO BE SUBMITTED BY (PROVIDE DATE)," etc. This will inform the reviewer that the product was not overlooked.
- e. Partial submittals from individual subcontractors may be provided which cover a particular sub-contractor's scope of work. In this case, arrange partial submittals by system classification such as: LIGHTING, POWER DISTRIBUTION, FIRE ALARM, ACCESS CONTROL SYSTEM, etc. Within each system classification, arrange product submittals by specification section, as described, such that each specification section can easily be reorganized into a master set of Divisions 26 and 27 product submittals organized by specification section. This will greatly simplify the preparation of IO&M manuals as described below.
- f. Bind product submittal information in 3 inch wide, hard backed, loose leaf, 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes such that the pages in each binder rest naturally on one side of rings.
- g. Provide a master table of contents at the front of each volume which lists the Divisions 26 and 27 specification sections and indicates which sections are located within each volume.
- h. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
- i. Provide identical cover and spine inserts for each product submittal volume.
- j. For multiple volumes, label each volume. Include the following typed information on the front cover and spine inserts of each volume:
  - 1). The Contracting Agency Name
  - 2). Project Name
  - 3). Contractor Name
  - 4). Subcontractor Name preparing the submittal.
  - 5). Date that the submittal or resubmittal was initiated.
  - 6). "Electrical Product Submittals", etc. as appropriate.
  - 7). "Volume 1 of X, Volume 2 of X," etc.

3. Product Information:

- a. Indicate manufacturer's name and address, and local supplier's name, address, phone number.
  - b. Indicate each product as "Basis of Design", "As Specified" or as "Proposed Substitution."
  - c. Identify Catalog designation and/or model number.
  - d. Neatly annotate each salient characteristic and design options of the product to demonstrate compliance with the Contract Documents to include: Scheduled information, drawing information and specified information. Clearly indicate product deviations from the Contract Documents and mark out non-applicable items on generic "cut-sheets."
  - e. Include manufacturer provided dimensioned equipment drawings with mechanical and electrical rough-in connections.
  - f. Include operation characteristics, performance curves and rated capacities.
  - g. Include motor characteristics and wiring diagrams for the specific system.
  - h. Provide basic manufacturer's installation instructions.
4. Provide coordination data to check protective devices.
  5. Provide information required to verify compliance with the short circuit withstand and interrupting ratings, as shown on the Drawings or further stated in these Specifications.
  6. Provide certification that all data shown on the Drawings or further stated in these Specifications concerning available short-circuit currents has been confirmed with the serving Electric Utility.
  7. Product Substitutions:
    - a. Clearly indicate both in the section table of contents and on the individual product submittal information each proposed substitution, deviation or change from the product as described in the Contract Documents.
    - b. Submittal approval does not include substitutions, deviations or changes from the requirements of the Contract Documents unless they are specifically itemized and approved. The term "No Exceptions Taken" will not apply to substitutions, deviations or changes not clearly identified.
    - c. Provision of a satisfactory working installation of equal quality to the system as described in the Contract Documents shall be the responsibility of the Contractor.
    - d. Correct unapproved deviations from the Contract Documents discovered in the field as directed by the Contracting Agency at no additional cost to the Owner.
- G. System Drawings:
1. Submit System Drawings for dynamic elements/systems of the project which are performance specified to include but not limited to: Fire Alarm Systems, Lightning Protection Systems and stand-alone packaged equipment.
  2. Prepare system drawings on full sized sheets of the same size as the original construction drawings.
  3. Include with each system a sequence of operation narrative which describes each mode of system operation in sufficient detail to demonstrate compliance with the Contract Documents to the satisfaction of the Contracting Agency.
- H. Shop Drawings:
1. General:

- a. The Contract Documents are not intended for nor are they suitable for use as shop drawings. Do not use Contract Drawings for direct fabrication or installation of products or equipment.
  - b. Divisions 26 and 27 products and systems shall not be installed without shop drawings approved by the Contracting Agency.
  - c. Rework, changes or additional engineering support required as a result of the installation of products and systems prior to the approval of applicable shop drawings by the Contracting Agency shall be provided at the Contractor's expense.
2. Preparation:
- a. Review each Divisions 26 and 27 specification section and identify the project's shop drawing requirements.
  - b. Prepare shop drawings on full sized sheets of the same size as the original construction drawings.
  - c. Arrange shop drawings to scale, showing dimensions where accuracy of location is necessary for coordination or communication purposes.
  - d. Incorporate the actual dimensions and configurations of the products and systems approved through the product submittal process into the shop drawings.
  - e. Provide dimensioned maintenance clearance areas around each product as recommended by the manufacturer.
  - f. Meet with and coordinate Divisions 26 and 27 work with the interrelated work of other trades including Architectural, Civil, Structural, and Mechanical to identify and resolve potential conflicts.
  - g. Clearly identify and provide recommendations to resolve major conflicts which may impact the design of the systems as shown. Resolve such conflicts during the shop drawing review process.
  - h. In cases where one or more equipment items in a mechanical or electrical room or space differ in dimensions or configuration from Basis of Design equipment, the working drawing shall show the entire area. The drawing shall be dimensioned to indicate that required aisle ways and maintenance clearances are being maintained to at least the degree shown on the Contract Drawings.
  - i. Provide shop drawings for all products, systems, system components, and special supports that are not a standard catalog product and which may be fabricated for the Contractor or by the Contractor. In addition provide shop drawings for:
    - 1). Electrical and telecommunications rooms and spaces, including all equipment. Demonstrate all required clearances and working spaces are provided.
    - 2). Routing and interdisciplinary coordination of groups of conduits numbering more than one and over two inch trade size.
    - 3). Busways.
    - 4). Cable Trays.
    - 5). Floor ducts.
    - 6). Telecom equipment rack elevations.
    - 7). CCTV equipment rack elevations.
    - 8). Where noted on the drawings.
    - 9). Where noted in other Divisions 26 and 27 sections.
3. Shop Drawing Submittal:

- a. Submit dimensioned shop drawings as specified to demonstrate proper planning and sequencing of the applicable trades for the installation and arrangement of Divisions 26 and 27 with respect to other interrelated work.
  - b. Installation conflicts arising from the failure to properly coordinate the work of related trades shall be resolved at the Contractor's expense.
- I. Record Drawings
- 1. General: As the Work progresses, neatly annotate a designated and otherwise unused, set of Divisions 26 and 27 Contract Drawings to show the actual locations and routing of Divisions 26 and 27 Work and the terminal connection points to related Work. As a minimum, include the following:
    - a. Annotate record drawings to incorporate each applicable addendum.
    - b. Annotate record drawings as directed by each applicable Request for Information (RFI) and accepted Change Order Proposal.
    - c. Modify record drawings to show actual equipment sizes and locations.
    - d. Provide fully dimensioned locations for permanently concealed conduits (i.e. conduit cast in concrete or buried underground/underslab).
    - e. Show routing of work in permanently concealed blind spaces within the building.
    - f. Maintain drawings in an up-to-date fashion in conjunction with the actual progress of installation. Accurate progress mark-ups shall be available on-site for examination by the Contracting Agency or his representative at all times.
  - 2. Preparation:
    - a. Neatly annotate record drawings to provide clear interpretation to support electronic drafting by a third party.
    - b. Tape electronic sketches from addendums and/or RFIs directly to the record drawings as overlays.
    - c. Annotate the record drawings in colored pencil using the same symbols and abbreviations as indicated in the Divisions 26 and 27 legends and schedules of the Contract Drawings.
      - 1). Red to add information.
      - 2). Green to delete information.
      - 3). Blue to provide additional clarifying information which is not to be drafted.
    - d. After submittal to the Contracting Agency, provide additional clarification, information or rework as necessary to support the accurate interpretation and electronic drafting of the record drawings.
  - 3. Submittals:
    - a. Provide dimensioned underslab record drawings to the Contracting Agency prior to pouring the slab. For slabs poured in multiple sections, provide record drawings for the applicable slab sections to the Contracting Agency prior to each pour.
    - b. Provide complete record drawings for concealed areas (i.e. above lay-in and hard ceilings and inside walls) to the Contracting Agency prior to concealment.
    - c. Provide the remaining portion of the record drawings for exposed areas to the Contracting Agency prior to the final completion of the project.
    - d. Prepare wiring diagrams using the latest release of AutoCAD for individual special systems as installed. Identify components and show wire and



terminal numbers and connections. Include diagrams from the shop drawings and submittals, updated to show as-built condition.

J. Test Certificates:

1. Review the submittal requirements for Quality Assurance/Control Submittals for each specification section.
2. Submit copies of design data, test reports, certificates, manufacturer's instructions and field test reports as specified. This information may be included within the Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.

K. Operations and Maintenance (IO&M) Manuals:

1. Provide specific product IO&M information for each section as detailed within each Divisions 26 and 27 section.
2. Begin the preparation of the electrical Operation and Maintenance Manuals with a complete and fully approved set of electrical product submittals organized, annotated and with the product information as indicated within the "Product Submittals" article for each specification section.
3. Next, augment each individual product submittal with the written installation, operations and maintenance information for each specific product. Obviously, this type of information is not applicable (or available) for bulk commodity or simplistic products such as conduit or equipment tags, etc.
4. Maintenance information shall include:
  - a. Preventive maintenance requirements for each product, including the recommended frequency of performance of each preventive maintenance task.
  - b. Instructions for troubleshooting, minor repair and adjustments required for preventive maintenance routines, limited to repairs and adjustments that may be performed without special tools or test equipment and that require no extensive special training or skills.
  - c. Information of a maintenance nature covering warranty items, etc., that have not been discussed in the manufacturers' literature.
  - d. Information data for spare and replacement parts for each product and system. Properly identify each part by part number and manufacturer.
  - e. Recommended spare parts list.
5. Organize the Operation and Maintenance Manual information by specification section (not by sub-contractor) with a tabbed divider separating each section. Provide the typed section number on each tab.
6. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable section. Provide sub-tabs within each section for each product. Provide the typed product article number on each tab.
7. Bind the information in identical, 3 inch wide; hard backed loose leaf 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
8. Provide a master table of contents at the front of each volume which lists the Divisions 26 and 27 specification sections and indicates which sections are located within each volume.
9. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
10. Provide identical cover and spine inserts for each IO&M manual volume.

11. For multiple volumes, label each volume.
12. Include the following typed information on the front cover and spine inserts of each volume:
  - a. The Contracting Agency Name.
  - b. Project Name.
  - c. "Electrical Operations and Maintenance Manual".
  - d. "Volume 1 of X, Volume 2 of X," etc.
13. Submit copies of all Operation and Maintenance Manuals in electronic format (Adobe PDF).

## 1.7 QUALITY ASSURANCE

- A. Qualifications: Perform the Work using qualified workmen that are experienced and usually employed in the trade.
- B. Product Testing and Certification:
  1. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors shall be "Approved," "Certified," "Identified," or "Listed" and "Labeled" to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
  2. Further details on the specific NRTLs, as well as the product standards that they are specifically recognized to evaluate equipment in accordance with, can be found on the OSHA Web site: <http://www.osha.gov/dts/otpca/nrtl/>
- C. Drawings and Specifications:
  1. The Drawings and specifications are complementary. Do not scale the Drawings. Locations of devices, fixtures, and equipment are approximate unless dimensioned.
  2. The Drawings are partly diagrammatic and do not show precise routing of conduits or exact location of all products, and may not show in minute detail all features of the installation; however, provide all systems complete and in proper operating order.
  3. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.
- D. Tests and Inspections:
  1. Schedule, obtain, and pay for permits and fees required by local authorities and by these specifications.
  2. Request for Tests: Notify the Contracting Agency a minimum of 72 hours in advance of tests. In the event the Contracting Agency does not witness the test, certify in writing that all specified tests have been made in accordance with the specifications.
  3. Deficiencies: Immediately correct deficiencies that are evidenced during the tests and repeat tests until system is approved. Do not cover or conceal electrical installations until satisfactory tests are made and approved.

4. Operating Tests: Upon request from the Contracting Agency, place the entire electrical installation and/or any portion thereof, in operation to demonstrate satisfactory operation.
5. The Contracting Agency may inspect and approve sample installation of systems and equipment prior to general installation of units.
6. Test Witness: Arrange for the Contracting Agency to witness tests. The Contracting Agency may waive witnessing any specific test at its discretion.

1.8

## 1.9 WARRANTY

- A. Warranty work shall be promptly coordinated and performed at the Contractor's sole expense. Workmanship, labor and materials (without limitation) in this Division shall be warranted for the longer of the following:
  1. As called for in the General Conditions of the Contract.
  2. For a minimum period of one year from the date of final acceptance.
  3. For the extended warranty period specified in a specific Section under this Division.
- B. Where a specific product carries a longer warranty as a standard offering of its manufacturer, extended warranty coverage beyond these requirements shall be retained by the Owner. The Owner will have recourse back to the manufacturer only in these cases, when the warranty as specified in A above has expired.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT FURNISHED IN DIVISIONS 26 AND 27

- A. Materials furnished and installed in permanent construction shall be, new, full-weight, standard in every way, and in first class condition.
- B. Materials shall conform to the standards of an organization acceptable to the Authority Having Jurisdiction and concerned with product evaluation that maintains periodic inspection of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner. Only materials designed for the purpose employed shall be used.
- C. Materials shall be identical with apparatus or equipment that has been in successful operation for at least two years. Materials of similar class or service shall be of one manufacturer.
- D. Capacities, sizes, and dimensions given are minimums unless otherwise indicated. Systems, materials and equipment proposed for use on this project shall be subject to review for adequacy and compliance with Contract Documents.

### 2.2 MATERIALS AND EQUIPMENT FURNISHED IN OTHER DIVISIONS

- A. Controls, including conduit, wiring, and control devices required for the operation of systems furnished in other Divisions shall be provided complete under the Division of the Specifications in which the equipment is specified, unless otherwise noted or specified.



- B. Work on the project that falls under the jurisdiction of the electrical trade shall be performed by Licensed Electricians in conformance with the electrical specifications.
- C. Provide complete power connections to equipment including but not limited to feeders, connections, disconnects and motor running overcurrent protection. Where starters are provided as part of packaged equipment, overcurrent heaters shall be provided under Divisions 26 and 27.

## PART 3 - EXECUTION

### 3.1 COORDINATION WITH ROOM NUMBERING

- A. Certain systems provided under this Division rely on identification systems that are based on room names or numbers. Systems labeled in this fashion include, but are not limited to, panelboards, circuit directories, communication and data systems identifiers, fire alarm systems, etc.
- B. The numbering scheme indicated in these Contract Documents is based on room numbers assigned during the design process. The Owner reserves the right to change the numbers prior to substantial completion, and the final names and numbers will not necessarily match those found in the Documents. Obtain from the Owner the final room numbers prior to commencing the numbering of Divisions 26 and 27 systems. Tag and label all system circuits and devices in accordance with the final numbering scheme at no additional cost.

### 3.2 INSTALLATION

- A. Skilled craftsmen shall install materials and equipment. The norms for execution of the work shall be in conformity with NEC Chapter 3 and the National Electrical Contractors' Association "National Electrical Installation Standards", which herewith is made part of these specifications.
- B. Repair surfaces and furnish all required material and labor to maintain fireproof, airtight and waterproof characteristics of the construction.
- C. Installation of equipment shall be in accordance with manufacturers' instructions.

### 3.3 MULTIWIRE BRANCH CIRCUITS

- A. Multiwire branch circuits shall not be used on this project. Each branch circuit shall be provided with its own dedicated neutral conductor.

### 3.4 MOUNTING HEIGHTS

- A. Mounting height shall be to center of box above finished floor (AFF) as noted below unless otherwise shown or indicated. Other mounting heights are indicated on the Drawings by detail. Specific dimensions AFF are shown adjacent to the symbol. Where devices are shown on architectural elevations, the elevation height shall govern.

Lighting switches	48 inches
Convenience outlets and similar devices	18 inches (see note below)
Convenience outlets in mechanical, boiler rooms and workrooms	48 inches
Motor controllers	60 inches to top
Panelboards	76 inches to top
Telephone panels	72 inches to top
Bracket lights	84 inches
Exterior WP convenience outlets	24 inches AFG
Clock hanger outlets and clocks	90 inches
Clock/speaker units	90 inches
Speakers	90 inches
Telecommunications (Data/Telephone) outlets	18 inches (see note below)
Range outlets	6 inches (or as required for access through drawer)
Dryer outlets	36 inches
Welder outlets	48 inches
Doorbell push buttons	48 inches
Wall mounted audible and/or visual appliances such as bells, horns, strobes and similar signal devices	90 inches (or 6 inches below ceiling height for ceiling heights less than 96 inches)
Manual fire alarm box	48 inches (or 48 inches to operable part where operable part of device is above centerline of device)
Fire alarm control panel	72 inches to top
Fire alarm graphic annunciator	72 inches to top
Fire alarm text annunciator	60 inches to center
Security Keypad	60 inches to center
Security Card Reader	48 inches to center
Nurse call annunciator	72 inches to top
Nurse call switches	48 inches
Intercom handsets and call-in switches	60 inches
Intercom administrative phone outlets	18 inches (see note below)

- B. NOTE: In locations where baseboard-heating enclosures are to be installed, outlet-mounting height shall be raised to 6 inches above top of enclosure unless otherwise noted on drawings.

### 3.5 CUTTING & PATCHING

- A. Obtain written permission of the Contracting Agency before cutting or piercing structural members.
- B. Wall and floor penetrations shall be in accordance with Section 26 0529 - Hangers and Supports.
- C. Holes through existing concrete shall be core drilled. X-ray concrete before core drilling. Do not cut rebar without specific authorization from the Contracting Agency. Seal openings with UL Listed fire resistant resilient sealant.

### 3.6 VAPOR RETARDER/BARRIER PENETRATIONS

- A. Provide solid blocking installed flat at all vapor retarder penetrations. Provide flat blocking at the interior face of the exterior stud wall. Blocking shall be a minimum of 4 inches larger than the penetration. Locate the penetration at the centerline of the flat blocking. Secure vapor retarder to blocking.
- B. Seal the interior of raceways penetrating the vapor retarder inside the building. Between point of sealing inside of raceway (typically at junction box or conduit) and vapor retarder penetration, seal conduit joints (connectors and couplings) with vapor retarder tape, paint on sealer or approved means acceptable to Contracting Agency.
- C. Penetrations of the building vapor retarder/barrier caused by the electrical installation shall be minimized, and where they are required, the opening in the vapor retarder/barrier shall be cut smaller than the penetrating object, so that the penetration will be a stretch fit. The penetration shall then be securely sealed with vapor barrier tape or an adhesive or caulk compatible with the surfaces being sealed.
- D. Boxes (electrical boxes, outlet boxes and telecommunication boxes, etc) penetrating walls with vapor retarder/barriers shall be sealed airtight using STI Series SSP Firestop Putty Pads. Mold putty pads around electrical junction boxes and conduits and behind vapor retarder/barrier to form an airtight seal in accordance with manufacturer's installation instructions.

### 3.7 FIRE RESISTIVE CONSTRUCTION

- A. Provide "tenting" or other protection acceptable to the Authority Having Jurisdiction for devices or fixtures installed in fire resistive construction (i.e., ceilings, walls, etc.) to maintain the fire resistive rating of the complete assembly.
- B. Where electrical raceways or other features penetrate fire rated building surfaces, they shall maintain the integrity of the building surface being penetrated. This shall be accomplished with either of the following methods:
  - 1. Sealing the penetration with an approved fire rated caulk or putty.
    - a. Fire rated caulk or putty: 3M Fire Barrier Caulk No. CP25, 3M Fire Barrier Moldable Putty, or as approved.
  - 2. A fire rated assembly enclosing the penetration.
    - a. Fire rated assembly: STI EZ Path, or as approved.

3. Firestopping shall be applied according to the manufacturer's recommendations, and in a manner that is listed by a nationally recognized independent testing agency (such as UL) as preserving the fire time rating of the construction.

### 3.8 PROTECTIVE FINISHES

- A. Take care not to scratch or deface factory finish of electrical apparatus and devices. Repaint all marred or scratched surfaces.
- B. Provide hot dip galvanized components for ferrous materials exposed to the weather.

### 3.9 SEPARATION OF SYSTEMS

- A. Conductors and equipment of different voltage levels, frequency, current characteristics (AC & DC) or functions (normal vs. emergency, etc.) shall not share the same raceways or enclosures unless specifically shown on the Drawings or approved by the Contracting Agency, or inherently necessary for correct system function (i.e., at transfer switches, transformers, etc.)

### 3.10 TESTING

- A. Prior to final test, switches, panelboards, devices and fixtures shall be in place.
- B. Test electrical systems. They shall be free from short circuits and unintentional grounds.
- C. Make changes necessary to balance the actual electrical loads on the complete system. Arrange for balanced conditions of circuits under connected load demands, as contemplated by the normal working conditions. Final load and balance test shall be demonstrated in the presence of the Contracting Agency.
- D. Feeder cables shall be megger tested prior to final termination. If conductor fails test, replace wiring or correct defect and retest. Perform a 1,000 volt megohm meter test on each circuit cable rated 600 volts between the conductor and ground. Submit logs of megger readings. The insulation resistance between conductor and ground shall not be less than the following:
  1. 8 megohms for a single conductor length of less than 2,500 feet.
  2. 6 megohms for a total single conductor length of 2,500 feet and over.
- E. Furnish one (1) copy of certified test results to the Contracting Agency prior to final inspection.

### 3.11 STORAGE AND HANDLING

- A. Items shall be delivered and stored in original containers, which shall indicate manufacturer's name, the brand, and the identifying number. Items subject to moisture and/or thermal damage shall be stored in a dry, heated place. Items shall be covered and protected against dirt, water, chemical, ultraviolet (UV) and/or mechanical damage.

### 3.12 PROTECTION OF MATERIAL AND EQUIPMENT

- A. The Contractor shall be responsible for materials and equipment to be installed under this Contract. The Contractor shall make good at his own cost any injury or damage which said materials or equipment may sustain from any source or cause whatsoever before final acceptance.
- B. Cover and protect electrical equipment during construction from dust, dirt, debris, overspray, or other construction contaminants.

### 3.13 CLEANING AND REPAIR

- A. Throughout the work, the Contractor shall keep the work area reasonably neat and orderly by frequent periodic cleanups.
- B. Prior to substantial completion, clean equipment and systems used during construction.
- C. Repair surfaces damaged or impacted by the work. Restore to original condition or better. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish.
- D. As independent parts of the installation are completed, they may be tested and utilized during construction.

### 3.14 ACCESS DOORS

- A. Provide access doors required for access to equipment provided under Divisions 26 and 27. Doors shall be rated for the surrounding construction. Use of access doors shall be minimized, and all locations and cosmetic features shall be submitted for approval in advance.
- B. Doors shall be finished to match surrounding surfaces as approved by the Contracting Agency.

### 3.15 DEMOLITION

- A. Examination Prior to Bid: Drawings involving existing conditions are based on building record drawings and/or limited field observation. Conduct a site inspection prior to submission of Bid to become thoroughly familiarized with the Scope of Work. Report discrepancies to Contracting Agency. Submission of bid certifies acceptance of existing conditions.
- B. Examination Prior to Start of Demolition: Conduct a thorough site inspection before disturbing existing installation. Verify field measurements and circuiting arrangements. Verify that abandoned wiring and equipment serve only abandoned facilities. Beginning of demolition certifies acceptance of existing conditions.
- C. Preparation:
  - 1. Disconnect electrical systems in walls, floors, ceilings, etc., scheduled for removal.
  - 2. Coordinate utility service outages with utility companies and Contracting Agency.

3. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
4. Existing Electrical Service: Maintain existing systems in service until new systems are complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 72 hours before partially or completely disabling system. Contractor shall not be entitled to any additional compensation due to inability of Owner to grant an outage at the desired time. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
5. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and applicable Fire Department Authorities at least 72 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

D. Demolition of Existing Electrical Work:

1. Remove, relocate, and extend existing installations to accommodate new construction.
2. Remove abandoned wiring to source of supply.
3. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut concealed conduit flush with walls and floors, and patch surfaces.
4. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets, which are not removed. In finished areas, blank covers shall be blank plates matching the device plates specified for new work, unless otherwise noted or specified.
5. Disconnect and remove abandoned panelboards and distribution equipment.
6. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
7. Disconnect and remove abandoned light fixtures. Remove brackets, stems, hangers, and other accessories.
8. Repair adjacent construction and finishes damaged during demolition and extension work.
9. Maintain access to existing electrical installations that remain active. Modify installation or provide access panels as appropriate.
10. Restore circuits and systems to remain that are affected in any way by demolition Work, such as loads downstream of demolished equipment, switched lighting circuits where selected fixtures are demolished, etc.
11. Salvage or disposal of removed items shall be as noted on the Drawings or as directed by the Contracting Agency. Items, which the Owner does not desire to retain, shall be disposed of at a legal disposal site.

E. Cleaning and Repair:

1. Clean and repair existing materials and equipment that remain or are to be reused or are affected by this work.
2. Panelboards: Clean exposed surfaces and interior of cabinet and retorque electrical connections. Provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3. Light Fixtures: Remove existing light fixtures for cleaning. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

END OF SECTION 26 0000

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## SECTION 26 0519

## LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section includes specific requirements, products, and methods of execution relating to wire and cable, 600 volts or less, approved for use on this project.
- B. Related Sections
  - 1. 26 0533 – Raceways and Boxes for Electrical Systems
  - 2. 26 0553 – Identification for Electrical Systems

## 1.2 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

## 1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.

## 1.4 QUALITY ASSURANCE

- A. Conductors shall be sized according to American Wire Gauge (AWG). Stranding, insulation, rating and geometrical dimensions shall conform to UL and ICEA specifications.

## PART 2 - PRODUCTS

## 2.1 INSULATION TYPES

- A. Branch circuit conductors shall be 600 volt insulated, and unless otherwise noted on the Drawings, shall have the following insulation types:
  - 1. Heated indoor spaces - THHN/THWN or XHHW.
  - 2. Outdoors, wet locations (such as slab-on-grade), or other cold locations (such as unheated attics) - XHHW.

## 2.2 FLEXIBLE CORD

- A. Flexible cord shall be Type SO or ST, or for the larger sizes, Type G.

## 2.3 MISCELLANEOUS

- A. Miscellaneous: Miscellaneous wire and cable for special purpose applications and not covered in the categories as indicated above or otherwise specified, shall be as shown on the plans and/or required by the intended use.

## 2.4 MINIMUM SIZE

- A. Unless specified otherwise minimum wire sizes shall be as follows:
  - 1. #12 AWG for branch circuit wiring.
  - 2. #20 AWG for low voltage switching circuits if part of an approved cable assembly, #18 AWG otherwise.
  - 3. #14 AWG for control circuit wiring.
  - 4. #16 AWG for light fixture whips, refer to specification section 26 0533 - Raceway and Boxes for Electrical Systems, for maximum fixture whip lengths.
- B. On 20A circuits, with one-way conductor lengths measured from panel to farthest receptacle, or center of lighting string (as applicable):
  - 1. #10 AWG for 120V circuits of 75 feet to 120 feet.
  - 2. #8 AWG for 120V circuits of 120 feet to 200 feet.
  - 3. #10 AWG for 277V circuits of 130 feet to 215 feet.
  - 4. #8 AWG for 277V circuits of 215 feet to 330 feet.
- C. Similar oversizing shall apply to circuits of other ratings and/or greater lengths, as necessary to comply with the voltage drop limitations in Part 3 of this Section.
- D. Cable or conductors for fire alarm systems and other special systems shall be as described in other sections of the specifications, noted on the drawing, or recommended by the equipment manufacturer, whichever is greater.

## 2.5 CONDUCTORS

- A. Conductors used on this project shall be copper, solid or stranded for wiring #10 and smaller, stranded for #8 and larger.
- B. Stranded control, communication, and alarm conductors shall have compression terminations where terminated on screw terminals.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Unless otherwise noted or specified, all conductors shall be run in raceways as specified in Section 26 0533 – Raceways and Boxes for Electrical Systems. Raceways shall be installed as a complete system, free from obstructions, and clean before conductors are installed.

- B. Provide conductors from outlet to outlet and splice branch circuit conductors only at outlet or junction boxes. Install all conductors in a single raceway at one time and leave sufficient cable at all fittings or boxes. Keep conductors within the manufacturer's allowable tension. Do not violate minimum bending radii. Lubricants for wire pulling, if used, shall conform to UL requirements for the insulation and raceway material.
- C. Do not install Type XHHW conductors in temperatures below -10° F, or the other types in temperatures below +20° F.
- D. Conductors that extend below grade shall be suitable for wet locations (type XHHW or XHHW-2). The use of THHN below grade is not acceptable.

### 3.2 CONDUCTOR SUPPORT

- A. Provide conductor supports as recommended by the NEC or cable manufacturer in vertical conduits.

### 3.3 SPLICING

- A. No splicing or joints are permitted in branch circuits except at outlet or accessible junction boxes. Prior to splicing, conductors shall be stripped to the exposed length recommended by the splicing device manufacturer.
- B. Utilize compression type solderless connectors when making splices or taps in conductors No. 8 AWG or larger. Provide heat or cold shrink type insulating tubing on splices and tape outer surface continuously with Scotch #88 plastic tape to secure insulation strength equal to that of the conductors joined.
- C. Utilize pre-insulated connectors, hard-shell type only, Ideal Industries, Inc., "Wing-Nut" or "Twister Pro" or "In-Sure Push-in Connectors" for splices and taps in conductors No. 10 AWG and smaller in dry locations.
- D. Utilize Ideal "Twister DB Plus", water repellent, sealant filled, UL 486D Listed connector splices and taps in conductors No. 10 AWG and smaller in damp or wet locations.
- E. Utilize "Buchanan pre-insulated crimp connectors" on stranded conductors for fire alarm control and alarm circuits.
- F. Feeder conductors shall be installed with no splices unless otherwise noted on the Drawings. Splices in feeder conductors, where specifically allowed, shall be compression type butt splices.

### 3.4 CONDUCTOR TERMINATION

- A. Provide power and control conductors that terminate on equipment or terminal strips with solderless lugs or T & B "Sta-Kon" terminals.
- B. Prior to termination, conductors shall be stripped to the exposed length recommended by the termination device manufacturer.

### 3.5 CONDUCTOR PHASE COLOR CODING

- A. Service, feeder and branch circuit conductors throughout the project secondary electrical system shall be color coded as follows:

208/120 Volts	Phase	480/277 Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray (see following)
Green	Ground	Green

- B. Where color coded conductors are not commercially available, colored non-aging, plastic tape may be utilized where permitted by NEC.
- C. Where neutrals of different systems exist on the project, neutral conductor identification method shall satisfy the Authority Having Jurisdiction, as to compliance with NEC Article 200. Branch circuit neutral conductors shall have a color stripe matching the corresponding phase conductor where neutral is not shared.
- D. Phases in panelboards and similar equipment shall be connected Phase A, B, C from left to right, top to bottom, or front to back.

### 3.6 DERATING OF CONDUCTORS

- A. Derating of conductors shall be per National Electrical Code.

### 3.7 VOLTAGE DROP

- A. The maximum total voltage drop shall not exceed three (3) percent in branch circuits or feeders, for a total of five (5) percent to the farthest outlet based on steady state design load conditions. Wire sizes shown on the Drawings are for minimum ampacity. Wire and conduit sizes shall be increased to limit voltage drop based upon actual lengths required in the field. Base voltage-drop calculations on NEC Chapter 9, Table 9.
- B. Secondary transformer voltage taps may be used to offset voltage drop as long as no load voltage does not exceed 125 volts at transformer secondary.

### 3.8 TESTING

- A. Feeder cables shall be megger tested prior to final termination in accordance with Section 26 0000 – Electrical General Requirements.

END OF SECTION 26 0519

## SECTION 26 0526

## GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section includes general requirements, products and methods of execution relating to the furnishing and installation of a complete grounding system as required for this project.

## 1.2 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only, latest edition.

NUMBER	TITLE
ANSI/IEEE C2	National Electrical Safety Code
ANSI/NFPA 70	National Electrical Code
ANSI/TIA/EIA 606-A	Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage Surge Protective Devices
IEEE C62.42	Guide for the Application of Gas Tube Arrester Low-Voltage Surge Protective Devices
IEEE Draft P1250 (D4)	Guide on Service to Equipment Sensitive to Momentary Voltage Disturbances
IEEE Std 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
IEEE Std 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE STD 81	Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth
NFPA 70	National Electric Code (NEC) - Codebook and Handbook
REA PE-33	(1985) Shield Bonding Connectors
UL 1449 Edition 3	Surge Protective Devices (SPDs)
UL 467 Edition 6	Grounding and Bonding Equipment

NUMBER	TITLE
UL 497 Edition 5	Protectors for Paired Conductors for Communication Circuits
UL 497A Edition 1	Secondary Protectors for Communication Circuits
UL 497B Edition 1	Protectors for Data Communication and Fire Alarm Circuits

### 1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1. Include copies of catalog cuts, data sheets and other descriptive information for all specified materials.

### 1.4 MINIMUM REQUIREMENTS

- A. The minimum requirements for the system shall conform to Article 250 of the NEC.

### 1.5 SPECIAL REQUIREMENTS

- A. Unless specified elsewhere, the ohmic values for grounds and grounding systems shall be as follows:
1. For grounding metal enclosures and frames for electrical and electronically operated equipment -- 5 ohms maximum.
  2. For grounding systems to which electrical utilization equipment and appliances are connected -- 5 ohms maximum.
  3. For grounding secondary distribution systems, neutrals, noncurrent carrying metal parts associated with distribution systems, and enclosures of electrical equipment not normally within reach of other than authorized and qualified electrical operating and maintenance personnel -- 10 ohms maximum.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- A. Grounding conductors, ground rods, and equipment required for ground systems shall be listed for the purpose intended and approved by a Nationally Recognized Testing Laboratory (NRTL), and be in accordance with U.L. 467 and as follows:
1. Ground rods shall be 3/4 inch by 10 foot copper bonded steel. Erico Eritech or approved equal.
  2. Grounding conductors shall be copper. Unless specified otherwise, raceway for service grounding conductor shall be Schedule 40 PVC.
  3. Grounding conductor for telephone service entrance and telephone/data panels shall be #6 insulated copper, with 6 feet-0 inches slack cable at each panel. Comply with intersystem bonding requirements of NEC.
  4. Grounding conductor for television and radio distribution systems shall be #6 AWG insulated copper. Comply with intersystem bonding requirements of NEC.

## 2.2 CONNECTIONS

- A. Joints in grounding conductors and mats below grade shall be made with exothermic welding process or hydraulically crimped fittings listed for direct burial. Terminations above grade shall be made with solderless lugs, securely bolted in place.
- B. Clamps, lugs, connectors, bonding bushings, and other such grounding and bonding items shall be:
  - 1. Labeled or listed for the purpose.
  - 2. Shall be made (both body and hardware) of hot dip galvanized steel, bronze, or other corrosion resistant alloy (except bushing throats shall be plastic).
  - 3. Shall be the products of O-Z/Gedney, T & B, Raco, or accepted equals.
  - 4. In outdoor, damp, or corrosive environments, metals for these items shall be copper (with or without tin-plating), bronze, or other corrosion resistant alloys only; O-Z/Gedney or accepted equal.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT GROUND

- A. The raceway system shall be bonded in conformity with NEC requirements to provide a continuous ground path. Where required by Code or Ordinance or where called for on the plans an additional grounding conductor shall be provided, sized in conformity with Table 250.122 of the NEC, unless larger size is noted.
- B. Provide separate grounding conductor securely bonded and effectively grounded to the enclosures at both ends of all non-metallic raceways and all flexible conduit.
- C. Provide an equipment grounding conductor sized in conformity with Table 250.122 of the NEC, unless larger size noted, for all new feeder and branch circuit conduits. Where conductors are adjusted in size to compensate for voltage drop, equipment grounding conductors shall be adjusted proportionately according to circular mil area.

### 3.2 CONCEALED CONNECTIONS

- A. Permanent grounding connections, where permitted by the NEC to be concealed, shall not be so concealed until inspected and accepted by the Contracting Agency. Failure to comply with this requirement shall make the Contractor liable for all expenses incurred in the process of re-exposing the connections for inspection, and subsequent repair and patching of the concealing construction, including the work of other trades. The Contractor shall schedule inspection of such connections at least one work week in advance of concealment, and shall not be entitled to any additional compensation or time extension for delays caused by inability of the Contracting Agency's representative to be available at the desired time.

### 3.3 CORDS AND NONMETALLIC CABLES

- A. Unless specifically permitted otherwise, cords and nonmetallic cables shall be furnished with integral Code-sized grounding conductor. Securely bond metal components and effectively ground the entire electrical system.

END OF SECTION 26 0526



## SECTION 26 0529

## HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes:
  - 1. General hanger and support requirements for electrical equipment, conduit and cable trays not required to be vibration and/or seismically controlled.
  - 2. Penetrations, sleeves and seals.
- B. Products Installed But Not Supplied Under this Section:
  - 1. Vibration Isolation and Seismic Control anchoring and support systems furnished under Section 20 0529 – Mechanical Hangars and Supports.
- C. Related Sections:
  - 1. 20 0529 - Mechanical Hangars and Supports
  - 2. 26 0000 - Electrical General Requirements
  - 3. 26 0533 - Raceways and Boxes for Electrical Systems
  - 4. 26 2900 - Low Voltage Controllers
  - 5. 26 5000 - Lighting Fixtures
  - 6. Division 9 - Painting

## 1.2 REFERENCES

- A. NFPA 70: National Electrical Code (NEC) latest legally enacted edition.

## 1.3 DESCRIPTION

- A. Provide general hanger and support requirements for electrical equipment, conduit and cable trays not required to be vibration and/or seismically controlled in accordance with the manufacture's written installation instructions and NFPA 70.
- B. Coordinate directly with Section 20 0529 – Mechanical Hangars and Supports to identify electrical equipment and systems which require vibration and/or seismic control bracing in addition to the requirements of this section.

## 1.4 SUBMITTALS

- A. See Section 26 0000 - General Electrical Requirements for general submittal requirements
- B. Product Data:

1. Provide manufacturers catalog data for each product specified. Indicate channel gauge and maximum load capacities of the selected products.
2. Manufacturer's Installation Instructions: Include assembly instructions, recommended parts and special procedures as required.

C. Shop Drawings:

1. Provide a single shop drawing submittal which integrates the shop drawing requirements of this section along with the additional requirements of Section 20 0529 – Mechanical Hangars and Supports.
2. Provide shop drawings to include the following:
  - a. Housekeeping pads (coordinated with approved electrical equipment footprints and anchor point locations).
  - b. Pre-engineered and field fabricated support system details for each installation location. To include but not limited to:
    - 1). Raceway and lighting fixture support.
    - 2). Conduit and control panel support.
    - 3). Trapeze hangers.
    - 4). Electrical equipment support.
  - c. Equipment locations and conduit and cable tray routing coordinated with mechanical equipment and systems. Indicate routing height above finished floor.
  - d. Indicate hanger type/attachment method and hanger spacing intervals.

D. Project Record Information:

1. Indicate installed locations of hangers and supports on project as-built shop drawings.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:

1. Verify products are delivered in original factory packaging and are free from damage and corrosion.
2. Replace equipment delivered to job site that does not comply with above requirements at no expense to the Owner.

B. Storage and Protection:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items to avoid damage.
3. Replace damaged items with same item in new condition.

## 1.6 WARRANTY

- A. Provide warranty in accordance with Section 26 0000 - General Electrical Requirements.

## PART 2 - PRODUCTS

## 2.1 PRE-ENGINEERED SUPPORT SYSTEMS

- A. Manufacturers:
  - 1. Unistrut
  - 2. Super-Strut
  - 3. B-Line
  - 4. K-Line
  - 5. Erico.
- B. Material:
  - 1. Cold worked steel.
  - 2. Type 304 stainless steel: Use for PVC, liquid-tight flex, or plastic-coated conduit installed on wood construction in outdoor, damp, corrosive or marine environments.
- C. Finish:
  - 1. Heated indoor areas: Pre-galvanized zinc coating.
  - 2. Outdoor areas: Hot dipped galvanized finish. In addition, coat hot dipped galvanized finish channel field cuts with zinc rich paint provided by the support system manufacturer.
  - 3. Painted areas: Paintable galvanizing or phosphatized and primed.
  - 4. Surface metal raceways: U.L. Listed epoxy coating.
- D. Channel:
  - 1. Standard Size: 1-5/8 inch x 1-5/8 inch. Gauge thickness as required for attached load.
  - 2. Standard Hole Pattern: Slotted. Provide solid channel in exposed public areas.
- E. Nuts and Hardware:
  - 1. Channel nuts: Hardened steel (ASTM-A675 and ASTM A36).
  - 2. Bolts, screws and nuts: Hardened steel (ASTM-A307, ASTM A563 and SAE J429).
  - 3. Finish: Electroplated zinc.
- F. Fittings: Plate steel (ASTM A635). Epoxy or electroplated zinc coating.
- G. Electrical Accessories: Provide accessories from the support system manufacturer designed for the specific equipment to be supported to include but not limited to:
  - 1. Fluorescent fixture hangers.
  - 2. Outlet box adapters.
  - 3. Snap-in closures.
  - 4. Conduit connection plates.
  - 5. Junction box adapters.
  - 6. Strut joiners.
  - 7. "Caddy" fasteners are permitted for support of conduit to concealed metal studs and for conduit concealed above suspended acoustical ceilings.

## 2.2 SLEEVES, ACOUSTICAL SEALS AND FIRE-STOPPING

- A. See Part 3 - PENETRATIONS.
- B. Sleeves for pipes through fire rated and fire resistive floors and walls, and fire proofing: UL listed prefabricated fire rated sleeves and seals.

## 2.3 WALL/FLOOR PENETRATION WATER SEALS

- A. Mechanical seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the wall opening.
- B. EPDM seals.
- C. 316 Stainless steel bolts and nuts.
- D. Hot-dipped galvanized or coated sleeve with full water stop flange with continuous weld on both sides.
- E. Manufacturer: Metraflex, Thunderline, Crouse-Hinds, or pre-approved equal.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prior to installation, prepare detailed shop drawings of the planned installation of hanger and support products specified by this section. Coordinate the location, type and size of hangers and supports, housekeeping pads (thickness/perimeter overhang dimensions) and roof curbs with Architectural and Structural elements utilizing the shop drawing review process.
- B. Submit shop drawings required by this section coordinated with the seismic design and associated shop drawings required by Section 20 0529 – Mechanical Hangars and Supports.
- C. Do not install hangers and supports without approved shop drawings.

### 3.2 GENERAL INSTALLATION

- A. Install hangers and supports in accordance with manufacturer's instructions, applicable Code requirements (NFPA 70) and approved shop drawings.
- B. See Section 26 0000 – Electrical General Requirements for electrical equipment wall mounting heights.

### 3.3 VIBRATION AND SEISMIC CONTROL PRODUCT INSTALLATION

- A. Install vibration isolators, seismic control and wind restraint systems in strict compliance with the manufacturer's written instructions and certified and approved application engineering installation drawings and details in accordance with Section 20 0529 – Mechanical Hangars and Supports.

### 3.4 INSERT AND ATTACHMENT INSTALLATION

- A. Inserts
  1. Provide inserts or cast-in-place channels for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  4. Use expansion type anchor bolts with pre-cast concrete including concrete masonry units within loading limits of the pre-cast material and anchor bolt manufacturer's recommendations.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
  6. Plastic screw inserts and caulked lead inserts are prohibited, except for mounting instructions and control diagrams.
- B. Attach electrical equipment to structure as follows:
  1. Hollow masonry: Toggle bolts.
  2. Solid masonry and concrete: Preset inserts or expansion bolts.
  3. Structural steel: Beam clamps which engage both sides of structural member or have retaining clips or other approved means for positive engagement.
  4. Metal surfaces: Machine screws, bolts or welding.
  5. Wood construction: Wood or sheet metal screws. Bugle head drywall screws or deck screws are not allowed.
  6. Do not use powder actuated fasteners for anchorage in tension applications. Obtain written permission from the Owner prior to using any type of powder powered studs.
  7. Attachment to plaster or gypsum board (sheet rock) not approved. Equipment shall be attached to or supported from structure.

### 3.5 RACEWAY INSTALLATION

- A. Support raceways using approved types of wall brackets, ceiling trapeze hangers or malleable iron straps utilizing attachment methods described above. "Perforated plumber's strap" is not permitted as a means of support.
- B. Support raceways independent of ceiling systems, piping and ductwork. Exceptions: Lighting fixtures and outlet boxes (i.e. ceiling speaker boxes) specifically designed for attachment to suspended ceiling systems
- C. Support EMT conduit (1-1/2 inch and smaller/dry locations) using hanger rods with spring steel fasteners.

- D. Support cable trays and multi-conduit runs independently from other support systems utilizing double hanger rods at each support point.

### 3.6 LIGHTING INSTALLATION

#### A. General

- 1. Attach safety hanger wires to lighting fixtures such that in event of a ceiling suspension system failure, no part of the fixture will drop more than 6 inches below normal ceiling height. Secure each end of each wire with a minimum of three tight wraps.

#### B. Fixtures (greater than 20 pounds/non-suspended ceiling applications)

- 1. Support lighting fixtures from structural members capable of supporting the total weight of the fixture and independent from electrical wiring system. Attach to steel members using approved beam clamps and rods.

#### C. Fixtures (suspended ceiling system applications)

- 1. Positively attach lighting fixtures to suspended ceiling grid for 100 percent of fixture weight acting in any direction using positive clamping devices that fully surround the supporting member (i.e. Caddy "IDS" or equal).
- 2. Provide supplemental safety hanger wires as follows:
  - a. Fixtures (weighting less than 56 pounds): Provide two 12 gauge wires or equivalent chains connected from the diagonal corners of the light fixture housing to the structure above. These wires may be slack.
  - b. Fixtures (weighting greater than 56 pounds): Provide full direct support from the structure above. Attach wires from within 3 inches of each corner of the fixture.
  - c. Pendant-hung lighting fixtures
    - 1). For each fixture, provide direct support from the structure above using a minimum of two 12 gauge wires, equivalent aircraft cable or an approved alternate support system without using the ceiling suspension system for direct support. Securely attach wire/cable to fixture, route through fixture stem and securely attached to structure.
    - 2). Provide loop and hook or swivel hanger assemblies fitted with a restraining device to secure stem in the support position during earthquake motion.
    - 3). Support fluorescent fixtures with flexible hanger device at the attachment point to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

### 3.7 PENETRATIONS

- A. Coordinate electrical penetrations with architectural, structural and mechanical construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
- B. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.

- C. Penetrations through roof, exterior walls and floors shall be weather and water tight (see floor penetration seals).
- D. Firestopping: Provide UL rated firestopping assemblies for rated roof, wall and floor penetrations in accordance with Division 7.
- E. Conduit Sleeves
  - 1. Provide sleeves for conduit passing through floors, walls, ceilings, or roofs.
    - a. Fabricate sleeves in non-load bearing walls from 20 gauge galvanized sheet steel conforming to ASTM A 924/A 924M.
    - b. Fabricate sleeves in load bearing walls from standard weight galvanized steel pipe conforming to ASTM A 53/A 53M.
    - c. Provide 1/2 inch clearance between conduit and sleeve opening.
  - 2. Provide escutcheons for conduit passing through walls, floors and ceilings in finished areas, below counters and inside closets and casework subject to view when doors are open. Size escutcheons to cover sleeves. Secure escutcheons in position.
- F. Wall Penetration Seals
  - 1. Provide pre-engineered wall penetration water seal systems for exterior wall penetrations.
  - 2. Select appropriate wall penetration sealing systems based on conduit material and nominal conduit size in accordance with the manufacturer's selection charts.
  - 3. Install conduit and sealing system prior to waterproofing the wall. Grout void between water seal and outside face of foundation wall to provide continuous bearing surface for waterproofing fabric.

END OF SECTION 26 0529

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## SECTION 26 0533

## RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes specific requirements, products, and methods of execution relating to conduit, conduit fittings, surface raceways, multi-outlet assemblies, wireways, outlet boxes, pull boxes and junction boxes approved for use on this project. Type, size and installation methods shall be as shown on Drawings, required by Code and/or specified in this Section.
- B. Related Sections
  - 1. 26 0519 – Low Voltage Electrical Power Conductors and Cables
  - 2. 26 0526 – Grounding and Bonding for Electrical Systems
  - 3. 26 0529 – Hangers and Supports for Electrical Systems

## 1.2 REFERENCES

- A. American National Standards Institute/Underwriters Laboratory
  - 1. ANSI C80.1 – Electrical Rigid Steel Conduit
  - 2. ANSI C80.3 – Steel Electrical Metallic Tubing
  - 3. ANSI C80.5 – Electrical Rigid Aluminum Conduit
  - 4. ANSI C80.6 – Electrical Intermediate Metal Conduit
  - 5. ANSI/UL 1 – Flexible Metal Conduit
  - 6. ANSI/UL 6 – Electrical Rigid Metal Conduit – Steel
  - 7. UL 6A – Standard for Electrical Rigid Metal Conduit – Aluminum and Stainless Steel
  - 8. UL 360 – Standard for Liquid Tight Flexible Steel Conduit
  - 9. UL 514A – Metallic Outlet Boxes
  - 10. UL 514B – Conduit, Tubing and Cable Fittings
  - 11. UL 651 – Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
  - 12. UL 651A – Type EB and A Rigid PVC Conduit and HDPE Conduit
  - 13. ANSI/UL 651B – Standard for Continuous Length HDPE Conduit
  - 14. ANSI/UL 797 – Electrical Metallic Tubing – Steel
  - 15. ANSI/UL 1242 – Electrical Metal Intermediate Conduit – Steel
- B. National Electrical Manufacturers Association
  - 1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 2. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
  - 3. NEMA OS 1 – Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports
  - 4. NEMA RN 1 – Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

5. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
6. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
7. NEMA WD 6 - Wiring Device Configurations.

C. NECA (National Electrical Contractors Association) Standard of Installation.

### 1.3 SUBMITTALS

- A. Provide submittals for all products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.
- B. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, surface raceway finishes (custom factory pre-painting, color as selected by architect), and accessories.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

### 1.4 QUALITY ASSURANCE

- A. Raceways and boxes shall be standard types and sizes as manufactured by a nationally recognized manufacturer of this type of materials and be in conformity with applicable standards and UL listings.
- B. Surface raceways shall be of the latest approved design as manufactured by a nationally recognized manufacturer and shall be listed by the Underwriters' Laboratory and bear the UL label.
- C. Pull and junction boxes 50 cubic inches and smaller shall conform to specifications for outlet boxes.
- D. Pull and junction boxes larger than 50 cubic inches shall conform to U.L. Standard 50, Cabinets and Boxes.
- E. Perform Work in accordance with NECA Standard of Installation.
- F. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

## PART 2 - PRODUCTS

### 2.1 CONDUIT

- A. Conduit types specifically approved for use on this project shall be of the following types only:
  1. Galvanized rigid metal conduit - GRC or RMC.
  2. Intermediate metal conduit - IMC.
  3. Rigid copper-free aluminum conduit.

4. Electrical metallic tubing - EMT.
5. Polyvinyl chloride conduit - PVC: May be Schedule 40 or Schedule 80, except where Schedule 80 is specifically noted or specified.
6. Flexible metal (steel) conduit - FMC or flex: In short lengths as specifically permitted.
7. Liquid-tight flexible steel conduit - LFMC: In short lengths as specifically permitted.
8. Extreme temperature liquid-tight flexible steel conduit - AT: Shall have temperature rating of -67 ° F to +220 ° F, Liquestat "ATLA", or as approved.

## 2.2 FIRE ALARM CONDUIT

- A. EMT conduit utilized for fire alarm system wiring shall be factory pre-painted with a bright red topcoat, Allied Fire Alarm Red or as approved. Other conduit types utilized for fire alarm system wiring shall be identified with red paint or red tape wrapped a minimum of 4 times around the conduit every 10 feet and at each fire alarm system junction box.

## 2.3 CONDUIT FITTINGS

- A. Fittings utilized with rigid steel, IMC, and aluminum shall be galvanized steel or iron or copper-free aluminum and shall be threaded. Conduit bushings shall be provided and shall be of the insulated types. Where grounding bushings are required, provide insulated grounding bushings with integral pressure type ground lugs, Thomas & Betts "Blackjack", or as approved.
- B. Couplings and connectors for EMT shall be made of steel or malleable iron. Die-cast products shall not be used. Connectors shall have insulated throats. Connectors and couplings shall be setscrew or compression type.
- C. Fittings for PVC 40 shall be polyvinyl chloride, installed using PVC solvent to form a watertight joint, except elbows (including bends exceeding 15°) shall be metallic. These metallic elbows and bends shall be of the type specified in this section for the environment in which they are to be installed.
- D. Fittings for flexible metal conduit shall be steel or malleable iron only. All throats shall be insulated.
- E. Fittings for liquid-tight flexible conduit shall be steel or malleable iron, of a type incorporating a threaded grounding cone, nylon or plastic compression ring, and a tightening gland, providing a low resistance ground connection. All throats shall be insulated.

## 2.4 CAST BOXES

- A. Cast boxes with threaded hubs, external mounting brackets or holes, and gasketed covers shall be used in the following locations:
  1. Exterior locations.
  2. Wet or damp locations.
  3. Shops, mechanical rooms, pump stations, bag makeup areas, etc., where exposed to mechanical damage.

4. Exposed interior locations below 48 inch above floor where subject to damage.

## 2.5 STEEL BOXES

- A. Galvanized pressed steel boxes may be used wherever they are permitted by code, except in areas indicated in the preceding paragraph.
- B. Flush mounted, pressed steel boxes shall be equipped with external mounting brackets for attachment to framing members with screws or nails.
- C. Ceiling boxes and wall boxes for bracket lights shall be not less than 4 inch in diameter by 1 ¼ inch deep and shall have 3/8 inch malleable iron fixture studs if required.
- D. Grounding Screw: All stamped steel boxes shall have a drilled and tapped hole in the back of the box for a grounding screw.
- E. Accessories: Box covers, extension rings, bases, hanger bars, etc., for use in connection with the installation, shall be approved for use in the various applications.

## 2.6 INDOOR PULL AND JUNCTION BOXES

- A. Indoor pull and junction boxes shall conform to Article 314 of the NEC and the following requirements:
  1. Sheet metal boxes are approved for use in all dry, interior, nonhazardous locations.
  2. Boxes installed in wet locations shall be NEMA 4X, unless otherwise noted.
  3. Special boxes, as noted on the Drawings, shall be installed in areas of specific service and/or hazards.
- B. Junction box extension rings will not be accepted on new boxes. Appropriate size boxes shall be used for each application.

## PART 3 - EXECUTION

### 3.1 CONDUIT USES PERMITTED

- A. Conduits shall be of the sizes shown on the Drawings or as required by the NEC, whichever is larger. Base sizes on using type XHHW for wire sizes #6 and smaller and type THHN/THWN wire for wire sizes #4 and larger. Unless otherwise noted, conduits installed in the following locations shall be of the types specifically identified only:
  1. Underground or encased in concrete - rigid steel or PVC-40.
  2. Outdoors aboveground or damp locations - RMC.
  3. Dry indoor locations, concealed or exposed - RMC, rigid aluminum, EMT (where not susceptible to physical damage), flexible conduit where necessary, or IMC.
  4. Indoor locations, exposed, where susceptible to physical damage - RMC or IMC.
  5. Motor and equipment flexible connections - LFMC or FMC (when installed in plenum spaces).

### 3.2 RACEWAY INSTALLATION METHODS - GENERAL

- A. Concealed raceways: In occupied areas, conduit and raceways shall be concealed unless specifically noted otherwise. In service spaces (mechanical equipment rooms, electrical rooms, storage closets, etc.), approved raceways may be surface-mounted for connection to equipment in exposed surface mounted locations and in exterior locations as noted on the Drawings.
- B. Concealed raceways shall be routed as directly as possible with a minimum of bends. Concealed raceways above lay-in ceilings shall be installed a minimum of 12 inches above the ceiling grid.
- C. Exposed Raceways: Where allowed by this Specification or specifically noted on the Drawings, raceways may be mounted on the surface of walls, ceilings and other surfaces. Exposed raceways shall comply with the following:
  - 1. Exposed raceways shall be run parallel or perpendicular to building lines and bent symmetrically or made up with standard elbows or fittings.
  - 2. Surface-mounted conduit, junction boxes, pull boxes, outlet boxes, etc. installed in finished areas shall be painted to match the surrounding surfaces.
  - 3. Connectors and fittings for raceways and conduits installed on the surface in exterior locations shall be suitable for and Listed for use in a wet location.
  - 4. Conduits installed in exterior locations shall be painted to match the exterior finish of the building surface to which they are attached. This shall include conduits attached via racks and stand-off brackets, or attached directly to the surface.
- D. Conduit and tubing shall be cut square and reamed smooth at the ends and all joints made tight. Conduit threads shall be lubricated with an approved thread lubricant.
- E. Raceway for power wiring shall not be installed in the floor slab beneath telecommunication rooms.
- F. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box or outlet box by means of a locknut on the outside and a locknut/bushing on the inside, or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter. Connections shall be made wrench tight. Locknuts shall be the bonding type with sharp edges and shall be installed in a manner that will assure a locking installation. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into threaded connections. Conduit runs shall be protected from the entrance of foreign material prior to the installation of conductors.
- G. Conduit or tubing deformed or crushed in any way shall not be installed. Conduit shall be bent only with approved bender (hydraulic or hickey). Bending machines shall be used to make field bends in conduit of 1-1/4 inch size and larger. Torches shall not be used in making conduit bends.
- H. Raceways shall be spaced at least 6 inches from parallel runs of heating system pipes, flues, other high temperature piping systems, and other heat sources. This basic spacing shall be increased if necessary to ensure that raceways experience no significant temperature rise from external sources. Raceways shall not be embedded in any spray applied insulation, fireproofing, or other materials that would restrict heat dissipation.

- I. Pull wires shall be provided in spare and unused conduits. (Nylon "jet-line" or as approved.)
- J. Conduits stubbed up out of floor and terminating inside of an enclosure shall have insulating grounding bushings installed.
- K. Raceways penetrating vapor barriers or traversing from warm to cold areas shall be sealed on the inside with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall be taped airtight to the vapor barrier on the outside. Refer to Section 26 0000 for additional requirements and limitations regarding penetration of vapor barriers.
- L. Raceways (particularly PVC) shall be provided with expansion joints where necessary to allow for thermal expansion and contraction. Set initial opening of expansion joints per manufacturer's instructions, to suit the ambient temperature at the time of installation.
- M. Provide flexible conduit connection at seismic joints to allow for displacement of conduit in all three axes. Provide appropriate lengths of flexible conduits at seismic joints and appropriate amounts of slack in conduit to allow movement of conduit/cabling in accordance with the design of the seismic joint. Slack shall be maintained in conduit after cabling is installed. Minimum lengths of flexible conduit and minimum amount of slack for various size conduits shall be as follows:
  - 1. 2 inch and greater: 4 foot length, 4-6 inches slack.
  - 2. 1-1/2 inch and smaller: 2 foot length, 3 inches slack.
- N. Flexible metal conduit with supplemental ground jumper shall be used for connection to vibrating equipment, or where installation conditions warrant its use with express permission. Flexible conduit shall not penetrate walls. Liquid-tight flexible conduit with supplemental ground jumper shall be used for motor and transformer connections (except utilize flexible metal conduit in plenum spaces). The ground jumper in flexible conduits shall be routed within the conduit.
- O. Length of flexible conduit shall not exceed 36 inches, except for lighting fixture whips and where specifically noted. Fixture whips shall not exceed 72 inches. Flexible conduit shall not penetrate walls or vapor barrier retarder/barrier.

### 3.3 CONDUIT SIZES – GENERAL

- A. Minimum sizes for rigid steel, IMC, FRE, rigid aluminum and PVC-40 conduits shall be  $\frac{3}{4}$  inch.
- B. Minimum size for EMT shall be  $\frac{1}{2}$  inch.
- C. Minimum size for flexible conduits shall be  $\frac{1}{2}$  inch , except fixture whips may be  $\frac{3}{8}$  inch as allowed by the NEC.
- D. Maximum size for EMT shall be 3 inch, except telecom backbone conduits may be 4 inch where shown on the Drawings.



### 3.4 STRUCTURAL COORDINATION

- A. Layout conduits in slabs to avoid compromising structural integrity. Obtain approval from Structural Engineer for maximum conduit sizes, quantities, arrangement, and placement in structural slabs.
- B. Structural members shall not be cut, drilled, or notched for raceways or other electrical features unless specifically accepted by the Contracting Agency.
- C. Underfloor raceways for slab-on-grade construction shall be embedded in the fill under the slab, not in the slab itself. Where raceways are required or permitted to be embedded in concrete, the thickness of concrete on all sides of each raceway shall not be less than 2 inches.

### 3.5 SURFACE RACEWAY INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Use flat-head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.
- C. Provide outlets in locations shown or according to spacing specified on the Drawings. Where spacing is specified, the maximum distance from each end of the raceway to the first outlet shall not exceed one-half of the specified spacing distance. Mounting elevations shall be as noted on the Drawings or as shown on the Architectural Elevations. If a conflict exists, the elevation shown on the Architectural Elevations shall take precedence.
- D. Provide field paint touch-up with factory furnished paint to match factory pre-painted finish, for all chips, scraps, scratches, fittings and unpainted sections of the surface raceways and multi-outlet assemblies, after installation of all devices and covers are complete.
- E. Provide appropriate separate device finish plates for outlets and telecommunication jacks as specified in other Sections.
- F. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- G. Close ends of wireway and unused conduit openings.
- H. Ground and bond raceways, multi-outlet assemblies and wireways under provisions of Section 26 0526 – Grounding and Bonding for Electrical Systems.

### 3.6 OUTLET BOX INSTALLATION

- A. Outlet boxes shall be securely fastened in position and supported independently of the conduit system.
- B. Outlet boxes located in suspended ceiling system shall be fastened to ceiling "t-bar" system with bar-hanger rods manufactured for the purpose, or from hanger rods with

solid supports from structure above. "T-bar" hanger rods shall be clipped to cross-members supported by the main ceiling support members. Outlet boxes supported from the suspended ceiling system shall be provided with one safety wire attached to the box or box support clip, or two safety wires attached to the bar hanger.

- C. Boxes shall be installed true to the building lines and at equal heights in conformity with mounting heights specified in other sections of the specification.
- D. Provide the best suitable box for each outlet requirement. Extension rings shall not be used on new construction except where needed to bring an outlet box out to 1/8 inch of the finished wall or ceiling line.
- E. Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.
- F. Boxes shall be rigidly secured in position. Recessed boxes shall be so set that the front edge of the box shall be flush with the finished wall or ceiling line, or not more than 1/8 inch back of same. This requirement is more stringent than NEC requirements.
- G. Boxes shall be accessible.
- H. Provide boxes for each application that will not violate the fire rating of the wall, floor or ceiling assembly in which the box is installed.
- I. Do not place order for floor boxes without ensuring that the Contracting Agency has positively approved submittals for the specific cover types/styles colors necessary for all applications and locations.
- J. Recessed boxes shall not be placed back-to-back in adjacent rooms. They shall be offset at least 12 inches, or greater as required by codes and standards applicable to the specific construction.
- K. Boxes (electrical boxes, outlet boxes and telecommunication boxes, etc) penetrating fire rated walls, walls with vapor retarder/barriers, wall types that extend to structure or wall types that contain batts shall be sealed airtight with approved Firestop Putty Pads to reduce sound transmission, reduce air transmission and increase fire resistance. Mold putty pads around electrical junction boxes and conduits to form an airtight seal in accordance with manufacturer's installation instructions.

### 3.7 JUNCTION BOX AND PULL BOX INSTALLATION

- A. Junction and pull boxes shall be installed so that covers are readily accessible and adequate working clearance is maintained after completion of the installation.
- B. Select boxes properly sized per NEC for power and lighting applications.



### 3.8 TELECOMMUNICATIONS SYSTEM PULL BOXES

- A. Where a pull box is required in a 1 inch conduit run, outlet boxes as specified in this Section may be used. Where a pull box is required in a conduit run 1 1/4 inch or larger, or where required for multiple raceways, the box shall be sized in accordance with the Table in this Section.
- B. Pull boxes shall be located in straight-through sections of horizontal cabling pathways (conduits). Pull boxes shall not be used for angle pulls or to accomplish changes in direction of the pathway.
- C. Multiple raceways connecting to telecommunications system pull boxes shall penetrate box walls such that they are distributed evenly along the Box wall.

END OF SECTION 26 0533

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## SECTION 26 0553

## IDENTIFICATION FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Provide identification of on all equipment, raceways, boxes and conductors.
- B. Section includes:
  - 1. Nameplates
  - 2. Labels
  - 3. Wire markers
  - 4. Conduit markers
  - 5. Miscellaneous Electrical Identification
- C. Related Sections: Divisions 26 and 27 Sections.

## 1.2 SUBMITTALS

- A. Division 1 and Section 26 0000 – Electrical General Requirements.
- B. Product Data:
  - 1. Submit manufacturer's catalog literature for each product required.
  - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

## PART 2 - PRODUCTS

## 2.1 NAMEPLATES

- A. Electrical Distribution Equipment Labels and Nameplates
  - 1. Name equipment in accordance with Contract Documents.
  - 2. Nameplates shall be laminated plastic, 0.125 inch thick, with matte finish and square corners. Minimum lettering size as noted elsewhere in this section.
    - a. Label and Nameplate Colors:
      - 1). Normal Equipment: White letters on a black background.
    - b. Securely attach labels with threaded fasteners or pop-rivets. Adhesive attachment not acceptable.
    - c. Temporary markings not permitted on equipment. Repaint trims, housings, etc., where markings cannot be readily removed. Refinish defaced finishes.
  - 3. Include item designation and branch circuit designation (panel and circuit number) on disconnects, starters, equipment and device nameplates, e.g., "FAN No. 4, Circuit LA-30").

## 2.2 WIRE AND CABLE MARKERS

- A. Wire and Cable Markers: Wrap on labels, cloth tape type wire markers or tubing type for all phase, neutral and ground conductors.

## 2.3 LABELS

- A. Adhesive film label with clear protective overlay: Machine printed, in black, by thermal transfer process or equivalent. Minimum lettering size as noted elsewhere in this section. Overlay shall provide a weatherproof and UV resistant seal for label.

## 2.4 UNDERGROUND ELECTRICAL LINE PLASTIC LINE MARKER

- A. Minimum 4 inch wide plastic tape with metallic core with suitable legend describing buried electrical lines.

## 2.5 POWER ONE-LINE DIAGRAM

- A. Laminated, approved print of the "As-Built" power distribution system. Install in accordance with Part 3.

# PART 3 - EXECUTION

## 3.1 NAMEPLATE INSTALLATION

- A. Install nameplate parallel to equipment lines.
- B. Mechanically fasten nameplates using threaded fasteners or pop rivets.
- C. Mechanical fasteners shall have no sharp edges or points which can damage conductors or injure personnel.
- D. Temporary markings are not permitted on equipment. Repaint trims, housings, etc., where markings cannot be readily removed. Refinish defaced finishes.
- E. No labeling abbreviations are permitted without prior approval.

## 3.2 BRANCH AND DISTRIBUTION PANELBOARD NAMEPLATES

- A. Nameplate shall contain the following information (minimum ½ inch height letters):
  - 1. Line 1: Panel Name as noted on drawings and schedules.
  - 2. Line 2: Voltage and Phase.
  - 3. Line 3: Shall indicate if panelboard is "NORMAL" (black background), or "STANDBY" (yellow background) or "EMERGENCY" (red background).
  - 4. Line 4: Source from which panel is fed, "FED FROM: PANEL NH-031".
- B. Install a 2 inch x 4 inch nameplate on each branch panelboard where a building contains distribution systems of different voltages (minimum 1/8 inch height letters):

**THIS BUILDING CONTAINS TWO WIRING SYSTEMS:**

	<u>Phase A</u>	<u>Phase B</u>	<u>Phase C</u>	<u>Neutral</u>
480Y/277V	Brown	Orange	Yellow	Gray
208Y/120V	Black	Red	Blue	White

**3.3 NAMEPLATE LOCATIONS**

- A. Provide 1/2 inch minimum height letters on following equipment:
1. Service equipment Fault Current: Provide signage in accordance with NEC indicating maximum available fault current and date of fault current calculation.
  2. Secondary feeder breakers in distribution equipment. Designation as required by load served.
  3. Special equipment housed in cabinets, as designated on plans, on outside of door.
  4. Equipment housed in equipment cabinets, as designated on plans, on inside of cabinet door.
  5. Switchboards, motor control centers, transformers, as designated on plans, on outside of door or equipment.
  6. Control or low voltage system panels such as Fire Alarm, Security, Video Surveillance, etc., with the following information:
    - a. Line 1: Unique panel name as shown on the shop drawings.
    - b. Line 2: System description such as Fire Alarm, Security, etc.
    - c. Line 3: Panelboard and circuit number from which the panel is fed if applicable.
- B. Provide 1/4 inch minimum height letters on:
1. Disconnects, starters, VSDs and contactors:
    - a. Line 1: Load Served (Use nameplate designation for source).
    - b. Line 2: Panelboard and circuit number from which the device is fed.
    - c. Line 3: Voltage, Phase, fuse size or circuit breaker size.
  2. Lighting control relays, dimmer controls and remote lighting control equipment.
  3. Switches and receptacles where item controlled is not visible from the switch, or as noted on Drawings.
  4. External Power Sources: Provide 1/4 inch white letters on red background on all starters or controllers that receive power from an external source that is not de-energized by operating the associated disconnecting means.
  5. Designated electrical equipment.

**3.4 RECEPTACLE AND LIGHT SWITCH DEVICE PLATES**

- A. Provide 3/16 inch minimum height letters on receptacle and light switch device plates:
1. Engrave branch circuit designation (panel and circuit number) on receptacle and light switch device plates, e.g., "NHA-30"). Verify final panel designations with Contracting Agency prior to engraving nameplates.

### 3.5 TELECOMMUNICATION LABELING REQUIREMENTS.

- A. Provide machine printed labels for all telecommunication racks, cabinets, patch panels, cables, outlets, etc., in accordance with ANSI/TIA/EIA-606-B. Provide labeling nomenclature in accordance with information on the Drawings or Owner's labeling conventions. Submit labeling samples for all required applications.
- B. Machine Printed Label Requirements:
  - 1. PC Compatible.
  - 2. Can save and modify files.
  - 3. Fully integrated with AutoCAD.
  - 4. Editable Fonts and Sizes.
  - 5. Rotate Text and Objects.
  - 6. Vary Line Spacing.
  - 7. Ability to import graphical images.
  - 8. Capable for customization of layout.
  - 9. Re-positional labels.
- C. Basis of Design:
  - 1. Brady Electrical/Datacomm Worldwide (latest version of LabelMark).
  - 2. Cable Management Software International (latest version of docIT).
  - 3. Approved alternate.
- D. Labeling and color coding identification for this project shall conform to TIA/EIA-606-B for a Class 1 Administrative System.

### 3.6 LABEL LOCATIONS

- A. Provide 3/16 inch minimum height letters on the following equipment:
  - 1. Security System Device Labels:
    - a. Provide label on each security field device, denoting device address. Affix label to device faceplate for ceiling-mounted devices or wall mounted devices above 8'-0" AFF. Affix label inside back box for exterior devices.
  - 2. Fire Alarm Device Labels:
    - a. Provide label on exterior surface of each initiating device denoting the unique device address corresponding to the text annunciator description. For detectors, the label shall be affixed to the base and not to the detector itself. For pull stations, the label shall be affixed to the top of the device and not to the vandal proof cover.
    - b. Provide label on each remote test station indicating description and location of device being tested.
    - c. Provide label on telecom conductors at each end denoting FACP lines for use with the digital alarm communicator transmitter (DACT).

### 3.7 DISTRIBUTION/BRANCH CIRCUIT PANELBOARD CIRCUIT LABELING

- A. Distribution Panels and Branch Circuit Panelboard Directories: Provide neatly typed schedule (odd numbered circuits on left side or top, even on right side or bottom) under plastic jacket or protective cover to protect the schedule from damage or dirt. Securely mount on inside face of panelboard door. Define briefly, but accurately, nature of connected load (i.e., Lighting Room 201, Receptacles Janitor Room 155, Etc.) as approved. Sequentially numbered schedules shall not be used.
- B. Use final approved room numbers from finished construction (not necessarily as indicated on the drawings).
- C. Provide numbering for terminals on terminal strips in the terminal enclosure that identifies the origin, function and destination of each conductor.
- D. Install wire marker for each conductor inside panelboards (phase, neutral and ground conductors). Locate label within 6 inches of termination. Labels shall be visible with panel dead front installed.
- E. Provide updated circuit directory in existing panelboards that are modified. Install directory in panelboard in protective cover and submit electronically in the O&M Manual.

### 3.8 WIRE MARKER INSTALLATION

- A. Install wire marker for each conductor (phase, neutral and ground conductors) at panelboards, pull boxes, outlet and junction boxes, and each load connection. Locate label within 6 inches of termination in panelboards. Labels shall be visible with panel dead front installed.
- B. Wire markers are not required on conductors in a pull or junction box that contains only an individual branch circuit, however, source panel and circuit number shall be noted on pull or junction box cover as noted elsewhere in this section.
- C. Fire Alarm Circuits: Provide cable markers showing Notification Appliance Circuit (NAC) or Signaling Line Circuit (SLC) loop identification number at fire alarm junction boxes and pullboxes.
- D. Security System Cables: Install wire marker for each cable at cabinets, pull boxes, junction boxes, and each load connection. Wire ID number shall be as shown on security system shop drawings.
- E. Power Circuits: Panelboard name and branch circuit or feeder number.
- F. Control Circuits: Control wire number as indicated on schematic and/or shop drawings.
- G. Color Code:
  - 1. Color code phases, neutral, and ground per NEC requirements and Section 26 0519 – Wire and Cable.
  - 2. Color code all low voltage system wiring in accordance with applicable Sections.

3. Color code standards: Red = Fire Alarm, Orange = Emergency, Yellow = Standby, and Blue = BAS.

### 3.9 TRANSFORMERS

- A. Nameplate shall contain the following information:
  1. Line 1: Transformer Name as noted on drawings and schedules.
  2. Line 2: KVA Rating/Primary/Secondary Voltage.
  3. Line 3: Source from which transformer is fed, "FED FROM: PANEL NHA"
  4. Line 4: Destination of transformer feed, "FEEDS: PANEL NPA.
- B. When the transformer disconnect is located in a remote location, the disconnecting means shall be labeled to reference the transformer location in accordance with NEC Article 450.

### 3.10 MISCELLANEOUS ELECTRICAL IDENTIFICATION

- A. Junction Boxes: Mark the circuit number(s) and panel source of wiring on all junction boxes with sheet steel covers. Mark with indelible black marker. On exposed junction boxes in finished areas mark on inside of cover.
- B. Conduits
  1. Mark all conduits entering or leaving panelboards with indelible black magic marker with the circuit numbers of the circuits contained inside.
  2. Fire Alarm System: Paint fire alarm conduits with a 6 inch band 10 feet on center with red paint where installed in concealed accessible location (or provide red conduit in accordance with Section 26 0519 – Low Voltage Electrical Power Conductors and Cables and Section 26 0533 – Raceways and Boxes for Electrical Systems. Where raceway is installed in exposed locations it shall be painted to match the adjacent surface.
  3. Empty Conduits: Provide tags with typed description of purpose, and location of opposite end, wired to each end of conduits.
- C. Junction Boxes
  1. Markings shall be made with indelible black marker.
  2. On exposed junction boxes in finished areas markings shall be on inside of cover.
  3. Mark the circuit numbers of wiring on all junction boxes with sheet steel covers.
  4. Mark all Special System junction boxes with sheet steel covers with appropriate system designation, e.g., "Intercom", "Clock", "Telecom", "Video Surveillance", etc. Fire Alarm System: Paint all fire alarm junction boxes inside and out with red paint where installed in concealed accessible location. Where installed in exposed locations paint boxes to match the adjacent surface.
- D. One-Line Diagram: Mount behind protective cover (1/8-inch minimum thickness clear Plexiglas) in accessible location at main switchboard.
- E. Exterior underground power, control, signal and communications lines.
  1. Install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches provide additional markers.



2. Install markers for both direct buried and conduit encased conductors.
  3. Label each underground conductor with its circuit number or identification tag.
- F. Provide a label at the fire alarm control panel that identifies the panelboard and circuit number that supplies the control panel. Provide a red label adjacent to the circuit breaker inside the panelboard that clearly identifies the circuit breaker that feeds the control panel in accordance with NFPA requirements.

### 3.11 CODE REQUIRED MARKINGS AND WARNINGS:

- A. Provide all placards, markings and identification systems required by Code and/or the Contract Documents, such as (but not limited to):
1. Arc Flash.
  2. Series Rated Systems.
  3. Conductor insulation color identification.
  4. Special conductor identification and legends.
  5. Multiple services placards.
  6. Emergency systems markings.
  7. Emergency source grounded circuit conductor connected to a grounding electrode at a location remote from the emergency source: Provide a sign at the grounding location identifying all emergency and normal sources connected at that location.
  8. Warning messages shall include an appropriate plain language imperative command, such as "DANGER HIGH VOLTAGE - KEEP OUT".
  9. Available Fault Current: Service equipment shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault calculation was performed and shall be of sufficient durability to withstand the environment involved.

### 3.12 CLEARANCE STRIPING

- A. For electrical equipment located in areas with uncarpeted floors, the clearances dictated by NEC Article 110 shall be indicated by two inches wide colored striping on the floor.
- B. Striping shall be of a bright color (typically red or yellow) that contrasts with the floor color, and shall be applied by the most durable process that is commercially available for the particular floor finish. Examples are: epoxy paint on concrete floors, and colored tile segments in composition tile floors. Striping color and method shall be subject to approval by the Contracting Agency.
- C. On the floor immediately inside the striping, stencil in two inch block letters the statement: "ELECTRICAL CLEARANCE – NO STORAGE." For floor types where painted stenciling is not feasible or sufficiently durable, this message shall instead be posted on the wall below the equipment as an engraved nameplate of the type specified in this Section, with 1/2-inch lettering. Note the specific clearance requirements on the engraved nameplate.

END OF SECTION 26 0553

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## SECTION 26 2726

## WIRING DEVICES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section includes general provisions, products and methods of execution relating to line voltage wiring devices for use on this project.
- B. Related Sections
  - 1. 26 0533 – Raceway and Boxes for Electrical Systems

## 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA WD 1 - General Requirements for Wiring Devices.
  - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

## 1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.
- B. Do not place order for devices, plates, etc., without ensuring that the Contracting Agency has positively approved submittals for the specific colors necessary for all applications and locations. Note that the selection of one color for general use does not rule out the selection of other colors for special applications or for aesthetic reasons.

## 1.4 QUALITY ASSURANCE

- A. Manufacturers mentioned and catalog numbers specified are for establishment of type, configuration and quality. Other manufacturers and types may be submitted for approval.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Catalog numbers shown are Hubbell unless noted otherwise. Equal devices manufactured by Arrow Hart (by Cooper Wiring Devices), Pass and Seymour, Leviton and Bryant are acceptable. Provide all similar devices of same manufacturer.

## 2.2 SWITCHES

- A. Provide 20 AMP, 277V rated switches with UL listing for tungsten lamp loads or inductive loads without derating. Switches shall be as follows:

	20A Rated Switches
Single Pole	CAT. NO. 1221
Three-way	CAT. NO. 1223
Four-way	CAT. NO. 1224
Key Operated	CAT. NO. HBL1221-L
Momentary Cont.	CAT. NO. HBL1557
Double Pole	CAT. NO. 1222
Pilot Switch	CAT. NO. HBL1221-PL

- B. Multiple 277V switches shall be installed in partition boxes or shall be furnished with shields.
- C. Other switch types shall be provided as called for on the Drawings or as required by the application.

## 2.3 RECEPTACLES

- A. Provide grounding type receptacles as follows, or as required to match equipment furnished in this or other divisions.

Single Phase, 3-Wire Devices		
15A-125V	CAT. NO. HBL 5262	NEMA #5-15R
15A-125V GFCI	CAT. NO. HBL GF-15LA	NEMA #5-15R
15A-250V Single	CAT. NO. HBL 5661	NEMA #6-15R
Clock hanger 125V	CAT. NO. HBL 5235	NEMA #5-15R
20A-125V USB Charger Tamper Resistant	CAT. NO. HBL USB20X2	NEMA #5-20R
20A-125V	CAT. NO. HBL 5362	NEMA #5-20R
20A-125V GFCI	CAT. NO. HBL GF-20LA	NEMA #5-20R
20A-125 SPD	CAT. NO. HBL 5362SA	NEMA #5-20R
20A-125V Tamper Resistant	CAT NO. HBL 8300SG	NEMA #5-20R
20A-250V Single	CAT. NO. HBL 5461	NEMA #6-20R
30A-250V Dryer	CAT. NO. RR430F	NEMA #14-30R
50A-250V Range	CAT. NO. RR450F	NEMA #14-50R

- B. Other products may be submitted if they provide equal or better performance to the products specified as the Basis of Design. The substitution request shall include a feature by feature comparison to the specified products or the request will not be reviewed. Substitutions are subject to approval. Samples may be required by the Electrical Engineer for evaluation of performance. Samples will not be returned.

## 2.4 DEVICE COLOR

- A. Device color shall be white.

## 2.5 DEVICE PLATES

- A. Indoor device plates for surface mounted boxes shall be stainless or galvanized steel, with design to match the box and device type being used.
- B. Label receptacle and light switch plates in accordance with Section 26 0553 – Identification for Electrical Systems.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install wiring devices indicated complete with cover plates. Cover plates shall fit snugly against finished surfaces and line up true with adjacent building lines, and be symmetrical in location and appearance.
- B. Switches shall be installed so their handles move in a vertical plane.
- C. Door swings shall be checked and, if necessary, switches shall be relocated to place them on the strike side of the door.
- D. Unless otherwise noted on the drawings, receptacles shall be installed in the vertical position with the grounding pin down unless wording on the face of the device requires other mounting.
- E. Receptacles identified as Ground-Fault Circuit Interrupter (GFCI) type shall be provided as individual GFCI receptacles.
- F. NEMA 5 configuration receptacles located in shops or commercial kitchens whether on single or multiple receptacle circuits shall be rated at least 20 amps.
- G. Occupancy sensors shall be installed in accordance with manufacturer's recommendations. Verify proper operation of sensors. The sensing units' coverage area shall be restricted if required to avoid sensing people or extraneous influences in adjacent areas or corridors. This shall be done by covering a portion of the sensing lens with white paper tape in accordance with manufacturer's recommendations.

END OF SECTION 26 2726

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## SECTION 26 2800

## LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Thermal Magnetic Molded Case Circuit Breakers.
  - 2. Electronic Trip Molded Case Circuit Breakers.
  - 3. Fusible switches and fuses.

## 1.2 REFERENCES

- A. The circuit breaker(s) referenced herein shall be designed and manufactured according to the latest revision of the following standards.
  - 1. ANSI/NFPA 70 - National Electrical Code (NEC).
  - 2. NEMA AB 1 - (National Electrical Manufacturers Association) Molded Case Circuit Breakers and Molded Case Switches.
  - 3. UL 489 - (Underwriters Laboratories Inc.) Molded Case Circuit Breakers and Circuit Breaker Enclosures.
  - 4. UL 943 - Standard for Ground Fault Circuit Interrupters.
  - 5. UL 1053 – Ground Fault Sensing and Relaying Equipment.
  - 6. CSA C22.2 No. 5 - (Canadian Standard Association) Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures.
  - 7. Federal Specification W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
  - 8. Federal Specification W-C-865 - Fusible Switches.
  - 9. IEC 60947 – Low Voltage Switchgear and Control Gear – Part 2: Circuit Breakers.
  - 10. IEC 61000-4 Series – Electromagnetic Compatibility.

## 1.3 SYSTEM DESCRIPTION

- A. Provide overcurrent protective devices as specified herein and as shown on schedules and/or drawings.

## 1.4 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.
- B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Submit product data for each type of overcurrent protective device, ground fault protector,

accessory, and component indicated. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

- C. Provide outline drawings with dimensions, and ratings for voltage, amperage and maximum interruption. Include instructions for circuit breaker mounting, trip unit functions and adjustments, trouble shooting, accessories and wiring diagrams.
- D. Coordination data to check protective devices: Manufacturer shall provide electronic and hard copy time/current characteristic trip curves (and  $I_p$  &  $I^2t$  let through curves for current limiting circuit breakers) for each type of circuit breaker.
- E. Provide information required to verify compliance with the short circuit withstand and interrupting ratings, as shown on the Drawings or further stated in these Specifications.

## 1.5 QUALITY ASSURANCE

- A. Devices shall be the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with applicable standards and UL listings.
- B. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors installed in the State of Alaska must be "Approved," "Certified," "Identified," or "Listed" and "Labeled" to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
- C. The overcurrent protection device manufacturing facility shall be Registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9000 Series Standards for quality.

## PART 2 - PRODUCTS

### 2.1 PRODUCT

- A. The Basis of Design is equipment from Square D by Schneider Electric to set a standard for quality. Equipment from Cutler-Hammer, Seimens Energy & Automation, General Electric, or alternative systems will be considered providing that sufficient documentation is provided to the Contracting Agency that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points that are pertinent to the Project.

### 2.2 MOLDED CASE CIRCUIT BREAKERS

- A. General Characteristics:
  - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle, and the accessory mounting area.



2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick make, quick break contact action. The circuit breaker shall have common tripping of all poles.
3. The circuit breaker handle shall reside in a tripped position between on and off to provide local trip indication. Circuit breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings.
4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
5. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes (except Type QO/EDB/EGB/EJB).
6. MCCBs shall be able to receive a device for locking in the isolated position. MCCBs that serve as the main service disconnect shall be provided with a device for locking in the isolated position.
7. Electronic components shall withstand temperatures up to 221°F (105°C).
8. Circuit breakers shall be UL listed to accept field installable/removable mechanical type lugs (except Type (except Type QO/EDB/EGB/EJB/QB/QD/QG/QJ).
9. Lugs shall be UL listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 75°C rated wire or 90 C rated wire, sized according to the 167°F (75°C) temperature rating in the NEC.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings. Install circuit breakers in accordance with manufacturer's instructions, the National Electrical Code and applicable local codes.
- B. Size devices as shown and specified, or as required by the load being served.

END OF SECTION 26 2800

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## SECTION 26 2816

## ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section includes general requirements, products, and methods of execution relating to fusible and non-fusible disconnecting devices approved for use on this project.
- B. Related Sections:
  - 1. 26 0519 – Low Voltage Electrical Power Conductors and Cables
  - 2. 26 0526 – Grounding and Bonding for Electrical Systems
  - 3. 26 0529 – Hangars and Supports for Electrical Systems
  - 4. 26 0553 – Identification for Electrical Systems

## 1.2 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.

## 1.3 QUALITY ASSURANCE

- A. Devices shall be of the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with U.L. listings and the governing NEMA standards.
- B. Disconnects shall be of the same manufacturer as switchboards and panelboards.

## PART 2 - PRODUCTS

## 2.1 SAFETY SWITCHES

- A. Safety switches, fusible and non-fusible, shall conform to NEMA Standard KS1 for type HD (Heavy Duty) unless otherwise noted.
  - 1. Switch Interior: Switches shall have switch blades that are fully visible in the OFF position when the door is open. Switches shall be of dead front construction with permanently attached arc suppressers. Lugs shall be UL listed for copper and/or aluminum cables and be front removable.
  - 2. Switch Mechanism: Switches shall have a quick-make and quick-break operating handle and mechanism that shall be an integral part of the box, not the cover. Switches shall have a defeatable dual cover interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open. The switch shall be capable of being locked in the OFF position with three (3) padlocks.

3. Enclosures: Switch enclosure shall be suitable for the environment in which the switch is mounted. NEMA 1 enclosure shall be code gauge, UL-98, sheet steel, treated with a rust inhibiting phosphate and finished in gray, baked enamel. NEMA 3R enclosure--same requirements as NEMA 1 except galvanized prior to painting.
4. Rating: Ampere, volt and horsepower ratings, as well as number of poles and presence of neutral bar shall be shown on the nameplate.

## 2.2 CIRCUIT BREAKERS

- A. Circuit breakers used as disconnects shall meet requirements specified in Section 26 2800 – Low Voltage Circuit Protective Devices. Enclosures for same shall meet the requirements as specified above.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Coordinate details pertaining to size of motor and/or equipment, location and requirements to enclosure, ratings, etc., so as to provide the most suitable unit for the intended purpose.
- B. Provide nameplates for disconnects. Coordinate names with mechanical equipment lists.
- C. Where the rating of a fused disconnect exceeds the ampacity of the conductors being protected, a permanent label noting maximum fuse size shall be installed in a conspicuous location within the switch.
- D. Where recommended or required by the equipment manufacturer, or required by underwriters' laboratories, disconnects shall be the fusible type, fused in accordance with the equipment nameplate information.
- E. Provide code required disconnects.

END OF SECTION 26 2816

## SECTION 26 2900

## LOW VOLTAGE CONTROLLERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This section includes general requirements, products, and methods of execution relating to manual and magnetic motor starters provided in this and other Divisions. Overloads shall be furnished and installed in Divisions 26, 27 and 28.
- B. Related Sections:
  - 1. 26 0553 – Identification for Electrical Systems

## 1.2 REFERENCES

- A. National Electrical Manufacturers Association:
  - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
  - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
  - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
  - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
  - 5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
  - 6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

## 1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 0000 - Electrical General Requirements and Division 1.

## 1.4 QUALITY ASSURANCE

- A. Equipment shall be of the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with the governing standards.

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PART 2 - PRODUCTS

## 2.1 BASIS OF DESIGN

- A. The Basis of Design is equipment from Square D by Schneider Electric to set a standard for quality. Equipment from alternative systems will be considered providing that sufficient documentation is provided to satisfy the CONTRACTING AGENCY that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points which are pertinent to the Project.

## 2.2 AC FRACTIONAL MANUAL STARTERS

- A. The manual starter shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relay.
- B. Thermal unit shall be one piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed.

## 2.3 AC MANUAL STARTERS--LINE VOLTAGE TYPE

- A. Manual starters shall be constructed and tested in accordance with the latest published NEMA standards.
- B. The manual starters shall consist of a manually operated switch equipped with melting alloy type thermal overload relays in every phase conductor. Thermal units shall be one piece construction and the starter shall be inoperative if any thermal unit is removed.
- C. Starters shall be furnished in a NEMA 1 general purpose enclosure unless otherwise indicated on the plans or required by the conditions of the area in which they are installed.

## 2.4 AC MAGNETIC STARTERS--LINE VOLTAGE TYPE

- A. Motor starters shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes and horsepower ratings.
- B. Starters shall be mounted in NEMA 1 general purpose enclosures unless otherwise indicated on plans or required by the conditions of the area in which they are installed.
- C. Starters shall be furnished with overload relays in every phase conductor and starters shall be inoperative if any overload unit is removed.
  - 1. Overload relays shall be melting alloy type. Thermal units shall be of one-piece construction and interchangeable.
- D. Starters through NEMA size five (5) shall be equipped with double break silver alloy contacts. Contacts shall be replaceable without removing power wiring or removing starter from panel.

- E. Coils shall be of molded construction and shall be 120 VAC. Starters shall have a fused 120V control power transformer in enclosure, or alternatively on 120/208 or 120/240 volt systems, the power system neutral conductor may be utilized. In all cases, control power shall be disconnected by the starter disconnecting means, unless otherwise specifically approved.
- F. Starters shall be suitable for field addition of at least four (4) auxiliary electrical interlocks of any arrangement, normally open or normally closed.
- G. Starters shall have enclosure mounted red running pilot light and Hand-Off-Auto switch.

## 2.5 AC COMBINATION STARTERS WITH FUSIBLE DISCONNECT SWITCH OR CIRCUIT BREAKER

- A. Combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes and horsepower ratings.
- B. Disconnect switch combination starters shall consist of a visible blade disconnect switch and a motor starter.
- C. Combination starters shall be mounted in NEMA 1 general purpose enclosures unless otherwise indicated on the plans or required by the conditions of the area in which they are installed.
- D. The disconnect handle used on combination starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off".
- E. Magnetic starters provided under all Divisions of the Specifications shall be in accordance with this Section.

## PART 3 - EXECUTION

### 3.1 COORDINATION

- A. Coordinate details pertaining to the motor control equipment with the Division of these specifications where the equipment is specified.

### 3.2 CONTROL WIRING

- A. Control wiring and control devices shall be provided under the Specification Division in which the controlled equipment is specified. Coordinate all related work.

### 3.3 CONNECTIONS

- A. Provide liquid tight flexible conduit connections to motors and other equipment subject to vibration where LFMC is an acceptable wiring method. Provide flexible conduit connections to motors and other equipment subject to vibration that is located in spaces used for environmental air (e.g. fan rooms). Minimum length 12 inches.

### 3.4 NAMEPLATES

- A. Provide engraved nameplates for all starters in accordance with Section 26 0553 – Identification for Electrical Systems. Coordinate names with mechanical equipment lists.

### 3.5 REDUCED VOLTAGE STARTERS

- A. Reduced voltage starters shall be provided for all motors larger than:
  - 208 volts                      25 horsepower
  - 460 volts                      50 horsepower
  - 1. This requirement shall apply to starters furnished in this Division and other Divisions of the specifications.
  - 2. Motors controlled by Variable Frequency Drives (VFDs) are not subject to this requirement.

### 3.6 TWO SPEED STARTERS

- A. Provide two speed starters for all two speed motors. Starters shall comply with the requirements of the equipment and motor manufacturers. Refer to Mechanical Equipment Lists for equipment with two speed motors.
- B. This requirement shall apply to starters furnished in this Division and other Divisions of the specifications.

END OF SECTION 26 2900



## SECTION 26 5000

## LIGHTING FIXTURES

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section describes general requirements, products and methods of execution relating to lighting fixtures lamps, ballasts, LEDs, LED drivers and related products approved for use on this project.
- B. The Fixture Schedule is a general guide to type, quality and other characteristics. Fixtures of equal or better performance and quality may be substituted, subject to approval.

## 1.2 RELATED SECTIONS

- A. 26 2726 – Wiring Devices

## 1.3 QUALITY ASSURANCE

- A. The fixture shall be a standard catalog item as described on the Drawings and as made by a nationally recognized manufacturer.
- B. Lamps specified in this Section shall be as manufactured by Osram Sylvania, Philips, General Electric or Venture.
- C. LEDs specified in this Section shall be as manufactured by Nichia, Samsung, or Cree.
- D. Ballasts specified in this Section shall be as manufactured by Osram, Advance, or Universal, unless noted otherwise.

## 1.4 SUBMITTALS

- A. Provide submittals for all products in accordance with Section 26 0000 and Division 1.
- B. Fixture mounting shall be clearly identified on submittal information and coordinated with architectural, features, assemblies, details and reflected ceiling plan.
- C. Lamps, ballasts, LEDs, LED Drivers and related products are generally included in the fixture schedule on the plans. Verify that the fixture types submitted for approval contain components complying with the product specifications of this Section.

## 1.5 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Interior lighting fixtures: 36 months from date of Substantial Completion.
  - 2. Controls mounted on or integral to lighting fixtures: 60 months from date of Substantial Completion.
  - 3. LEDs and LED Drivers: 60 months from date of Substantial Completion.
  - 4. Emergency Battery Ballasts and Drivers: 60 months from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provide fixtures in conformance with the Fixture Schedule, with all required flanges and supports. Lighting fixtures shall be provided complete with all suspension, trim, mounting, and operating accessories normally considered necessary for a complete, functional, and safe installation, whether specifically called for in the Contract Documents or not.

### 2.2 LIGHT EMITTING DIODE (LED) FIXTURES

- A. LED fixtures shall comply with Illuminating Engineering Society (IES) LM-79 guidelines.
- B. Fixture shall have an LM-79 photometric test report from a DOE CALiPER NVLAP accredited laboratory.
- C. Fixture shall utilize components (i.e. LEDs, driver, fixture housing, etc) included in LM-79 test.
- D. Fixture shall have lumen maintenance testing with minimum test duration of 10,000 hours.
- E. Manufacturer stated end of life shall be at 70% light output. Operating life shall be no less than 50,000 hours.
- F. Color temperature, and color rendering index (CRI) shall conform to the lighting fixture schedule shown on the Drawings.
- G. Fixture power factor shall be greater than 0.9 over all input voltages.
- H. Total Harmonic Distortion (THD) shall be less than 20% over all input voltages.
- I. Fixture components shall be lead free, mercury free and RoHS compliant.

### 2.3 LIGHT EMITTING DIODES (LEDs)

- A. LEDs shall comply with Illuminating Engineering Society (IES) LM-80 guidelines.

- B. Manufacturer stated lamp end of life shall be at 70% light output. Lamp operating life shall be no less than 50,000 hours.

## 2.4 BALLAST/DRIVER DISCONNECTING MEANS

- A. In indoor locations, luminaires that ballasts(s) or LED Driver(s) shall have a disconnecting means either internal or external to each luminaire to disconnect simultaneously from the source of supply all conductors of the ballast and LEDs/LED boards, including the grounded conductor in accordance with National Electrical Code (NEC) Article 410.

## 2.5 LED DRIVERS

- A. LED drivers – Non Dimming
  1. Input: 120-277V, 50/60Hz (100-305V with tolerances)
  2. Frequency: 47 - 63Hz
  3. Efficiency: >90% at full load at nominal working voltage
  4. Power Factor: >0.9 over all input voltages
  5. Total Harmonic Distortion: <20% overall all input voltages
  6. Output: Class 2 LED/55V max, Current range (adjustable) 150mA to 1,400mA
  7. UL recognized
  8. Phillips, GE, Osram, eldoLED or approved equal.
  9. Drivers and controls shall be compatible.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Ballasts and Drivers shall be installed per manufacturer's recommendations.
- B. Fixtures with integral ballasts and Drivers shall have the ballast or driver installed and prewired at the factory.
- C. Tandem wiring harnesses internal fixture wiring shall be factory assembled and installed in multiple fixtures which share a common ballast or driver. All wiring harnesses shall include an integral copper grounding conductor and be approved for use in air plenums.

### 3.2 INSTALLATION

- A. Install fixtures level, plumb and true. Align rows accurately in three dimensions.
- B. Support suspended acoustical ceiling fixtures according to the requirements of the IBC and Section 20 0529 – Mechanical Hangars and Supports.
- C. Fixture pendants, canopies, blank sections, corners, tees and other such accessories shall be finished to match their respective fixture.
- D. Refer to applicable details on architectural drawings for specific mounting requirements for all fixtures with special mounting requirements such as cove-mounted fixtures and linear fixtures.

- E. Utility Rooms: Surface ceiling mount fixtures in rooms/areas with ceilings. In areas without ceilings pendant fixtures down to bottom of structure. In areas with mechanical equipment, ductwork and piping, pendant fixtures down to bottom of mechanical ductwork or piping as appropriate. Fixture pendants shall be rigid (threaded hangar rods) and shall be sway braced where pendants exceed 24 inches in length.
- F. Provide an unswitched circuit connection for the following:
  - 1. Exit signs
  - 2. Emergency lighting units (ELUs)
  - 3. Emergency fixtures
  - 4. Emergency night lights
  - 5. Fixtures with emergency battery ballasts or LED drivers
- G. Wiring for fixtures connected to emergency circuits shall be kept entirely independent of other wiring and equipment in accordance with NEC article 700.
- H. Clean all fixtures and lenses prior to final acceptance.

END OF SECTION 26 5000

## SECTION 27 2010

## TELECOM DISTRIBUTION SYSTEM (TDS)

## PART 1 - GENERAL

## 1.1 DESCRIPTION AND GENERAL SPECIFICATIONS

- A. Provide the equipment, materials, and labor to install the systems shown on the Drawings and specified herein. This shall include (but not be limited to) provision of all trenching and backfill, raceways, sleeves, boxes, gutters, shelves, enclosures, shelf and enclosure supports, backboards, equipment racks, line and low voltage wire and cable, patch cords, pull ropes (in unused conduits), terminal modules, panels, outlets, jacks, splices, connections, cable management, labeling, testing and all other material, equipment, and labor required to make the systems fully operational.
- B. The intent of this Specification is to place in working order a complete, fully tested and documented Category 6 system complying with the Codes and Standards referenced herein.

## 1.2 RELATED SECTIONS

- A. 26 0533 - Raceway and Boxes for Electrical Systems

## 1.3 COORDINATION

- A. The necessity to coordinate this work with the Serving Utility, Owner and the Contracting Agency is emphasized. The Contractor shall be responsible for any omissions, delays and additional cost due to lack of coordination or approval from the same.
- B. Coordinate work with other contractors and trades. The layout and installation of the systems shown on the Drawings and specified herein shall be coordinated such that all special requirements for telecommunications systems shall be provided and incorporated into the project. The systems to be coordinated shall include (but are not limited to) electrical raceway, grounding, fire rated assembly, lighting, power distribution, control and instrumentation, and labeling of cables, terminations, outlets, jacks, etc. Report all conflicts to the Contracting Agency.

## 1.4 CODES AND STANDARDS

- A. Where a Nationally Recognized Testing Laboratory (NRTL) listing or classification exists for a product and the product is suitable for the purpose specified and indicated, the product shall bear the appropriate marking indicating the listing or classification.

- B. Where a UL Standard is in effect, equipment shall:
1. Meet that Standard.
  2. Bear the UL Label.

## 1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 26 0000 - Electrical General Requirements and Division 1 in sufficient detail to show full compliance with the specification:
1. Manufacturer's Catalog Data shall be submitted for the following items. Data shall include a complete list of parts, special tools, and supplies.
    - a. Copper Cable.
    - b. Splice Cases.
    - c. Information Outlets.
    - d. Patch Panels.
    - e. Equipment Racks.
    - f. Terminal Modules.
    - g. Patch Cords and other accessories.
  2. Manufacturer's Installations Instructions.
  3. Labeling System: Coordinate with Contracting Agency for Owner's labeling conventions. Submit Project labeling system for approval.
  4. Contractor qualifications and experience as specified in this Section.
  5. Manufacturer's Warranty as specified elsewhere in this Section, including all warranty provisions and procedures for Owner to follow to obtain warranty service.
  6. Quality Assurance Plan: Contractor shall prepare a quality assurance plan which provides a detailed outline of all testing to be accomplished.
  7. The Quality Assurance Plan shall include, as a minimum:
    - a. A schedule of when tests will be performed relative to installation milestones.
    - b. Specific test procedure that will be used.
    - c. A list of test equipment that will be used including manufacturer, model number, calibration certification, range and resolution accuracy.
    - d. A sample test report form with examples of data to be reported.
    - e. Test plan shall be submitted to the Owner for approval at least 30 days prior to the start of testing.
- B. DELETE SUPERFLUOUS INFORMATION FROM SUBMITTAL DATA, SUCH AS MODEL NUMBERS AND OPTIONS FOR EQUIPMENT CONTAINED ON MANUFACTURER'S DATA SHEETS BUT NOT USED ON THIS PROJECT.
- C. One copy of approved submittals shall be kept at the job site.

## 1.6 REFERENCE CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only, latest edition. The reference codes and standards are minimum requirements.

Reference	Title/Revision
ANSI/ICEA	Publication S-80-576
ANSI/IEEE C2	National Electrical Safety Code

Reference	Title/Revision
ANSI/NFPA 70	National Electrical Code
ANSI/T1E1.7/92-004R	Electrical Protection Applied to Telecommunications Network Plant at Entrances to Customer Structures or Buildings
ANSI/TIA/EIA-568-B.1	Commercial Building Telecommunication Cabling Standard Part 1: General Requirements
ANSI/TIA/EIA-568-B.2	Commercial Building Telecommunication Cabling Standard Part 2: Balanced Twisted-Pair Cabling Standards
ANSI/TIA/EIA-569-A	Commercial Building Standards for Telecommunications Pathways and Spaces
ANSI/TIA/EIA-571	Environmental Considerations for Telephone Terminals
ANSI/TIA/EIA-606-A	Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
ANSI/TIA/EIA-854-2001	A Full Duplex Ethernet Specification For 1000mbis/S (1000base-Tx) Operating Over Category 6 Balanced Twisted-Pair Cabling
BELLCORE TR-EOP-000063	Belcore Network Equipment Building Systems Generic Equipment Requirements
BICSI	Telecommunications Distribution Methods Manual
CFR 47 Part 68	Connection of Terminal Equipment to the Telephone Network
FCC Part 15	Radio Frequency Devices
FCC Part 68	Connection of Terminal Equipment to the Telephone Network
IEEE	LAN Standards: 802.3; 802.4; 802.5; 802.6
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage Surge Protective Devices
IEEE C62.42	Guide for the Application of Gas Tube Arrester Low-Voltage Surge Protective Devices
IEEE Draft P1250 (D4)	Guide on Service to Equipment Sensitive to Momentary Voltage Disturbances
IEEE Std 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book)
IEEE Std 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book)
IEEE Std 241	Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
IEEE Std 446	Recommended Practice for Emergency and Stand-by Power Systems for Industrial and Commercial Applications (Orange Book)

Reference	Title/Revision
NTP 638 - 3031 - 300 STD	Northern Telecom Practice "Bonding and Grounding QCF-Type Bond Clamps Description and Installation"
UL 1283	Electromagnetic Interference Filters
UL 1449	Transient Voltage Surge Protection
UL 1459	Standard for Telephone Equipment
UL 1950	Standard for Information Technology Equipment, Including Electrical Business Equipment
UL 467	Grounding and Bonding Equipment
UL 497	Protectors for Paired Conductors for Communication Circuits
UL 497A	Secondary Protectors for Communication Circuits
UL 497B	Protectors for Data Communication and Fire Alarm Circuits
UL 910	Safety Test for Flame-Propagation and Smoke Density Values for Electrical and Optical- Fiber Cables

### 1.7 OPERATING CONDITIONS

- A. The electronic equipment designed for office environments and Telecommunications Rooms shall be rated for continuous operation under ambient environment conditions of 10 degrees C (50 degrees F), to 30 degrees C (85 degrees F) and 35 to 65 percent relative humidity, non-condensing.

### 1.8 QUALITY ASSURANCE

- A. Perform all Work in accordance with all regulatory rules and regulations as well as references in this specification.
- B. Perform all Testing in accordance with ANSI/TIA/EIA-568-B specifications and submit all printed reports.

### 1.9 QUALIFICATIONS

- A. The telecommunications work specified in this Section is acknowledged to require special skills mastered by education, experience, or both. Bidders for telecommunications work described in this Section shall be specialty telecommunications contractors, who may be a division of the Divisions 26 and 27 Subcontractor.
- B. Contractor Experience:
1. Specialty subcontractors bidding telecommunications work shall have a minimum of three years experience in the construction, testing, and servicing of systems of the type and magnitude specified herein.
- C. Personnel and Equipment:
1. Demonstrate and document to the extent necessary that sufficient physical and personnel resources are available to accomplish the telecommunications work of this project without endangering timely and proper completion of the work.



### 1.10 REGULATORY REQUIREMENTS

- A. All Work shall conform to the requirements of NFPA 70 and all local amendments.
- B. All Work shall conform to the requirements of all Federal, State and Local Electrical and Telecommunications Regulations.

### 1.11 SPECIAL WARRANTY

- A. The warranty shall extend from the date of Substantial Completion to the longer of twenty (20) years or the length of the Extended Warranty offered by the successful manufacturer.
- B. The warranty shall be extended to the Owner via the manufacturer through a single point of contact and shall be fully backed by the manufacturer.
- C. The Extended Product Warranty and System Assurance Warranty for this wiring system shall be provided consisting of the following:
  - 1. Extended Product Warranty - The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA/EIA 568-B and ISO/IEC IS 11801-B, exceed the attenuation and NEXT requirements of ISO/IEC IS 11801-B for cabling links/channels, and that the installation will exceed the loss and bandwidth requirements of ISO/IEC IS 11801-B for links/channels. The warranty shall apply to all passive Telecommunication Distribution System (TDS) components.
  - 2. System Assurance - The System Assurance shall cover the failure of the wiring system to support any existing application, as well as additional application(s) introduced in the future by recognized standards or user forums that use the ANSI/TIA/EIA 568-B or ISO/IEC IS 11801-B component and link/channel specifications for cabling.
  - 3. All communications system components shall be rated for end-to-end system Category 6, or greater performance levels on all pair combinations and warranted to support any existing or future applications which are designed to operate over a 250MHz horizontal channel (as defined in ANSI/TIA/EIA 568-B.2.1), to include support of the following applications. Performance shall be guaranteed under the Special Warranty at 100 meters (328 feet):
    - a. IEEE 802.3 10Base-T, 100Base-TX and 100Base-T4.
    - b. IEEE 802.5 16 Mbps token ring.
    - c. IEEE 802.12 Demand Priority Access Control.
    - d. Asynchronous Transfer Mode (ATM) data transmission at 155 Mbps.
    - e. IEEE 802.3ab 1000Base-T.
    - f. ANSI/TIA/EIA-854-2001 "A Full Duplex Ethernet Specification For 1000mbis/S (1000base-TX) Operating Over Category 6 Balanced Twisted-Pair Cabling".
    - g. Future applications that become certified under the applicable standards as noted above.

## 1.12 MANUFACTURERS' RECOMMENDATIONS

- A. All installation procedures shall be in accordance with the recommendations of the manufacturer of the material being installed. Printed copies of these recommendations shall be submitted to the Contracting Agency 30 days prior to installation. Installation of the item shall not proceed until the recommendations are received and approved by the Contracting Agency. A copy of the recommendations shall be kept at the job site.

## 1.13 TERMINOLOGY

- A. "TDS" shall refer to the Telecommunication Distribution System cabling and hardware infrastructure internal and external to a building or buildings used to transmit voice, video and data, etc.
- B. "Stations" shall refer to individual telephone or computers, or remote peripherals of those systems (e.g., printers, facsimile machines, modems, etc.
- C. "Outlets" shall refer to the group of receptacles or jacks at the location where the stations connect.
- D. "Jacks" or "Ports" shall refer to the individual receptacles where phones, computers, etc. connect.
- E. "Station Cables" shall refer to the horizontal cables connecting patch panels or terminal blocks in the Telecommunications Rooms to the stations.
- F. "Pathways" shall refer to conduits, sleeves, cable-trays, distribution rings, etc., which are employed to route backbone and stations cables between equipment rooms, telecommunications rooms, stations, outlets, etc.
- G. "Backbone Cables", "Riser Cables" or "Tie Cables" shall refer to copper cables 25-pair or more and optical fiber cables 6-strand or more, connecting main cross-connect facilities, intermediate cross-connect facilities and telecommunications rooms. These cables may include outside plant cables between buildings and riser cables between floors.
- H. "Equipment Rooms" (ER) or "Communication Equipment Rooms" (CER) shall refer to a special-purpose room that provides space and maintains a suitable operating environment for large communications and/or computer equipment. Main rooms may also be referred to as an MDF.
- I. "Telecommunications Rooms (TR)" shall refer to a floor-serving facility for housing telecommunications equipment, cable terminations and cross-connect wiring. This is the point at which station cables terminate. It may also be referred to as an IDF.
- J. "Terminal Blocks" shall refer to multiple punch down cable terminations.
- K. "Patch Panels" shall refer to rack or frame mounted multiple punch down cable terminations with RJ-45 style, 8P8C jacks on the face for "plug and play" cross connect capability.

- L. "Cable Management" shall refer to rings, troughs, gutters etc., mounted in conjunction with telecommunications distribution equipment and terminal blocks, for the orderly routing of cables, patch cords, etc.
- M. "LEC" shall refer to the Local Exchange Carrier providing telephone service to the facility.

#### 1.14 STORAGE AND HANDLING

- A. Care shall be exercised in handling materials during construction. Damaged materials shall be repaired or replaced as directed by the Contracting Agency.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. All materials shall be as specified, first quality, manufacturer's current production.
- B. The Basis of Design for copper cabling, connecting hardware, and related hardware in this section is CommScope Systimax 6 as standard for quality and performance. Listed manufacturers meeting all the system quality, performance and warranty requirements of this specification are also acceptable. The burden of proof is on the Contractor to demonstrate that all performance and warranty requirements are met. Any listed manufacturers products submitted without information giving detailed item by item comparison with the Basis of Design will be rejected without review. All manufacturers other than those listed in this section will be rejected without review.
- C. The approved alternate cabling products manufacturers are:
  - 1. Superior/Ortonics.
  - 2. Berk-Tek.
- D. The approved alternate connecting hardware products manufacturers are: Below are the alternates. They depend on which Basis of Design you selected above. Delete the BOD from this list..
  - 1. Leviton.
  - 2. Ortronics.
- E. Products shall provide the standard of performance required under paragraph 1.1 and

#### 2.2 INFORMATION OUTLETS/JACKS

- A. Faceplate Requirements:
  - 1. Configure single gang outlet information outlets in single, duplex, triplex, or quadplex jack arrangement, as indicated on the Drawings.
  - 2. Provide outlet faceplates with both top and bottom labeling positions.
  - 3. Provided blank module inserts for all unused module locations.
  - 4. Equipment: Refer to Specification Section 26 2726-Wiring Devices for faceplate type/color.
- B. Jack Requirements:
  - 1. Jacks for Voice and Data:

- a. Communications jacks shall consist of multi-position 8-pin modular (8P8C) jacks, utilizing T568B termination style.
- 2. Category 6 Jacks:
  - a. Jacks shall be manufactured by the same manufacturer as the modular patch panels.
  - b. All Jacks shall conform to ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section and shall meet or exceed the following electrical and mechanical specifications:
    - 1). Electrical Specifications: Jacks shall meet or exceed performance specifications for the Channel as defined by ANSI/TIA/EIA-568-B.
    - 2). Mechanical Specifications:
      - a) Plug Insertion Life: 750 insertions.
      - b) Contact Force: 3.5 oz (99.2 g) minimum using FCC-Approved modular plug.
      - c) Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack.
    - 3). Temperature Range: -40° to 150°F (-40° to 66°C).
    - 4). Comply with FCC Part 68.
    - 5). ISO 9001 Certified Manufacturer.
    - 6). Equipment: Ortronics TracJack outlet.

## 2.3 WALL MOUNTED TELEPHONE LOCATIONS

- A. At wall mounted telephone locations, provide telecom outlet with VoIP telephone hanger bracket that accommodates a telecommunications modular jack as specified in this section. Provide one horizontal cable from jack to telecom room.

## 2.4 PATCH CORDS

- A. Provide factory assembled Category 6 Modular Patch Cords for each assigned port on the patch panel. All cords shall conform to the requirements of ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program. Cords shall be equipped with an 8 pin modular connector on each end and the minimum length patch cord shall be provided in each instance, to make an orderly, manageable connection between the patch panels or equipment being cross-connected.
- B. All patch cords shall be round, and consist of 24-AWG copper, stranded conductors, tightly twisted into individual pairs.
- C. Patch cords shall be manufactured by the manufacturer of the patch panels and jacks and meet or exceed the Channel performance defined by ANSI/TIA/EIA-568-B.
- D. UL or ETL Verified for ANSI/TIA/EIA 568-B Electrical Performance.
- E. The patch cord shall have exclusion features to prevent accidental polarity reversals and split pairs.
- F. UL Listed for Fire Safety.
- G. ISO 9001 Certified Manufacturer.

H. FCC Compliant.

I. Provide Patch Cord storage boxes for all spare patch cords provided in each TR.

## 2.5 HORIZONTAL CABLES

A. General:

1. Data cables shall be extended between the station location and its associated TR and shall consist of 4 pair, 24 gauge, UTP, and shall be terminated on the 8 pin modular jacks provided at each outlet. Cable jacket shall comply with Article 800 NEC for use as a plenum cable. The 4 pair UTP cable shall be UL Listed Type CMP (plenum).
2. All cables shall conform to the ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL LAN Certification and Follow-up Program.
3. Electrical Specifications:
  - a. DC resistance: 28.6  $\Omega$ /1,000 ft (9.38  $\Omega$ /100 m), maximum.
  - b. DC resistance unbalance: 5%, maximum.
  - c. Mutual capacitance @ 1 MHz: maximum pF/ft: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.
  - d. Delay skew: ns/100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.
  - e. Worst pair attenuation, dB/100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.
  - f. NEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.2.
  - g. PSNEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.2.
  - h. ELFEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.2.
  - i. PSELFEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.2.
  - j. Worst Pair Structural Return Loss (SRL), dB at 100m (328 ft.): meet or exceed the performance values specified in ANSI/TIA/EIA-568-B.2.
4. Cables shall meet or exceed Category 6 performance specifications for the Channel as defined by ANSI/TIA/EIA-568-B.2.
5. Environmental:
  - a. Storage temperature: 68° F to 122° F (20° C to 50° C).
  - b. Installation Temperature: 32° F to 122° F (0° C to 50° C).
  - c. Operating Temperature: 14° F to 140° F (-10° C to 60°).
6. UL or ETL Verified for Category 6 Electrical Performance.
7. UL Listed for Fire Safety.
8. ISO 9001 Certified Manufacturer.

## 2.6 LABELING

- A. Provide machine printed labels for all cables and outlets, etc., in accordance with ANSI/TIA/EIA-606-A. Provide labeling nomenclature in accordance with information on the Drawings or Owner's labeling conventions. Submit labeling samples for all required applications.

- B. Machine Printed Label Requirements:
  - 1. PC Compatible.
  - 2. Can save and modify files.
  - 3. Fully integrated with AutoCAD.
  - 4. Editable Fonts and Sizes.
  - 5. Rotate Text and Objects.
  - 6. Vary Line Spacing.
  - 7. Ability to import graphical images.
  - 8. Capable for customization of layout.
  - 9. Re-positional labels.
- C. Basis of Design:
  - 1. Brady Electrical/Datacomm Worldwide (latest version of LabelMark).
  - 2. Cable Management Software International (latest version of docIT).
  - 3. Approved alternate.

## 2.7 UNSPECIFIED EQUIPMENT AND MATERIAL

- A. Any item of equipment or material not specifically addressed on the Drawings or in this document and required to provide a complete and functional TDS installation shall be provided in a level of quality consistent with other specified items.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Provide, connect and test all equipment and materials for the systems herein specified and shown on the Drawings. All wiring shall be neatly tied or laced in cabinets and terminated on terminal strips provided for the purpose. Each cable shall be identified by an approved marking system at each end.
- B. Outlet/Jacks shall be identified with machine printed labels. Hand lettered labels shall not be used.
- C. Provide full set of snap-in icons for workstation outlets for use by Owner to mark jacks for analog and digital telephones as two unique classes of data. Store icons in clear plastic bags in each IDF/MDF.
- D. Wherever materials, methods or placements of materials and equipment for the communications work is provided by other Subcontractors or the Owner, it shall be the responsibility of this specialty Subcontractor to coordinate that work and assure that it is provided in such a manner as to enhance the final system operation.
- E. Test the systems, demonstrate operation to the Contracting Agency and provide training as specified.
- F. Work under this section shall be closely coordinated with work under other sections of the project.



### 3.2 CODES AND PERMITS

- A. Apply and pay for all fees, permits, and obtain serving utility and governmental approvals.
- B. Coordinate all work with the serving utility.
- C. Raceway fill requirements for communications systems shall be in accordance with ANSI/TIA/EIA-569-A and BICSI.
- D. NEC bending radius of all communications ducts, raceways, cabletrays, etc., shall be increased to not less than the installed cable manufacturer's recommendations, and the applicable ANSI and BICSI Standards.
- E. Communications work shall be in complete accordance with the following:
  - 1. National Electrical Code (NEC), latest legally enacted edition.
  - 2. Regulations of the State Fire Marshal.
  - 3. National Fire Protection Association (NFPA) Codes.
  - 4. All state, county and local codes and ordinances.

### 3.3 DELIVERY AND STORAGE

- A. Materials and Equipment shall be stored with protection from mechanical damage, weather, humidity and temperature variation, dirt and dust, and other contaminants.
- B. Materials shall be inspected and inventoried promptly upon receipt.
- C. Cables shall be tested immediately upon receipt and received or rejected and returned based upon testing or visual inspection.
- D. Report and record all serial numbers received and/or rejected.
- E. All inspection and testing shall be performed under the observation of the Contracting Agency at the Contracting Agency's option. Provide three (3) working days advance notice of tests.
- F. Keep up to date "As-built" record drawings at each job site detailing the layout of all data racks and telephone, data and trunk terminations, including a typed listing of cables/rooms served by each terminal block and patch panel. Refer to Section 26 0000 - Electrical General Requirements for other Record Document requirements.

### 3.4 CABLE INSTALLATION

- A. If cable dimensions shown are exceeded, all cable pathways and supports shall be resized to maintain the original fill ratios based on the dimensions shown.
- B. Follow cable manufacturer's specification regarding handling methods, retaining/support methods, bending radius and maximum pulling tension limitations.
- C. Telecommunication cables shall not be installed in the same raceway as power cables.

- D. Cables shall be installed in a neat and orderly manner and shall not cross or interlace other cables except at breakout points.
- E. Cables in vertical trays shall be individually retained with straps at a maximum of 6 feet on center.
- F. Tie wraps shall not deform the cable insulation when tightened.
- G. All cables shall be routed to minimize EMI and RFI interference. All cable shall be routed according to the following table. Spacings are minimum for all Category 3 and higher cable.

Minimum Separation of Telecommunications pathways from 480 volt or less power lines
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Condition	<2 kVA	2-5 kVA	>5 kVA
Unshielded power lines or electrical equipment in proximity to telecommunications open or nonmetal pathways.	5 in	12 in	24 in
Unshielded power lines or electrical equipment in proximity to telecommunications grounded metal conduit pathways	2.5 in	6 in	12 in
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a telecommunications grounded metal conduit pathway	N/A	3 in	6 in
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to telecommunications open or nonmetal pathways.	2.5 in	6 in	12 in
Mechanical ductwork, metal floors and other metallic planes to telecommunications open or nonmetal pathways.	2 in		
Mechanical ductwork, metal floors and other metallic planes to telecommunications open or grounded metal conduit pathways.	0 in		
Fluorescent or HID lighting fixtures	5 in	5 in	5 in



### 3.5 DAMAGE AND DEFECTS

- A. Use a tension monitoring device to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded. Provide replacement cable if cable manufacturer's maximum pulling tension is exceeded at any time during a pull.
- B. Cable shall be carefully inspected for sheath defects or other irregularities as it is paid out from the reel. When defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Contracting Agency. A system of communications shall be maintained between pulling and feed locations so that pulling can be stopped instantly, when required.
- C. Cable shall be hand guided through intermediate manholes and into the next duct section when making pull-throughs. Proper rigging shall be used in the intermediate manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Cables in pull-through manholes shall be set up and racked before the cable ends in adjacent manholes are set up and racked.
- D. Cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately shall be tied in fixed positions to prevent damage to the cables and provide adequate working space.
- E. Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

### 3.6 CABLE SUPPORTS

- A. Mount J-hooks on appropriate mounting hardware suitable for the specific application. Mount securely to the building structure. Maximum support spacing shall be 4 feet on center.
- B. Coordinate the layout of cableways with all other trades. Report conflicts to Contracting Agency for resolution by the Contracting Agency.

### 3.7 TERMINATION MODULES

- A. Layout telephone and data terminal blocks as indicated on drawings with spacing as recommended by manufacturer.
- B. Ground all metal back frames with #6 insulated copper to the Chassis Ground System (CGS). Use Cool Amp bolted connections or Cadweld connections.

### 3.8 CROSS-CONNECTIONS

- A. Cross-Connections at and/or between all terminal hardware shall be provided to form a complete and functioning system.

- B. Patch Cords shall be used to make all Cross-Connections.
- C. Cross-Connections from Terminal Modules color coded White to Terminal Modules color coded Blue shall be 4-pair wide and serve a single jack or termination in the horizontal distribution.

### 3.9 INTERCONNECTIONS

- A. Interconnections at all terminal hardware shall be provided to form a complete and functioning system.
- B. Equipment cables shall be interconnected to horizontal cabling on Termination Modules color coded blue.

### 3.10 TERMINATIONS

- A. Cables shall be marked with wire markers at both ends, and terminals on terminal blocks or patch panels shall bear the cable number. Trunk cables shall be neatly marked with "From-To" information.
- B. Wire twist shall be maintained to within 0.25 inch of the termination.

### 3.11 TERMINATION MODULES

- A. Install per manufacturer's recommendations.
- B. Protection modules shall conform to NEC 800-30 and be installed per manufacturer's recommendations.

### 3.12 COMPLETION AND TESTING

- A. Telecommunications System test reports shall be submitted to and approved by the Contracting Agency. The test reports shall certify that the Telecommunications Distribution System is complete, passes all test criteria, is fully operational, and that all work has been witnessed as specified.
- B. After installation and test of each system is complete, each system and the entire system shall be demonstrated and tested for proper operation. The Contractor shall schedule a demonstration with the following representatives present:
  - 1. Contractor's representative.
  - 2. Manufacturer's representative for each major communications subsystem.
  - 3. Contracting Agency's representative.
- C. The Contractor shall provide all forms, instrumentation and test equipment, loads, and other consumables required to demonstrate the systems to the Contracting Agency's satisfaction.
- D. Incoming Inspection Tests:
  - 1. Inspect all materials for damage.
- E. Patch Cord Testing:

1. All patch cords shall be tested and shown to comply with the applicable Category cord requirements of TIA/EIA-568B.
2. Compliance shall be proven by testing patch cords alone (i.e., not by inserting the patch cords into a channel).
3. Cord performance shall be measured on-site by either using either the TIA method delineated in Annex J or by using a cord-test adapter and a hand-held LAN cable tester. Cord compliance may be demonstrated by actual test reports supplied by the patch cord manufacturer.

F. Final Inspection Tests:

1. Testing of all copper wiring shall be performed prior to system acceptance. 100 percent of the horizontal and riser wiring pairs shall be tested. Link testing of all copper cabling shall be performed. Complete, end to end test results shall be submitted to the Contracting Agency.
  - a. Category 6 cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B.2, Category 6. Testing shall be done with a ANSI/TIA/EIA 568-B ETL verified Level II-E test set, with accuracy per Proposed TIA Level III standards.
    - 1). Test shall include all requirements of ANSI/TIA/EIA 568-B, including wiremap, length, characteristic impedance, insertion loss, ambient and impulse noise, NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT, return loss, ACR, PSACR, Propagation Delay and Delay Skew.
    - 2). Supported test frequency shall be 1-350 MHz to provide re-certification capability beyond Category 6 requirements.
    - 3). "Full Plot" storage shall store entire test, and be capable of uploading saved data and re-characterizing cables against new or evolving performance standards. Testers only saving worst case data are not acceptable. Test data shall be saved and provided to the Owner in neatly bound hardcopy and electronic format compatible with ScopeData Pro® software. Provide a copy of the software with the data.
    - 4). Reports shall be graphic, showing test results plotted against standards. Reports shall include a pass/fail summary of all network types specified.
    - 5). Any cables not meeting the requirements of the standard shall be brought into compliance at no charge to the Owner.
    - 6). Tester shall be equal to Agilent Technologies (HP) WireScope 350, Fluke DSP-4000, or IDEAL LANTEK 6P.
3. Test all cable with an approved cable tester in the presence of the Contracting Agency, at the Contracting Agency's option. Provide three (3) working days advance notice of tests. Record cable numbers on data test reports. Submit reports to Contracting Agency.
4. Test all cables from both ends.
5. Re-test all cable disturbed after testing, at the direction of Contracting Agency.
6. Spare unterminated cable shall be temporarily terminated for testing.

G. Replace all rejected materials.

H. Test AC grounds and voltages in equipment racks.

1. Record voltage at equipment rack power source both at no load and at 15 Amp resistive load.

### 3.13 OPERATING AND MAINTENANCE MANUALS

- A. Prepare manuals describing the servicing and maintenance requirements for the equipment being provided as required in this Section of these specifications.
- B. Information contained in the manuals shall consist of catalog data on each item, together with parts lists, wiring diagrams, test reports, description of routine maintenance required, suggested frequency of maintenance and recommended practices, and shall be 8-1/2 inches by 11 inches in size. Catalog pages and data in manuals shall be neat, clean copies. Drawings shall be accordion folded to above size. An index shall be provided which shall list all contents in an orderly manner. Include corrected shop drawings in the maintenance manuals. Each copy of the instruction manual shall be adequately labeled for identification and shall include plastic tabs coordinated with the index.
- C. Provide "Step-by-step" instructions for interpreting and utilizing the cable, outlet, jack and equipment identification system, including instruction for use of jack icons.
- D. Refer to "Submittals" requirements of this Section for additional O&M requirements.

### 3.14 INSTRUCTION AND TRAINING

- A. Provide detailed instructions to the Owner on how to obtain warranty service under the Special Warranty.

END OF SECTION 27 2010

## SECTION 31 2300 – EXCAVATION AND FILL

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. The Contractor shall provide all equipment, materials, labor to excavate and backfill piping between the cooling water well and the building as well as construct curb, concrete and asphalt sidewalks.
- B. Related Sections
  - 1. 33 1416 Site Water Utility Piping
- C. Existing Utilities
  - 1. The Contractor shall obtain utility locates prior to excavation and prevent damage to utilities within or adjacent to the project.
  - 2. The Contractor shall promptly notify the Engineer in the event of accidental interruption of utility service and cooperate with the Utility and the Engineer until service is restored. Protect the safety of workers and the public when performing work involving or near utilities.
- D. Testing
  - 1. The Contractor shall provide soil testing and inspection service by an independent geotechnical-civil engineering firm experienced in performing soil analysis. The testing firm shall be approved by code enforcement authorities and the Owner prior to commencing work.
  - 2. The testing firm shall inspect and report on imported fill material, backfill compaction, and existing bearing soil for compliance with the Drawings and Specifications.
- E. Environmental Requirements
  - 1. Do no earthwork when outside temperature is, or is expected to be below 35 degrees F.
  - 2. Do not place frozen fill materials.
- F. Protection
  - 1. Protect existing structures, sidewalks, paving, and curbs from equipment and vehicular traffic by timber cribbing, screens or other appropriate shielding.
  - 2. Protect above and below grade utilities which are to remain.
  - 3. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
  - 4. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.

## PART 2 - PRODUCTS

### 2.1 EXISTING SOILS ON SITE

- A. All pavement soils are to be over-excavated, inspected, and replaced with Type IIA Classified Fill, Type III Classified Fill and/or Leveling Course meeting the requirements of 2.3 of this Section, unless, upon inspection more excavation is required.
- B. Excavated inorganic subsoil materials may be used for non-structural fill in areas which require grading if it meets the requirements of Classified Fill Type III.

### 2.2 DELETERIOUS SUBSTANCES

- A. Substances such as sod, organic water, peat, wood chips, frozen material or construction debris will not be allowed in fill material.

### 2.3 TYPE IIA CLASSIFIED FILL, TYPE III CLASSIFIED FILL AND LEVELING COURSE

- A. Used in trench section, beneath concrete and asphalt paving.
  - 1. Shall comply with sections 20.21 and 20.22 of M.A.S.S.

### 2.4 BEDDING MATERIAL

- A. Used to bed utility pipes.
  - 1. Shall comply with section 20.16 of M.A.S.S.

## PART 3 - EXECUTION

### 3.1 EXAMINATION OF SITE

- A. Examine site surfaces and elevations, subsurface soils report, existing site survey and details on Drawings for defects that will adversely affect the work.
- B. Start of work shall mean acceptance of existing conditions as capable of producing an acceptable job.

### 3.2 EXCAVATION

- A. Conform to dimensions shown on the Drawings and as specified. Remove any loose and protruding rock over four inches from edges of excavation.

- B. Do not disturb bottom of excavation which receives building foundation or pipes. Smooth and compact as required to lines and grades indicated.

### 3.3 PLACING FILL

- A. Prior to fill or footing placement, proof-roll excavated subgrades to identify any soft or loose zones. Over-excavate and replace with compacted subgrade fill until firm, unyielding subgrade is produced.
- B. Place and compact fill horizontal layers not more than 12 inches loose depth (four inches if hand compacted).
- C. Moisture condition by adding water or drying as necessary for compaction.

### 3.4 COMPACTION

- A. Compact fill to required density with mechanical tampers of heavy vibrator type where possible.
- B. Compact to not less than the following percentages of maximum dry density (relative compaction) for material which exhibits a well-defined moisture density relationship determined in accordance with ASTM D1557-78.

<u>Location</u>	<u>ASTM D1557</u>
Areas to be paved	95 percent
Areas to be landscaped	95 percent

END OF SECTION 31 2300

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## SECTION 33 1113 – WATER SUPPLY WELL

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. The Contractor shall provide all equipment, materials, labor to construct a cooling water well, perform well logging and pump testing required
- B. Related Sections
  - 1. 33 1416 Site Water Utility Piping
  - 2. 25 4000 Variable Speed Drive
- C. Standards
  - 1. ANSI/AWWA A100-06 (Revision of ANSI/AWWA A100-97); effective date August 1, 2006.
- D. Desired Production Rates
  - 1. Cooling Water Well (6" diameter) - Supply 200 gpm
- E. Submittals
  - 1. The Contractor shall submit one digital copy (in PDF format) for each of the following items prior to commencement of construction. A resubmittal shall be required for all unapproved submittals. Construction shall not begin until all submittals are received and approved.
    - a) Well casing
    - b) Well screens
    - c) Grouting and sealing materials
    - d) Proposed screen to casing joint type.
    - e) Proposed screen to screen joint type.
    - f) Soils sampling plans (frequency and size of samples).
    - g) A plan for well development and pump testing. Describe methods to be used, and submit data sheets for measuring devices (water flowrate, well water levels, sand measurement, equipment to be used for flow control, etc.)
    - h) Test pump data, including pump curves.
    - i) Headloss calculations for test pumping systems.
    - j) Piping plan for delivering pump test discharge water to the designated discharge point, including pipe materials and sizes.
    - k) Work schedule.
    - l) Driller's Log
    - m) Well development records
    - n) Plan for achieving the required plumbness and alignment

## PART 2 - PRODUCTS

## 2.1 WELL CASING

- A. All casing materials shall be new single-ply carbon steel and shall conform to one of the manufacturing standards lined in ANSI/AWWA A100-06 Table 2.A., Manufacturing Standards for single-ply carbon-steel well casing. Manufacturer's certification of materials shall be provided by the Contractor.
- B. Minimum casing thickness shall be 0.25 inches.

## 2.2 SCREENS

- A. Schedule for Screen Selection
  - 1. Screens shall be selected after:
    - a. Well logging has been complete.
    - b. After aquifer and gravel-pack sieve analyses have been completed and submitted to the screen manufacturer.
- B. Screen Location:
  - 1. Screens segments will be located at intervals along the well casing; the length and location of each segment shall be as determined by well log report.
- C. Sieve Analyses for Screen Design:
  - 1. Sieve analyses provided by the Owner.
  - 2. Sieve analyses shall be performed for aquifer samples taken from water bearing layers, where screens will be installed.
  - 3. The sieve analyses shall be provided to the screen manufacturer for selection of the screen aperture size.
- D. Screen Aperture Size: Selected per ANSI/AWWA A100-06, 4.5.5 Screen Aperture Size.
- E. Screen Length: Final screen segment lengths shall be sized based on the screen aperture size and the specified screen entrance velocities. The maximum screen entrance velocity shall be 0.1 feet per second.
- F. Screen Sump:
  - 1. Provide a 2-foot screen sump.
  - 2. The sump materials shall be the same as the screens and shall be joined to the screen by a threaded coupling.
- G. Bottom of Screen Seal

1. The bottom of the screen seal shall be a threaded, or welded steel plate constructed of the same materials as for the well screen or screen sump, as applicable.
2. Optionally, the Contractor may use a self-closing valve, if required to remove mud in the bottom of the well. The valve shall be covered by a cement plug as least 1.0 feet in depth, once removal of mud is complete.

H. Screen Construction, Materials, Manufacturer

1. Screens shall be manufactured by Johnson Screens, or approved alternative.
2. Screen materials shall be 304 stainless steel.
3. Screen type shall be rod-based wire-wound continuous-slot screens per ANSI/AWWA 4.5.7.2.
4. Screen strength: Screens shall be designed for the well depth and method of installation. The Contractor shall coordinate screen design with the screen manufacturer.

## 2.3 GROUTING AND SEALING MATERIALS

- A. Grouting and sealing materials shall be per the Alaska Department of Environmental Conservation (ADEC) requirements (refer to 80 AAC 80.015).

## 2.4 PUMP AND INSTRUMENTATION

- A. The pump shall be compatible for use with the Variable Speed Drive referenced in section 25 40 00.
- B. The pump shall be valved to accept drainback of cooling water from the building to the well.
- C. The cooling well shall be equipped with the proper instrumentation to continuously monitor source water levels and temperature. The instrument shall be compatible with and connected to UAA's centralized electronic monitoring system. Data is to be recorded in standard increments, a minimum of every 15 minutes, when the cooling system is operating.

## PART 3 - EXECUTION

### 3.1 WELL DEPTH

- A. Well depth shall be sufficient to meet the requirements of this specification.

### 3.2 DRILLING METHOD

- A. The method of drilling shall be by rotary drill using air to maintain the borehole.

- B. The well casing shall be installed concurrently with the drilling of the hole. Once the well hole is complete, the casing shall be withdrawn.
- C. The drill head shall be retrieved from the drill casing.

### 3.3 AQUIFER SAMPLING AND SIEVE ANALYSES

- A. Sampling is the responsibility of the Contractor.
- B. Samples shall be taken from the boring using a 2.5-inch inside diameter split spoon casing. All samples shall be taken from undisturbed soil.
- C. Formation samples shall be taken below 100 feet at maximum intervals of 20 ft, and at each change in formation. Particular care shall be taken when collecting samples from expected water producing zones.
- D. Sieve analyses (by Owners Representative) shall be performed for all samples taken at, or within, the bottom 50 feet of hole. Sieve analyses shall provide sufficient information to allow for the screen aperture size determination per ANSI/AWWA A100-06, 4.5.5 Screen Aperture Size. Sufficient screens shall be utilized to cover the sand particle sizes (coarse through very fine) such that the D10, D60, and uniformity coefficient of the sand portion of the samples can be accurately calculated.

### 3.4 PLUMBNESS AND ALIGNMENT

- A. Well Casing shall be constructed such that a submersible pump and pump discharge piping can be freely installed in, and removed from, the well; and such that the well casing and screen can be installed without damage to either of these components.

### 3.5 CASING AND SCREEN INSTALLATION

- A. The method of well casing and screen installation shall be at the option of the Contractor, provided the installation meets with the plumbness and alignment requirements, and the installation process does not alter the shape, size, configuration or strength of the casing or screens.
- B. Casing joints shall be welded, or threaded and coupled, per ANSI/AWWA A100-06, Section 4.7, Table 6.
- C. Screen to casing joints shall be welded or threaded and coupled, as recommended by the screen manufacturer.
- D. Screen segment to screen segment joints shall be welded or threaded and coupled, as recommended by the screen manufacturer.

### 3.6 GROUTING AND SEALING

- A. Furnish and install a temporary outer surface casing to a minimum depth of 20 feet. The casing may be withdrawn as the grout is placed.
- B. The well shall be sealed by a continuous seal between the depths of 10 to 20 feet below ground level.
- C. The annular space which shall be grouted around the casing shall be not less than 3 inches in radial thickness, or 6 inches in net diametrical difference.

### 3.7 WELL SITE REQUIREMENTS

- A. At all times during the work the Contractor shall use reasonable precaution to prevent either tampering with the well, or the entrance of foreign material or surface water into the well.
- B. On completion of the well the Contractor shall install a suitable threaded, flanged, or compression fitting seal at the top of the casing.
- C. The top of the casing shall terminate at least two feet above the finished ground level.
- D. For a distance of at least 10 feet in all directions around the well, the surface must be sloped or contoured to slope away from the well.
- E. For a distance of at least 2 feet in all directions around the well, the surface must be sloped or contoured to slope away from the well and impervious.

### 3.8 WELL DEVELOPMENT

- A. The preliminary method(s) of development of the wells shall be at the Contractor's option, but shall be a commonly used technique(s). Following the use of one or more preliminary methods, a well pump shall be used for final development and testing.
- B. The pump and prime mover shall have a capacity in excess of the required total dynamic head (TDH) at the final production capacity of the well. The Contractor shall provide headloss calculations to include all piping, fittings, valves, etc. from the pump to the designated discharge point.
- C. The well shall be developed so that it will produce the specified final production capacities.
- D. The development equipment used shall permit variable pumping discharge rates.
- E. The Contractor shall furnish and install all discharge piping. The discharge piping provided shall be of sufficient length to conduct required water flowrates to a discharge point designated in the construction documents, and shall include orifices, or other devices that will accurately measure the discharge rate. The discharge piping shall also include a valve, or other appropriate device, that will vary the discharge rate. The flow measurement device to measure pump discharge rate shall have a minimum accuracy of

- 95%.
- F. Development Records
1. The following data shall be recorded in the work record:
    - a. Static water levels
    - b. Pumping water levels
    - c. Recovery rate data
    - d. Methods of measurement
    - e. Duration of each operation
    - f. Observation of results
    - g. Sand content as a function of discharge rate and time
    - h. A description of materials and equipment used for pumping and measurement.
    - i. All other pertinent information
- G. Pump Testing
1. A step-drawdown test shall be conducted. The well shall be pumped at a minimum of at least three progressively increasing rates, and the time length of each step shall be long enough to indicate a straight-line trend on a plot of drawdown versus logarithm of time since pumping began.
  2. Following the step-drawdown test, a 24 hour constant-rate test shall be conducted. Prior to the constant-rate test the well shall be allowed to recover to approximately static conditions. Following recovery the constant-rate flow test shall be conducted at the specified production capacity. The well shall be pumped at a constant rate until a straight-line trend is observed on a plot of water level versus the logarithm of time since pumping began.
  3. Recovery time of the pumping well and any observation wells to be used in the test shall be such that a straight-line trend is observed in all of the wells on a plot of water level versus the logarithm of time since pumping stopped.
  4. Water level measurement shall be obtained before, during and after each step of the step-drawdown test; and before, during and after the constant-rate test. The measurement frequency shall adequately define the drawdown trend and the recovery trend.
  5. Measurement of water level shall be by Air-Line Method or Electric-Sounder Method per ANSI/AWWA A100-06, Appendix E, Well Development; or an approved alternative.
  6. Measure of sand content shall be per ANSI/AWWA A100-06, Appendix E, Well Development. Sand content shall average not more than 5 mg/L for a complete pumping cycle of 2-hr duration, when pumping at the final production capacity of the well.

### 3.9 AQUIFER EVALUATION

#### A. General

1. The Contractor shall provide a hydrogeologist/ground water professional to perform well logging of the test well, supervise and gather data from well pump test, evaluate well pump test results, and evaluate aquifer impacts. The hydrogeologist must be familiar with subsurface conditions at the project site.
2. The hydrogeologist must be capable of evaluating potential impacts to surrounding water users from the use of the logged well. The hydrogeologist must be capable of determining an aquifer type from a single well test. This means differentiating between a confined aquifer with aquitard leakage, a confined aquifer with storage within the aquitard, a confined aquifer without aquitard storage, and an aquifer displaying well bore storage.
3. The hydrogeologist shall submit a plan for the data logging procedure, including a list of the logs to be provided.
4. The hydrogeologist shall submit a plan for the well pump test. At minimum, pump testing shall meet the requirement of 3.08.G Pump Testing of this specification.
5. The hydrogeologist shall interpret the pump tests and provide an evaluation of the aquifer properties, including the aquifer capacity.
6. The work shall be performed by Terrasat, Inc. (Dan Young, 344-9370), or an approved alternate with equivalent experience.

#### B. Well Logging

1. The hydrogeologist must have local experience with well logging techniques to at least 150 feet deep.
2. The hydrogeologist shall complete the following work for the well:
  - a. Provide a lithologic log for each well
  - b. Identify aquifers encountered
  - c. Identify aquitards
  - d. Predict aquifer yields for each aquifer from the well logs
  - e. Identify optimum zones within the aquifers for well screen placement.
  - f. The hydrogeologist shall provide a report for the wells logged. The report must contain each log for a single well on one figure with interpretations of the aquifers and their properties based on geophysical logging, including expected aquifer yield. Lithologic descriptions must be provided with each well log. Optimum screen locations must be shown and described.

### 3.10 DRILLER'S LOG

- A. During drilling and completion of the well, the Contractor shall maintain a complete log setting forth items required by ADEC regulations (refer to 18 AAC 80.210 (h)). The well log shall contain the follow information:
1. Method of construction
  2. Location of the well
  3. Accurate log of the soil and rock formations encountered and the depth at which the formations occur
  4. Depth of the casing
  5. Height of the casing above ground
  6. Depth and type of grouting

7. Depth of any screens
8. Casing diameter
9. Casing material
10. Depth of perforation or opening in the casing
11. Well development method
12. Total depth of the well
13. Depth of static water level
14. Anticipated use of the well
15. Maximum well yield
16. Results of any well yield, aquifer, or drawdown test that was conducted
17. Depth of pump intake and pump performance data, if a pump is installed at the time of construction.

### 3.11 COORDINATION WITH OWNER'S REPRESENTATIVE

- A. The Owner's representative will perform the following work:
  1. Survey staking of hole location in field.
  2. Collect soil samples, perform sieve testing and analysis.
  3. Review data logging
  4. Logging results of the well.
  5. Coordinate with the Contractor to develop a pump testing program.
  6. Review and approval of required submittals.

### 3.12 CONSTRUCTION SCHEDULE

- A. Well screens shall not be ordered or be installed until the following has been completed, on a well-by-well basis:
  1. Data logging and the associated report have been completed and discussed with the Owner.
  2. Sieve analyses of aquifer samples have been completed.
  3. Sieve analyses, screen depths, and any other pertinent information has been provided to the screen manufacturer.
  4. The screen submittal has been reviewed and approved by the Engineer.

END OF SECTION 33 1113



## SECTION 33 1416 – SITE WATER UTILITY PIPING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. The Contractor shall provide all equipment, materials, labor to construct piping between the cooling water well and the building.
- B. Related Sections
  - 1. 31 1113 Water Supply Well
  - 2. 31 2300 Excavation and Fill
- C. Standards
  - 1. AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In., for Water Distribution and Transmission
  - 2. ASTM D3261 Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
  - 3. ASTM D3035 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
  - 4. ASTM D3350 Specification for Polyethylene Plastic Pipe and Fittings Materials
- D. Submittals
  - 1. The Contractor shall submit one digital copy (in PDF format) for each of the following items prior to commencement of construction. A resubmittal shall be required for all unapproved submittals. Construction shall not begin until all submittals are received and approved.
    - a) Pipe, fittings, joints and couplings
- E. Delivery and Storage
  - 1. Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground.
- F. Handling
  - 1. Handle pipe, fittings, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging.

## PART 2 - PRODUCTS

### 2.1 PE PIPE

- A. High Density Polyethylene Pipe (HDPE) and fittings are to be manufactured in accordance with AWWA C906 with the additional stipulation that the HDPE is to be manufactured from PE4710 polyethylene compounds that meet or exceed ASTM D3350 Cell Classification 445574. HDPE pipe and fitting material compound is to contain color and ultraviolet (UV) stabilizer meeting or exceeding the requirements of ASTM D3350. Electrofusion fittings will not be allowed. All fittings are to have pressure class ratings not less than the pressure class rating of the pipe to which they are joined. The pipe is to be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It is to be uniform in color, opacity, density and other physical properties. Butt fusion of the pipe and fittings is to be performed in accordance with the pipe manufacturer's recommendations as to equipment and technique. The fusion operation is to be performed by an individual who has demonstrated the ability to fuse polyethylene pipe in the manner recommended by the pipe supplier

### 2.2 JOINTS AND JOINING MATERIALS

- A. Mechanical Joint: Mechanical joint adapter and gaskets for mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11.

## PART 3 - EXECUTION

### 3.1 EXAMINATION OF SITE

- A. Examine site surfaces, subsurface soils report, existing site survey and details on Drawings for defects that will adversely affect the work.
- B. Start of work shall mean acceptance of existing conditions as capable of producing an acceptable job.

### 3.2 TRENCHING AND BACKFILL

- A. Trenching and backfill shall be per 31 23 00 Excavation and Fill.

### 3.3 INSTALLATION

- A. Install pipe and fittings according to these Specifications or the manufacturer's recommendations. Lay conduit to the grades and lines shown on the Plans.

- B. Bedding: The pipe shall be bedded with non-frost susceptible material, with a fine granular texture and containing no material larger than one-half inch (1/2"). The bedding shall be placed the full extent of trench and six inches (6") above the pipe

### 3.4 TESTING

A. Water Service Line Testing

1. Test all water main and service connection work for both pressure and leakage after laying. Leave pipe joints fully exposed. Place only enough backfill between joints to hold the pipe in place during testing. Fill all lines with water and eliminate all air. Open corporation stops after successful tests. Conduct all tests with the Engineer present.
2. Contractor shall furnish all testing equipment, labor, materials, and supplies. The Engineer has the right to test and approve all gauges used.
3. Use test pressure equal to the strength classification of the pipe. Use either pneumatic or hydraulic pressure. Maintain pressure on the tested portion for at least 2 hours. Allowable leakage during the test must not exceed the amount established by the AWWA. If visible leakage other than minor sweating occurs, immediately stop the test and tighten the joint to eliminate leakage when pressure is resumed. Replace leaking fittings, nipples, or lengths of conduit. Do not caulk or use paints, asphalts, enamels or other types of compounds to eliminate leaks.

END OF SECTION 33 1416

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# **APPENDIX A**

## **Asbestos Bulk Sample Field Survey Data Sheets and Laboratory Reports**

Field Data Sheets and Laboratory Reports  
Not Included to Save Paper,

Refer to Summarized Results in this Report

Reports Are Available for Review,  
Or Electronically Through the UAA Offices

## **APPENDIX B**

### **Dust Sampling for Asbestos Field Survey Data Sheets and Laboratory Reports**

Field Data Sheets and Laboratory Reports  
Not Included to Save Paper,

Refer to Summarized Results in this Report

Reports Are Available for Review,  
Or Electronically Through the UAA Offices



## **APPENDIX C**

### **Lead Analyzer Test Results**

**XRF LEAD TESTING SUMMARY**

Index	SITE	INSPECTOR	FLOOR	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	Duration	Time	Depth Index	RESULTS		
												LBP	PbC	PbC Error
1	UAA Science Bldg.	LOTTON	-	-	ShutterCal	-	-	-	78.28	1/8/2009 11:32			5.43	0
2	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.18	1/8/2009 11:35	1.08	Positive	1	0.1
3	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.42	1/8/2009 11:36	1.1	Positive	1.1	0.1
4	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.22	1/8/2009 11:37	1.08	Positive	1	0.1
5	UAA Science Bldg.	LOTTON	FIRST	119	COLUMN	METAL	WHITE	INTACT	20.44	1/8/2009 11:41	2.27	Negative	0	0.02
6	UAA Science Bldg.	LOTTON	FIRST	119	COLUMN	METAL	BROWN	INTACT	3.55	1/8/2009 11:42	1	Negative	0.02	0.02
7	UAA Science Bldg.	LOTTON	FIRST	119	COLUMN	METAL	BROWN	INTACT	20.16	1/8/2009 11:43	1.15	Negative	0.02	0.02
8	UAA Science Bldg.	LOTTON	FIRST	119	fume hood	METAL	cream	INTACT	21.57	1/8/2009 11:46	3.88	Negative	0.01	0.02
9	UAA Science Bldg.	LOTTON	FIRST	121	WALL	DRYWALL	WHITE	INTACT	20.22	1/8/2009 11:49	2.94	Negative	0.6	0.1
10	UAA Science Bldg.	LOTTON	FIRST	121	WALL	DRYWALL	WHITE	INTACT	20.38	1/8/2009 11:50	1.45	Negative	0	0.02
11	UAA Science Bldg.	LOTTON	FIRST	121	COLUMN	METAL	BROWN	INTACT	6.55	1/8/2009 11:51	1.29	Negative	0.07	0.02
12	UAA Science Bldg.	LOTTON	FIRST	123	fume hood	METAL	cream	INTACT	20.27	1/8/2009 11:54	1	Negative	0	0.02
13	UAA Science Bldg.	LOTTON	FIRST	123	CABINET	METAL	cream	INTACT	15.6	1/8/2009 11:56	1	Negative	0	0.02
14	UAA Science Bldg.	LOTTON	FIRST	125	CABINET	METAL	cream	INTACT	20.14	1/8/2009 11:58	1	Negative	0	0.02
15	UAA Science Bldg.	LOTTON	FIRST	125	DOORCASING	METAL	BROWN	INTACT	20.43	1/8/2009 12:00	1	Negative	0	0.02
16	UAA Science Bldg.	LOTTON	FIRST	127	ELEC PANEL	METAL	GRAY	INTACT	20.43	1/8/2009 12:02	1	Negative	0	0.02
17	UAA Science Bldg.	LOTTON	FIRST	128A	WALL	DRYWALL	cream	INTACT	20.44	1/8/2009 12:05	1.63	Negative	0	0.02
18	UAA Science Bldg.	LOTTON	FIRST	128C	DOORCASING	METAL	BLACK	INTACT	20.47	1/8/2009 12:07	1	Negative	0	0.02
19	UAA Science Bldg.	LOTTON	FIRST	128	DOORCASING	METAL	cream	INTACT	20.24	1/8/2009 12:09	1	Negative	0	0.02
20	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID
21	UAA Science Bldg.	LOTTON	FIRST	128	chalk board	METAL	BEIGE	INTACT	20.49	1/8/2009 12:11	1.54	Negative	0.08	0.02
22	UAA Science Bldg.	LOTTON	FIRST	128	WINDOW CASING	METAL	BROWN	INTACT	17.96	1/8/2009 12:13	1.62	Negative	0	0.02
23	UAA Science Bldg.	LOTTON	FIRST	122	DOORCASING	METAL	BLACK	INTACT	20.22	1/8/2009 12:15	1	Negative	0	0.02
24	UAA Science Bldg.	LOTTON	FIRST	122	WINDOW CASING	METAL	BLACK	INTACT	20.4	1/8/2009 12:17	1.37	Negative	0	0.02
25	UAA Science Bldg.	LOTTON	FIRST	122A	WALL	DRYWALL	cream	INTACT	20.12	1/8/2009 12:19	2.13	Negative	0	0.02
26	UAA Science Bldg.	LOTTON	FIRST	122C	DOORCASING	METAL	BLACK	INTACT	20.48	1/8/2009 12:22	1	Negative	0	0.02
27	UAA Science Bldg.	LOTTON	FIRST	100M1	FLOOR	CERAMIC	cream	INTACT	12.83	1/8/2009 12:31	3.6	Negative	0.02	0.02
28	UAA Science Bldg.	LOTTON	FIRST	100M1	DOOR	METAL	BLUE	INTACT	13.32	1/8/2009 12:33	1	Negative	0	0.02
29	UAA Science Bldg.	LOTTON	FIRST	100M1	WALL	DRYWALL	WHITE	INTACT	20.16	1/8/2009 12:34	3.93	Negative	0.01	0.02
30	UAA Science Bldg.	LOTTON	FIRST	100W1	DOORCASING	METAL	cream	INTACT	20.43	1/8/2009 12:37	1.46	Negative	0.01	0.02
31	UAA Science Bldg.	LOTTON	FIRST	100V2	DOORCASING	METAL	BROWN	INTACT	19.9	1/8/2009 12:40	1.19	Negative	0.05	0.02
32	UAA Science Bldg.	LOTTON	FIRST	100V2	DOOR	METAL	BROWN	INTACT	20.13	1/8/2009 12:41	1	Negative	0	0.02
33	UAA Science Bldg.	LOTTON	FIRST	100V2	COLUMN	METAL	BROWN	INTACT	20.49	1/8/2009 12:43	1	Negative	0	0.02
34	UAA Science Bldg.	LOTTON	FIRST	100V2	DOOR	METAL	WHITE	INTACT	20.16	1/8/2009 12:44	1.19	Negative	0.01	0.02
35	UAA Science Bldg.	LOTTON	FIRST	100S3	DOOR	METAL	RED	INTACT	13.69	1/8/2009 12:45	1	Negative	0	0.02
36	UAA Science Bldg.	LOTTON	FIRST	100S3	DOORCASING	METAL	RED	INTACT	8.74	1/8/2009 12:46	1	Negative	0	0.02
37	UAA Science Bldg.	LOTTON	FIRST	124	COLUMN	METAL	BLACK	INTACT	2.45	1/8/2009 12:48	1	Negative	0	0.02
38	UAA Science Bldg.	LOTTON	FIRST	124	COLUMN	METAL	BLACK	INTACT	20.44	1/8/2009 12:49	1	Negative	0	0.02
39	UAA Science Bldg.	LOTTON	FIRST	HALLWAY	WALL	DRYWALL	WHITE	INTACT	20.25	1/8/2009 12:50	1	Negative	0	0.02
40	UAA Science Bldg.	LOTTON	FIRST	HALLWAY	WALL	DRYWALL	WHITE	INTACT	18.83	1/8/2009 12:51	1	Negative	0	0.02
41	UAA Science Bldg.	LOTTON	FIRST	120	WALL	DRYWALL	BEIGE	INTACT	20.45	1/8/2009 12:53	1.01	Negative	0.02	0.02
42	UAA Science Bldg.	LOTTON	FIRST	120	CABINET	METAL	BLUE	INTACT	21.04	1/8/2009 12:54	1.44	Negative	0.1	0.02
43	UAA Science Bldg.	LOTTON	FIRST	HALLWAY	DOORCASING	METAL	BLACK	INTACT	20.18	1/8/2009 12:56	2.57	Negative	0	0.02
44	UAA Science Bldg.	LOTTON	FIRST	100W1	WALL	CERAMIC	WHITE	INTACT	20.21	1/8/2009 12:57	4	Negative	0.02	0.02
45	UAA Science Bldg.	LOTTON	FIRST	100W1	WALL	METAL	BLUE	INTACT	3.55	1/8/2009 12:58	1	Negative	0	0.02
46	UAA Science Bldg.	LOTTON	FIRST	100W1	WALL	METAL	BLUE	INTACT	6.55	1/8/2009 12:59	1	Negative	0	0.02
47	UAA Science Bldg.	LOTTON	FIRST	119	DOOR	WOOD	VARNISH	INTACT	20.46	1/8/2009 13:01	1.4	Negative	0.01	0.02
48	UAA Science Bldg.	LOTTON	FIRST	100J1	DOOR	WOOD	VARNISH	INTACT	15.01	1/8/2009 13:02	2.11	Negative	0	0.02
49	UAA Science Bldg.	LOTTON	FIRST	ELEVATOR	DOOR elevator	METAL	WHITE	INTACT	20.18	1/8/2009 13:04	1.43	Negative	0	0.02
50	UAA Science Bldg.	LOTTON	FIRST	ELEVATOR	DOORCASING	METAL	WHITE	INTACT	20.19	1/8/2009 13:05	1.44	Negative	0	0.02

**XRF LEAD TESTING SUMMARY**

Index	SITE	INSPECTOR	FLOOR	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	Duration	Time	Depth Index	RESULTS		
												LBP	PbC	PbC Error
51	UAA Science Bldg.	LOTTON	FIRST	100V1	CABINET	METAL	RED	INTACT	20.47	1/8/2009 13:07	1	Negative	0.5	0.1
52	UAA Science Bldg.	LOTTON	FIRST	100V1	DOORCASING	METAL	GRAY	INTACT	11.21	1/8/2009 13:08	1.38	Negative	0.01	0.02
53	UAA Science Bldg.	LOTTON	FIRST	100V1	DOORCASING	METAL	RED	INTACT	20.11	1/8/2009 13:10	1	Negative	0	0.02
54	UAA Science Bldg.	LOTTON	STAIRS	100S2	RISER	METAL	ORANGE	INTACT	6.28	1/8/2009 13:11	1.33	Positive	2.7	0.2
55	UAA Science Bldg.	LOTTON	STAIRS	100S2	RISER	METAL	ORANGE	INTACT	20.1	1/8/2009 13:12	1.33	Positive	3.1	0.1
56	UAA Science Bldg.	LOTTON	STAIRS	100S2	HAND RAIL	METAL	ORANGE	INTACT	18.55	1/8/2009 13:13	1.58	Positive	2	0.1
57	UAA Science Bldg.	LOTTON	STAIRS	100S2	DOOR	METAL	GRAY	INTACT	19.89	1/8/2009 13:15	2.47	Negative	0.01	0.02
58	UAA Science Bldg.	LOTTON	SECOND	200S3	HAND RAIL	METAL	ORANGE	INTACT	20.39	1/8/2009 14:08	1.25	Negative	0.23	0.03
59	UAA Science Bldg.	LOTTON	SECOND	243	DOORCASING	METAL	BLACK	INTACT	20.3	1/8/2009 14:09	1	Negative	0	0.02
60	UAA Science Bldg.	LOTTON	SECOND	200C4	DOORCASING	METAL	BROWN	INTACT	6.53	1/8/2009 14:10	1.45	Negative	0	0.02
61	UAA Science Bldg.	LOTTON	-	-	ShutterCal	-	-	-	78.25	1/8/2009 14:24	-	-	5.57	0
62	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.25	1/8/2009 14:26	1.1	Positive	1.1	0.1
63	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.49	1/8/2009 14:27	1.11	Positive	1.1	0.1
64	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.22	1/8/2009 14:28	1.1	Positive	1.1	0.1
65	UAA Science Bldg.	LOTTON	SECOND	228	WINDOW CASING	METAL	BROWN	INTACT	6.24	1/8/2009 14:34	1.15	Negative	0	0.02
66	UAA Science Bldg.	LOTTON	SECOND	232	WALL	DRYWALL	WHITE	INTACT	8.46	1/8/2009 14:36	1	Negative	0	0.02
67	UAA Science Bldg.	LOTTON	SECOND	232	WALL	DRYWALL	WHITE	INTACT	10.06	1/8/2009 14:37	1.64	Negative	0	0.02
68	UAA Science Bldg.	LOTTON	SECOND	235	WALL corner	METAL	BLACK	INTACT	20	1/8/2009 14:41	1	Negative	0	0.02
69	UAA Science Bldg.	LOTTON	SECOND	HALLWAY	COLUMN	DRYWALL	WHITE	INTACT	20.43	1/8/2009 14:43	1.1	Negative	0	0.02
70	UAA Science Bldg.	LOTTON	SECOND	236	DOOR	WOOD	VARNISH	INTACT	19.93	1/8/2009 14:46	7.34	Negative	0.01	0.03
71	UAA Science Bldg.	LOTTON	SECOND	248	FUME HOOD	METAL	BEIGE	INTACT	20.16	1/8/2009 14:53	1	Negative	0	0.02
72	UAA Science Bldg.	LOTTON	SECOND	248	COLUMN	METAL	BROWN	INTACT	20.16	1/8/2009 14:55	1	Negative	0.03	0.02
73	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID	VOID
74	UAA Science Bldg.	LOTTON	SECOND	248	WINDOW FRAME	METAL	BROWN	INTACT	20.13	1/8/2009 14:57	2.66	Negative	0.01	0.02
75	UAA Science Bldg.	LOTTON	SECOND	248	WALL	DRYWALL	WHITE	INTACT	20.48	1/8/2009 14:59	2.47	Negative	0	0.02
76	UAA Science Bldg.	LOTTON	SECOND	200M1	DOORCASING	METAL	BLUE	INTACT	20.21	1/8/2009 15:17	1	Negative	0	0.02
77	UAA Science Bldg.	LOTTON	SECOND	248	LOCKER	METAL	BROWN	INTACT	20.01	1/8/2009 15:40	1	Negative	0.01	0.02
78	UAA Science Bldg.	LOTTON	SECOND	248	WHITE BOARD	METAL	WHITE	INTACT	20.23	1/8/2009 15:47	1	Negative	0	0.02
79	UAA Science Bldg.	LOTTON	SECOND	241	WALL	DRYWALL	WHITE	INTACT	20.45	1/8/2009 16:25	1	Negative	0	0.02
80	UAA Science Bldg.	LOTTON	SECOND	237	WALL	DRYWALL	BEIGE	INTACT	10.62	1/8/2009 16:44	1.5	Negative	0	0.02
81	UAA Science Bldg.	LOTTON	SECOND	214	CABINET LAB HOOD	METAL	BEIGE	INTACT	19.97	1/8/2009 17:02	1	Negative	0	0.02
82	UAA Science Bldg.	LOTTON	SECOND	214	WHITE BOARD	METAL	WHITE	INTACT	20.15	1/8/2009 17:05	1.93	Negative	0.06	0.02
83	UAA Science Bldg.	LOTTON	SECOND	214	COLUMN ANGLED	METAL	BROWN	INTACT	21.27	1/8/2009 17:10	1.38	Negative	0.04	0.02
84	UAA Science Bldg.	LOTTON	SECOND	200W1	DOORCASING	METAL	PURPLE	INTACT	20.23	1/8/2009 17:41	1	Negative	0.03	0.02
85	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.2	1/8/2009 17:49	1.11	Positive	1.1	0.1
86	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.49	1/8/2009 17:50	1.13	Positive	1.1	0.1
87	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.47	1/8/2009 17:50	1.08	Positive	1	0.1
88	UAA Science Bldg.	LOTTON	-	-	ShutterCal	-	-	-	78.29	1/9/2009 11:55	-	-	5.47	0
89	UAA Science Bldg.	LOTTON	-	-	ShutterCal	-	-	-	78.25	1/9/2009 12:18	-	-	5.39	0
90	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.41	1/9/2009 12:19	1.07	Positive	1	0.1
91	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.4	1/9/2009 12:20	1.08	Positive	1	0.1
92	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK	-	-	-	20.45	1/9/2009 12:21	1.1	Positive	1.1	0.1
93	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	L CHANNEL	METAL	RED	INTACT	20.12	1/9/2009 12:37	1	Negative	0	0.02
94	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	I BEAM	METAL	RED	INTACT	4.92	1/9/2009 12:39	1.22	Positive	3.1	0.2
95	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	WALKWAY	METAL	RED	INTACT	3.55	1/9/2009 12:42	1	Negative	0	0.02
96	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	WALKWAY	METAL	RED	INTACT	3.81	1/9/2009 12:42	1	Negative	0	0.02
97	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	COLUMN	METAL	RED	INTACT	11.95	1/9/2009 13:02	1	Negative	0	0.02
98	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	WEB TRUSS	METAL	RED	INTACT	20.12	1/9/2009 13:08	1	Negative	0.03	0.02
99	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	X BRACING	METAL	RED	INTACT	17.72	1/9/2009 13:11	1	Negative	0	0.02
100	UAA Science Bldg.	LOTTON	INTERSTITIAL	INTERSTITIAL	WALKWAY	METAL	RED	INTACT	20.36	1/9/2009 13:14	1	Negative	0	0.02

**XRF LEAD TESTING SUMMARY**

Index	SITE	INSPECTOR	FLOOR	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	Duration	Time	Depth Index	RESULTS		
												LBP	PbC	PbC Error
101	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	WALL	METAL	BEIGE	INTACT	20.01	1/9/2009 14:05	1	Negative	0	0.02
102	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	DOOR	METAL	BROWN	INTACT	20.15	1/9/2009 14:06	1	Negative	0.01	0.02
103	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	DOORCASING	METAL	BROWN	INTACT	20.18	1/9/2009 14:07	1.11	Negative	0.04	0.02
104	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	DOORCASING	METAL	GRAY	INTACT	19.92	1/9/2009 14:13	1	Negative	0	0.02
105	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	WALL	METAL	BEIGE	INTACT	20.45	1/9/2009 14:28	1	Negative	0	0.02
106	UAA Science Bldg.	LOTTON	EXTERIOR	EXTERIOR	WALL	METAL	BEIGE	INTACT	20.44	1/9/2009 14:29	1.43	Negative	0.02	0.02
107	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK				20.44	1/9/2009 14:44	1.09	Positive	1	0.1
108	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK				20.42	1/9/2009 14:46	1.09	Positive	1.1	0.1
109	UAA Science Bldg.	LOTTON	-	-	CALIBRATION CK				20.15	1/9/2009 14:47	1.06	Positive	1	0.1

Table Heading Descriptions:

Ssec:

This is the nominal time in seconds that each sample was analyzed.

Depth Index:

Indicates the relative depth of the lead. A Depth Index (DI) of less than 1.5 indicates lead very near the surface layer of paint. A DI greater than 4.0 indicates the lead paint is deeply buried beneath multiple layers of paint.

LBP:

Results are shown as positive (POS > 1.0 mg/cm<sup>2</sup>), inconclusive (INC) or negative (NEG < 1.0 mg/cm<sup>2</sup>). The results are based on the combined results of the K and L shell readings. L shell and K shell readings are not provided. Positive results are also in bold print.

mg/cm<sup>2</sup>:

This is the testing results produced by the NITON XL-309 instrument in milligrams of lead per square centimeter (mg/cm<sup>2</sup>).  
The EPA defines lead based paint as paint containing lead at 1.0 mg/cm<sup>2</sup> or greater. A negative number is a result of an internal computation made by the instrument and should be interpreted as zero. Even though paint may be termed negative (less than 1.0 mg/cm<sup>2</sup>) by EPA definition, disturbance of the paint may still be regulated by OSHA under 29 CFR 1926.62. Where lead is present at any level, appropriate engineering controls, work practices and personal protective equipment should be used until a negative exposure assessment can be determined.

VOID:

This indicates that the test was intentionally terminated by the operator due to operator error (e.g. - operator moved analyzer while testing).

**XRF LEAD TESTING SUMMARY**

Index	SITE	INSPECTOR	FLOOR	ROOM	COMPONENT	SUBSTRATE	COLOR	CONDITION	Duration	Time	Depth Index	RESULTS		
												LBP	PbC	PbC Error
1	UAA Science Bldg.	HARPER			ShutterCal				58.27	6/18/2010 10:49			8.89	0
2	UAA Science Bldg.	HARPER			CALIBRATION CK				21.5	6/18/2010 10:50	1.02	Positive	1	0.1
3	UAA Science Bldg.	HARPER			CALIBRATION CK				20.97	6/18/2010 10:51	1.05	Positive	1	0.1
4	UAA Science Bldg.	HARPER	VOID	VOID	VOID	VOID	VOID	VOID	VOID	6/18/2010 10:51	VOID	VOID	VOID	VOID
5	UAA Science Bldg.	HARPER			CALIBRATION CK				24.25	6/18/2010 10:52	2.52	Positive	1	0.1
6	UAA Science Bldg.	HARPER	INTERSTITIAL	INTERSTITIAL	COLUMN	METAL	BROWN	INTACT	21	6/18/2010 11:09	1.78	Negative	0.02	0.02
7	UAA Science Bldg.	HARPER	INTERSTITIAL	INTERSTITIAL	BEAM	METAL	BROWN	INTACT	21.46	6/18/2010 11:12	1.85	Negative	0.02	0.02
8	UAA Science Bldg.	HARPER	VOID	VOID	VOID	VOID	VOID	VOID	VOID	6/18/2010 11:12	VOID	VOID	VOID	VOID
9	UAA Science Bldg.	HARPER	INTERSTITIAL	INTERSTITIAL	JOIST	METAL	BROWN	INTACT	17.05	6/18/2010 11:13	1.74	Negative	0.03	0.02
10	UAA Science Bldg.	HARPER	INTERSTITIAL	INTERSTITIAL	BEAM	METAL	BROWN	INTACT	20.91	6/18/2010 11:59	1.31	Negative	0.02	0.02
11	UAA Science Bldg.	HARPER	VOID	VOID	VOID	VOID	VOID	VOID	VOID	6/18/2010 11:59	VOID	VOID	VOID	VOID
12	UAA Science Bldg.	HARPER	INTERSTITIAL	INTERSTITIAL	COLUMN	METAL	BROWN	INTACT	20.99	6/18/2010 12:00	1.16	Negative	0.01	0.02
13	UAA Science Bldg.	HARPER	FIRST FLOOR	RM 119	CROSS BEAM	METAL	BROWN	INTACT	20.91	6/18/2010 12:19	1.93	Negative	0.13	0.03
14	UAA Science Bldg.	HARPER			CALIBRATION CK				20.92	6/18/2010 12:40	1.05	Positive	1	0.1
15	UAA Science Bldg.	HARPER			CALIBRATION CK				20.97	6/18/2010 12:41	1.01	Positive	1	0.1
16	UAA Science Bldg.	HARPER			CALIBRATION CK				22.07	6/18/2010 12:41	2.59	Positive	1.1	0.1

Table Heading Descriptions:  
Ssec:

This is the nominal time in seconds that each sample was analyzed.

Depth Index:

Indicates the relative depth of the lead. A Depth Index (DI) of less than 1.5 indicates lead very near the surface layer of paint.  
A DI greater than 4.0 indicates the lead paint is deeply buried beneath multiple layers of paint.

LBP:

Results are shown as positive (POS > 1.0 mg/cm<sup>2</sup>), inconclusive (INC) or negative (NEG < 1.0 mg/cm<sup>2</sup>). The results are based on the combined results of the K and L shell readings. L shell and K shell readings are not provided. Positive results are also in bold print.

mg/cm<sup>2</sup>:

This is the testing results produced by the NITON XL-309 instrument in milligrams of lead per square centimeter (mg/cm<sup>2</sup>).  
The EPA defines lead based paint as paint containing lead at 1.0 mg/cm<sup>2</sup> or greater. A negative number is a result of an internal computation made by the instrument and should be interpreted as zero. Even though paint may be termed negative (less than 1.0 mg/cm<sup>2</sup>) by EPA definition, disturbance of the paint may still be regulated by OSHA under 29 CFR 1926.62. Where lead is present at any level, appropriate engineering controls, work practices and personal protective equipment should be used until a negative exposure assessment can be determined.

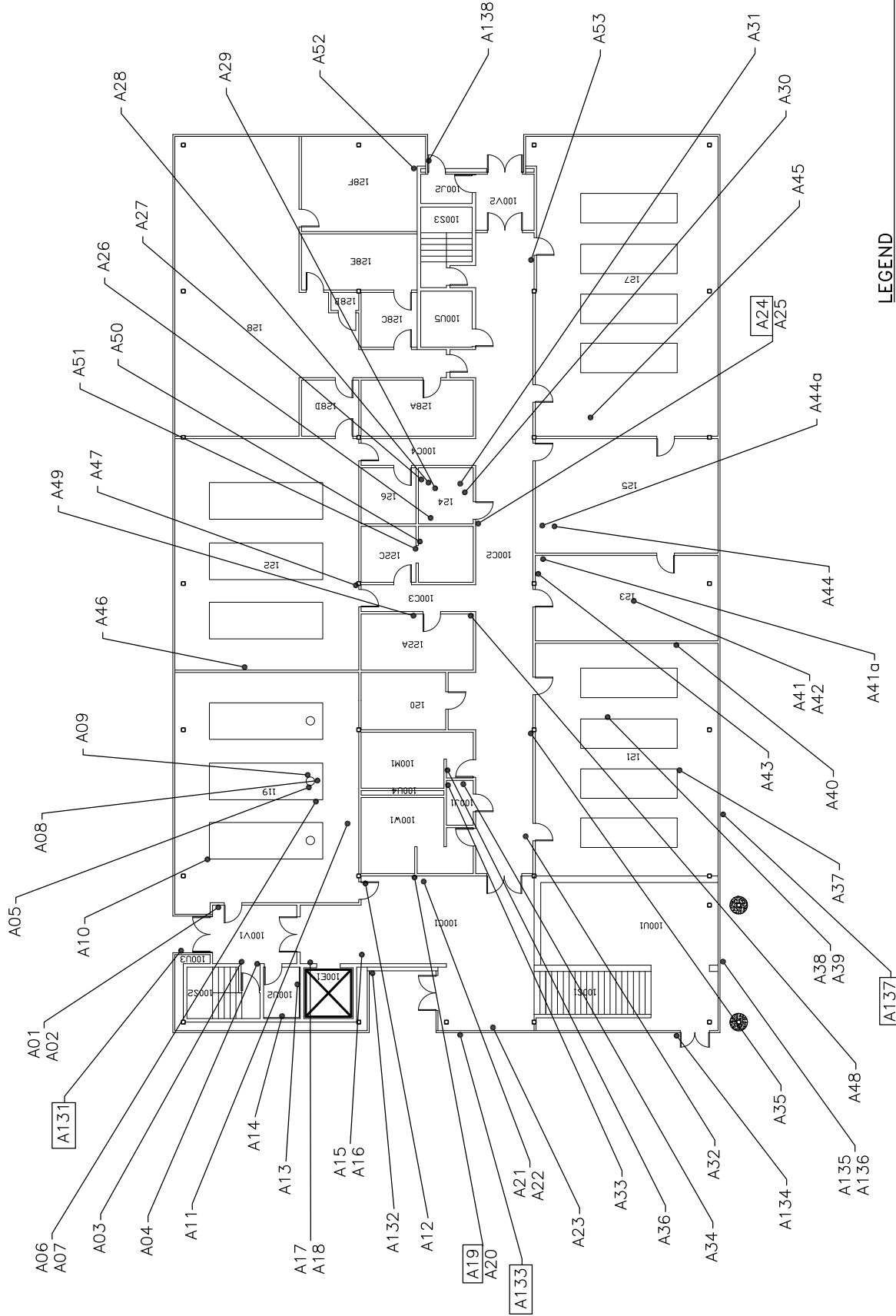
VOID:

This indicates that the test was intentionally terminated by the operator due to operator error (e.g. - operator moved analyzer while testing).

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## **APPENDIX D**

### **Drawings of Sample Locations**



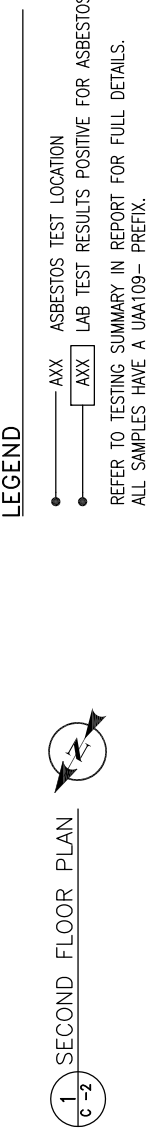
LEGEND

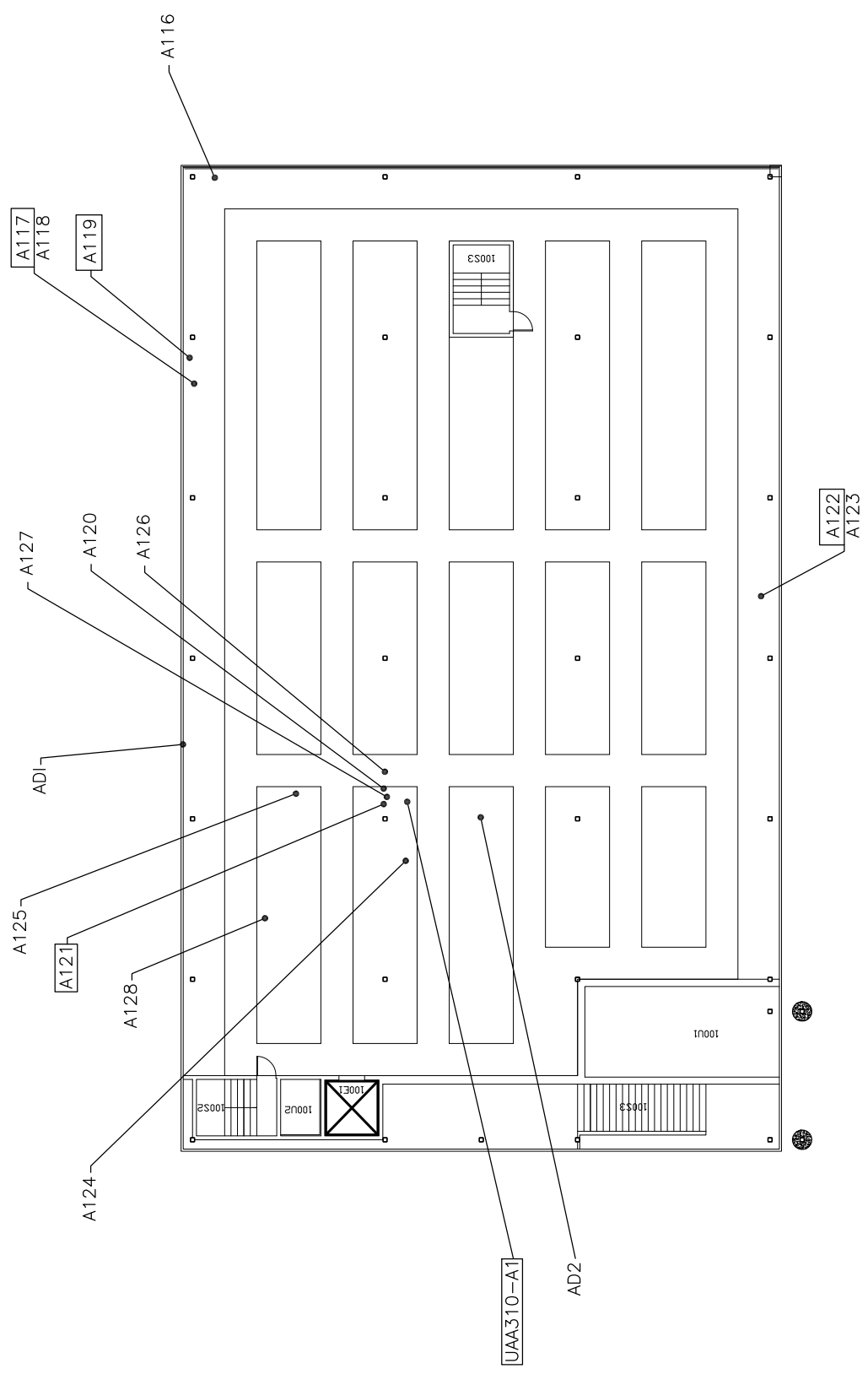
- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
 ALL SAMPLES HAVE A UAA109- PREFIX.



1 FIRST FLOOR PLAN







LEGEND

AXX ASBESTOS TEST LOCATION

AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS

REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.

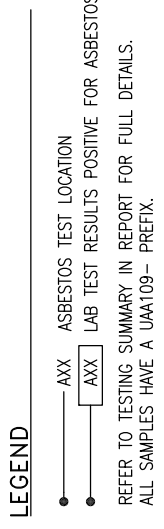
ALL SAMPLES EXCEPT ONE HAVE A UAA109- PREFIX.



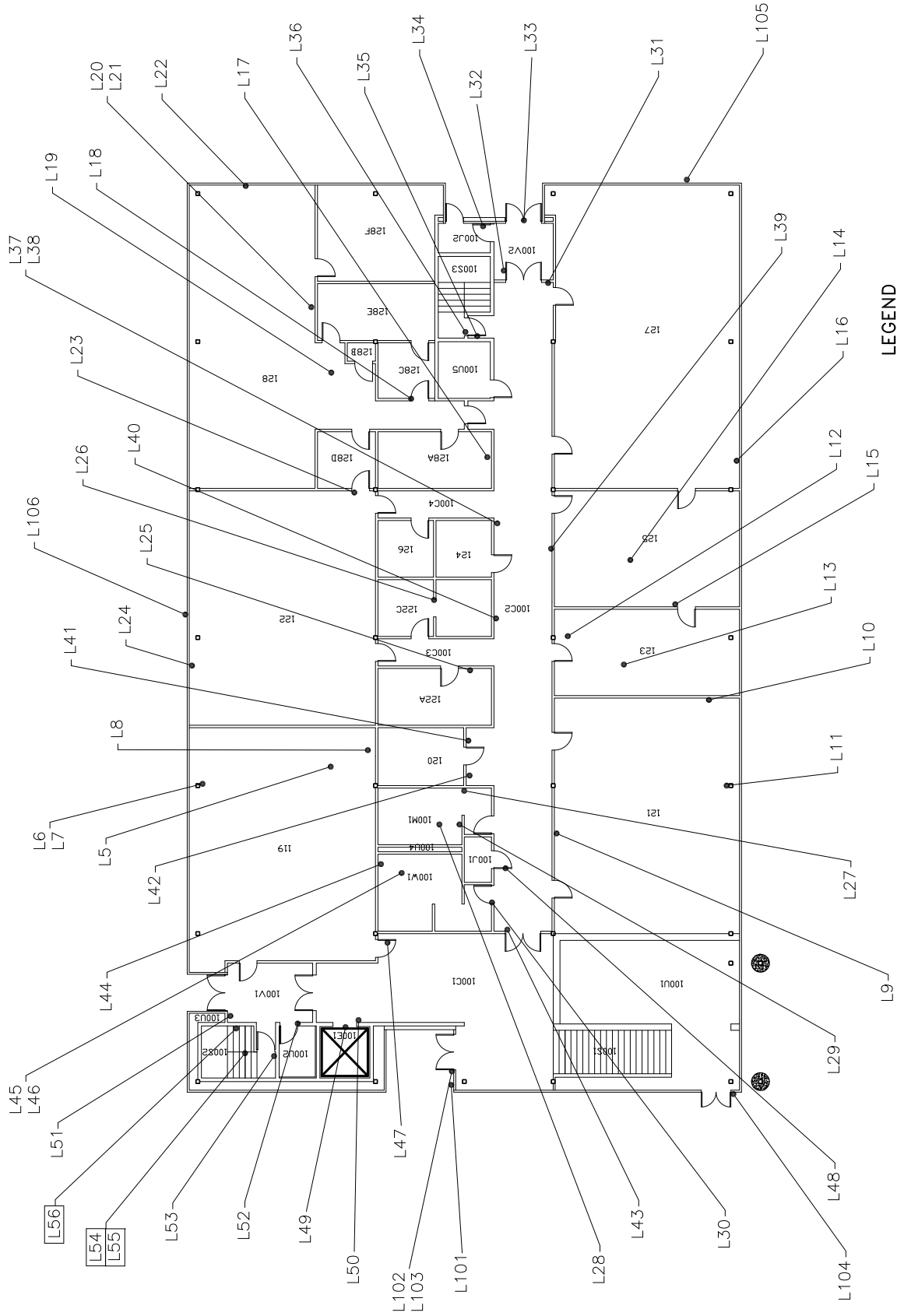
1

INTERSTITIAL PLAN

C-3



1 ROOF PLAN

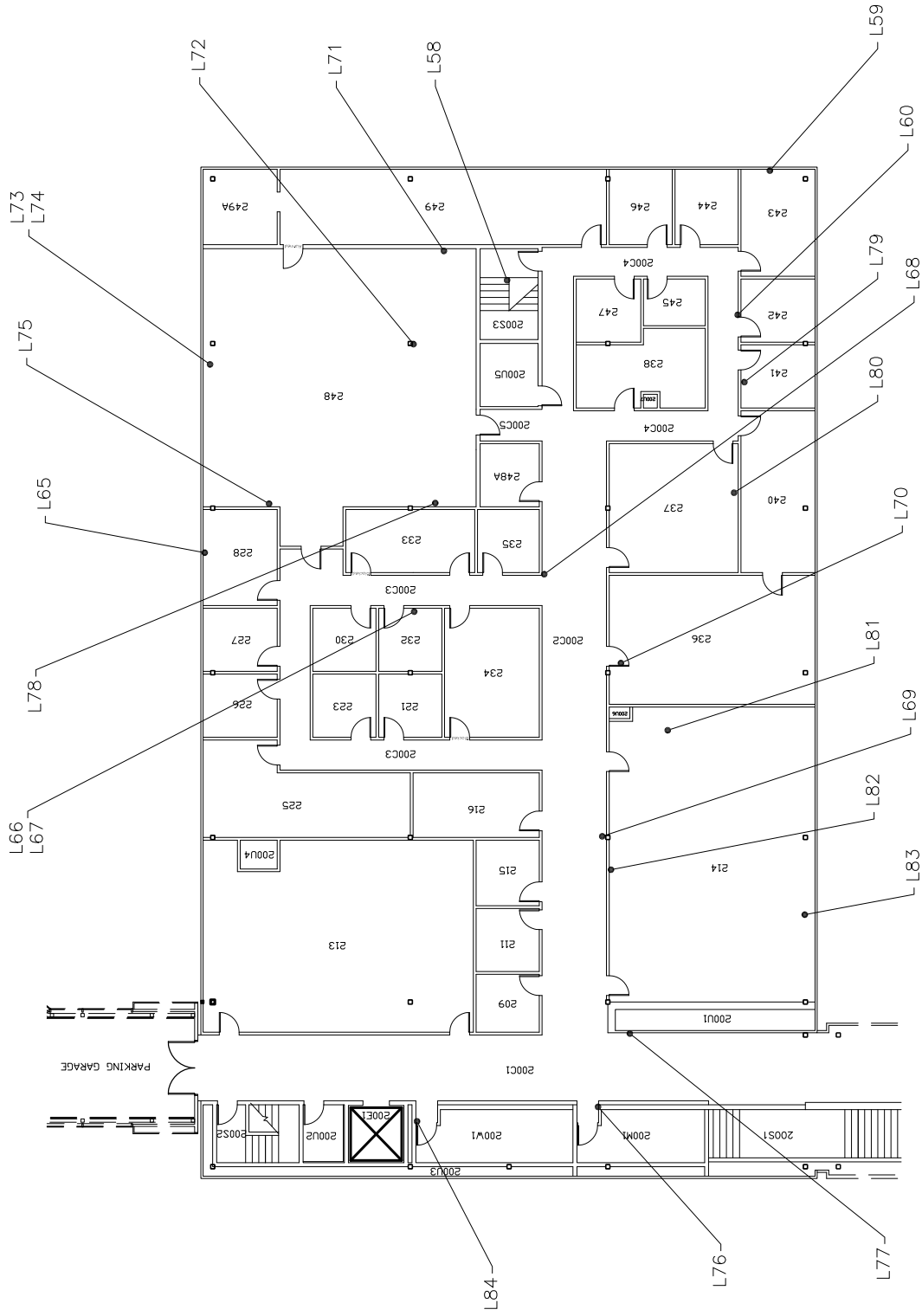


LEGEND

- LXX LEAD TEST LOCATION
  - LXX LEAD TEST CLASSIFIED AS LEAD-BASED PAINT
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.



1 FIRST FLOOR PLAN  
C-5



**LEGEND**

● LXX LEAD TEST LOCATION  
 ■ LXX LEAD TEST CLASSIFIED AS LEAD-BASED PAINT  
 REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.



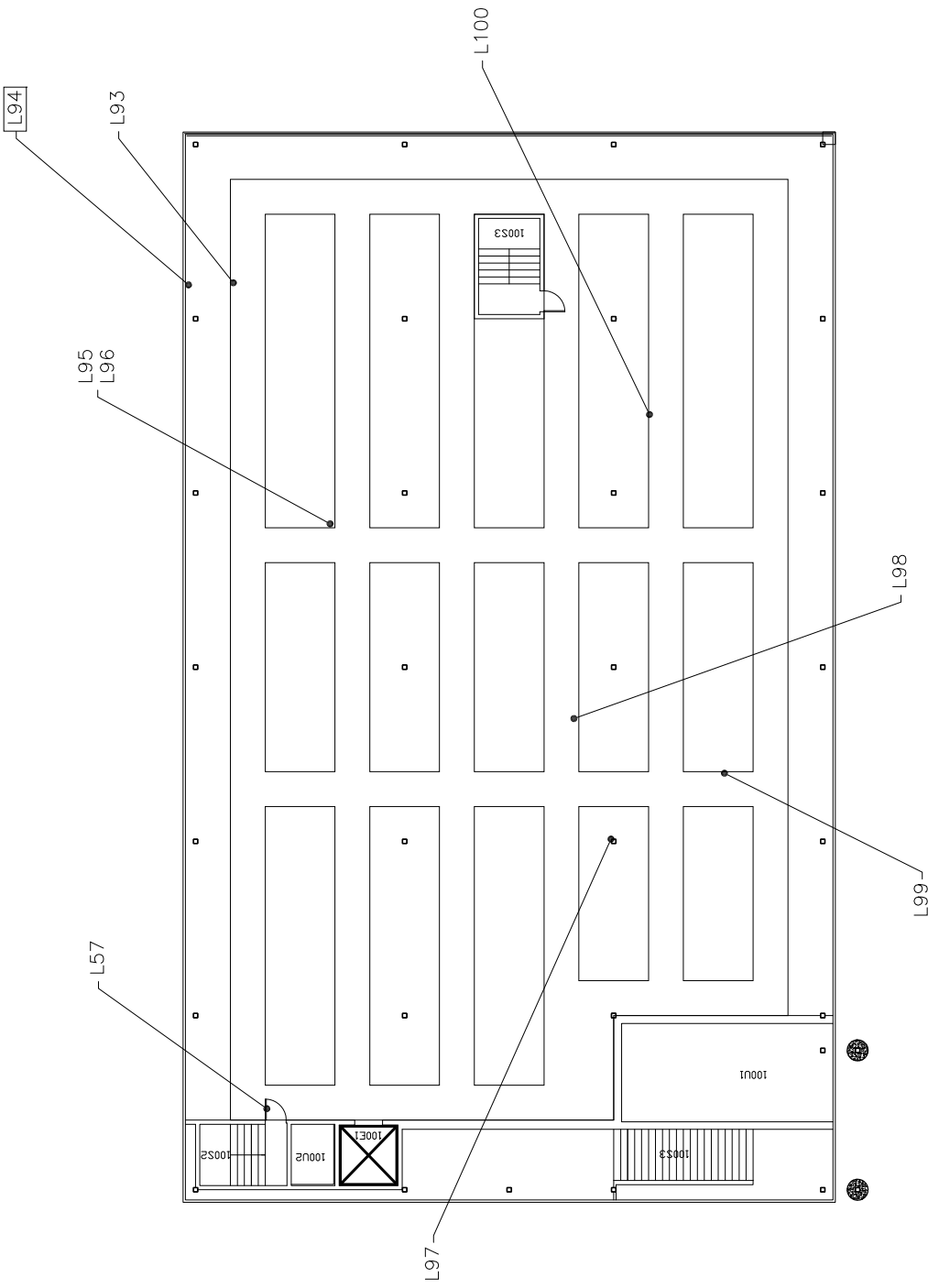
**1 SECOND FLOOR PLAN**  
 C-6

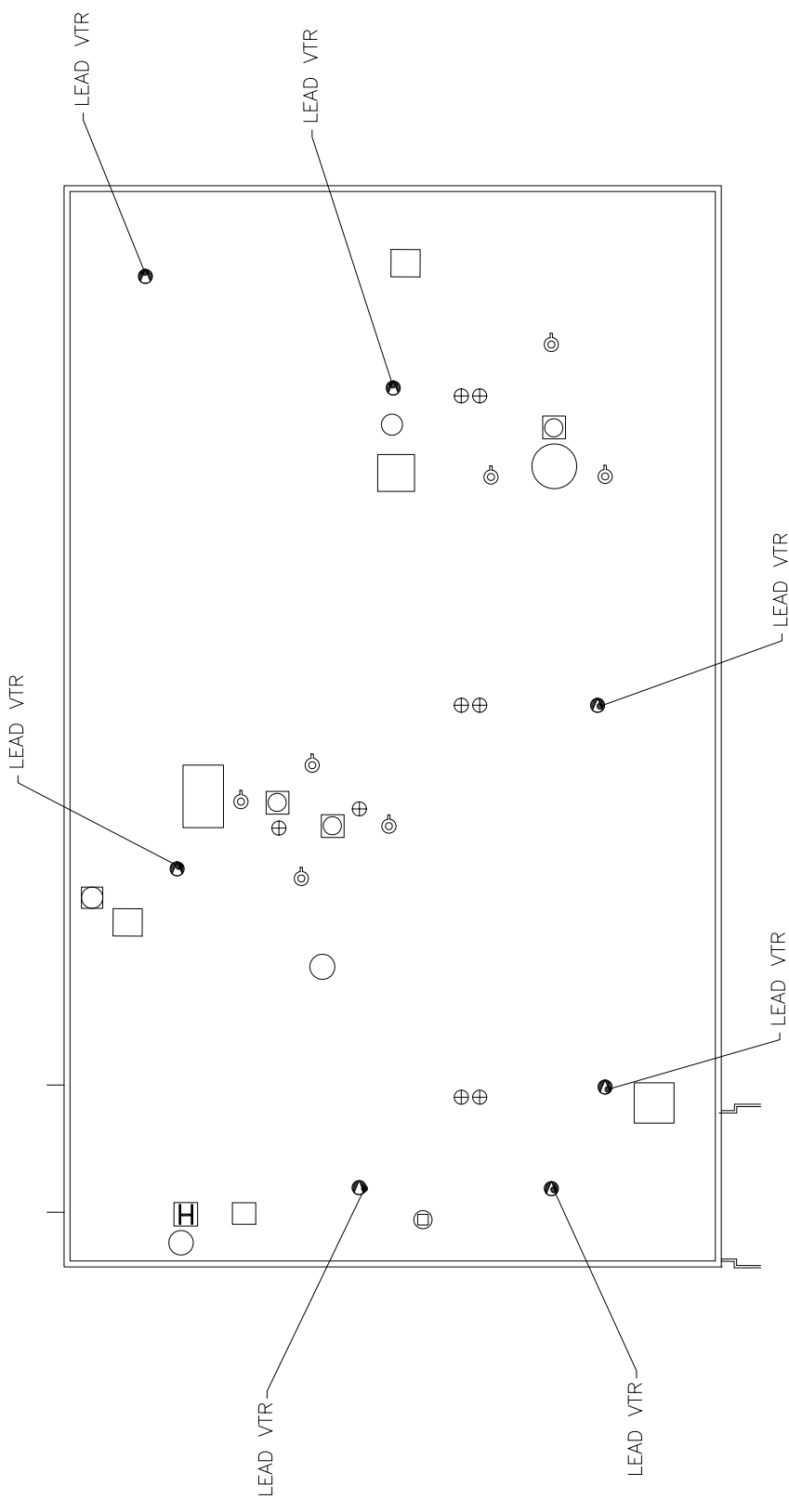
LEGEND

● LXX LEAD TEST LOCATION

● LXX LEAD TEST CLASSIFIED AS LEAD-BASED PAINT

REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.





**LEGEND**

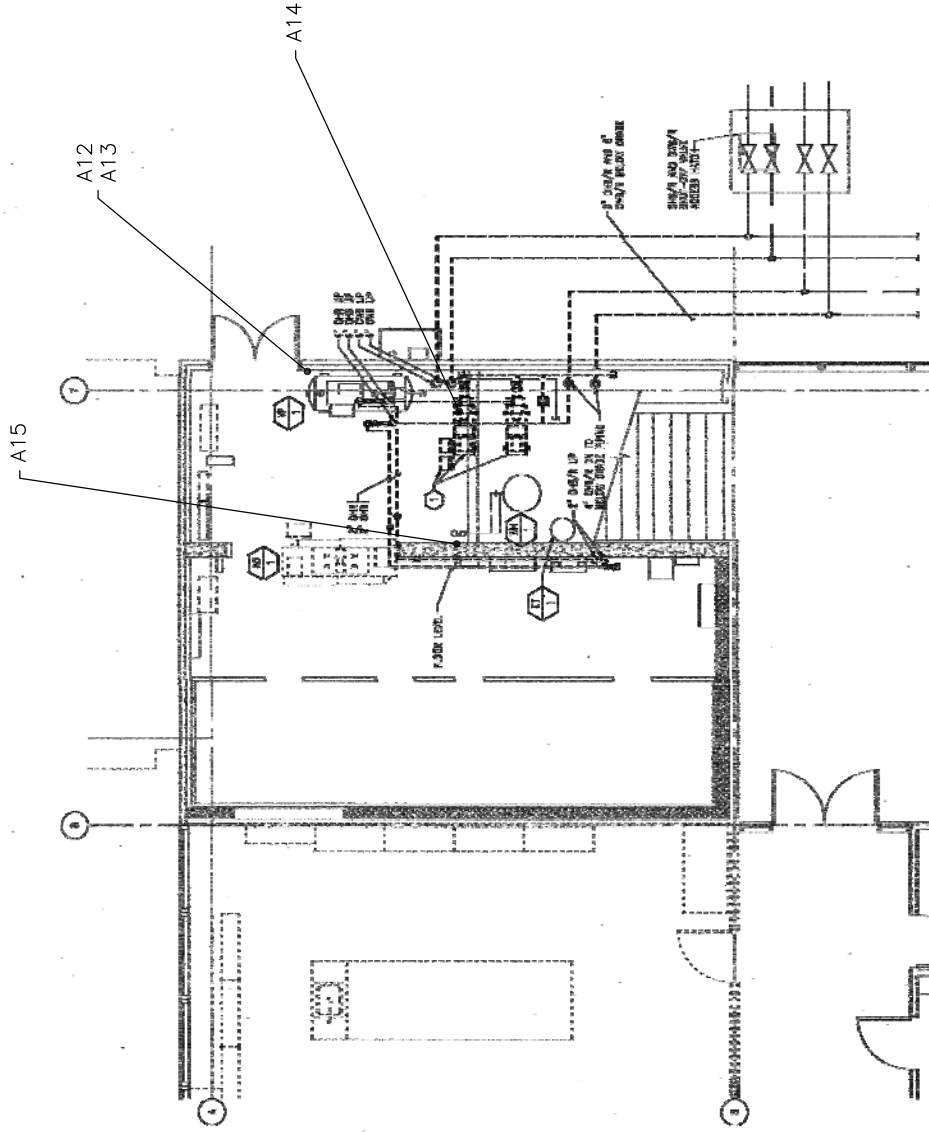
● LEAD VTR    LEAD VENT RISER

REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.

**1** ROOF PLAN  
**C-8**



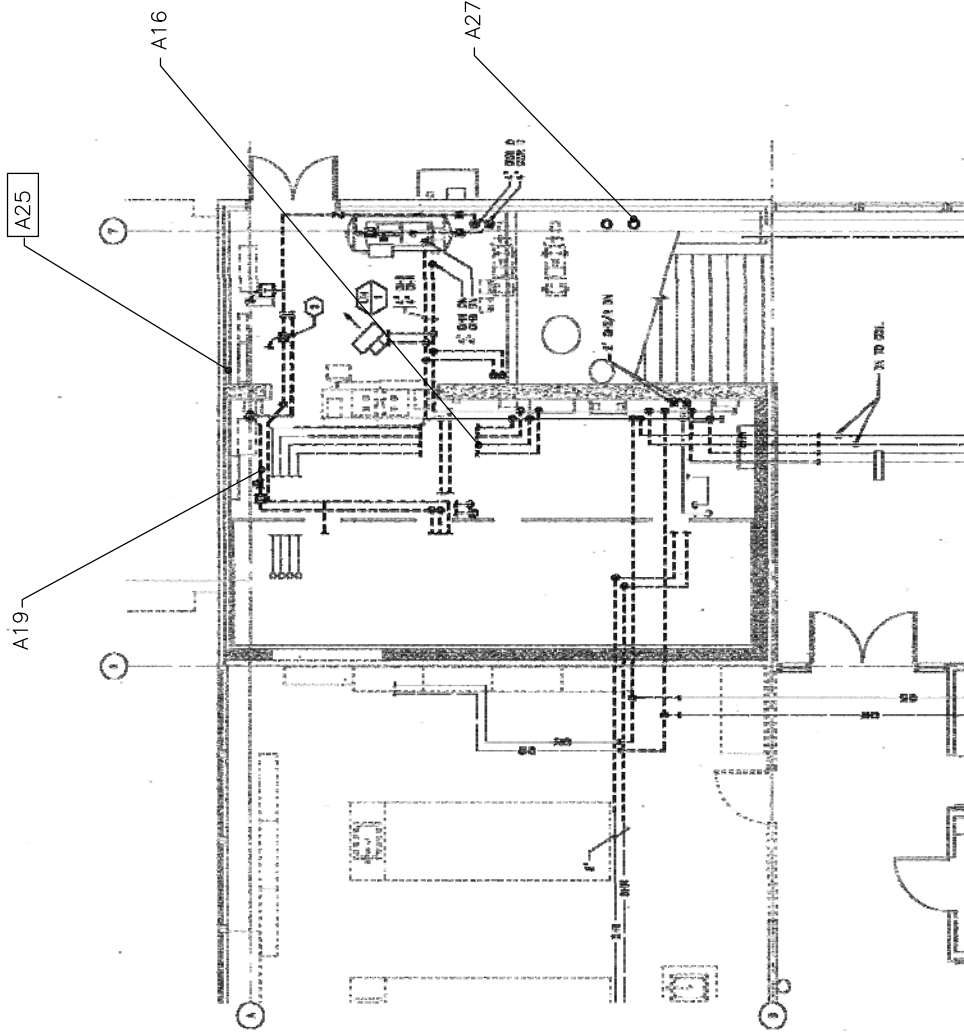




LEGEND

- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
 ALL SAMPLES HAVE A UAA510- PREFIX.





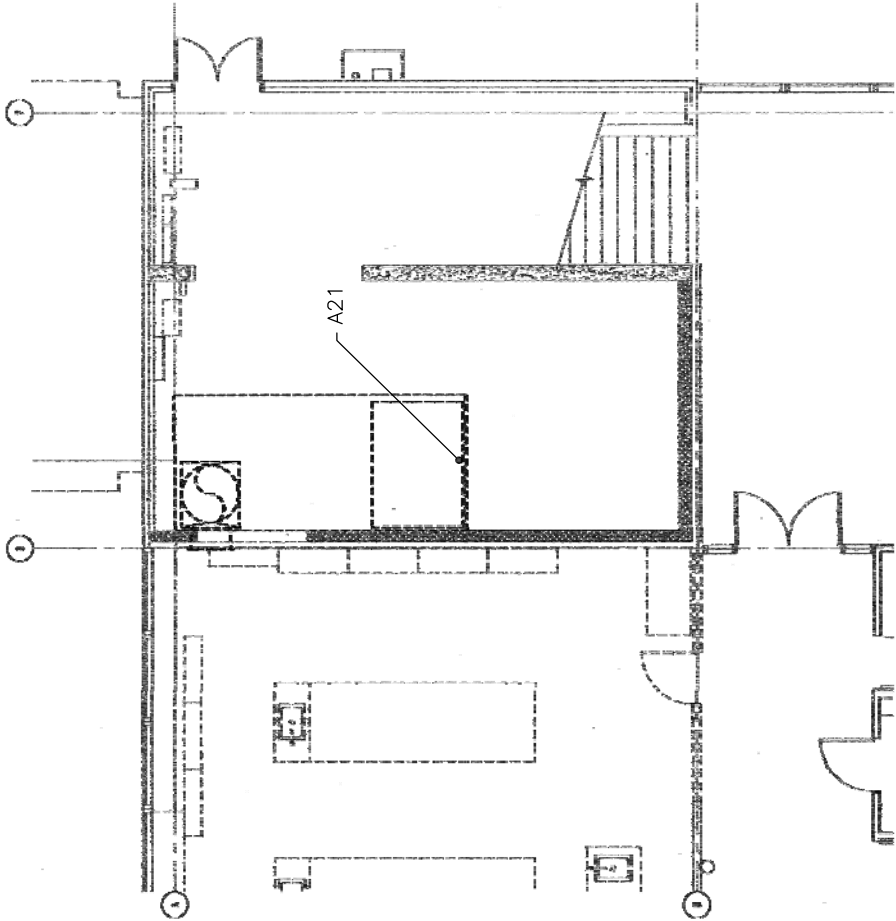
1 MECH. ROOM PLAN  
C-3 HYDRONIC PIPING (UPPER)

# LEGEND

- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
ALL SAMPLES HAVE A UAA510- PREFIX.

PROJECT NO.	6751
DESIGNED:	SEL
DRAWN:	FCW
CHECKED:	RAF
SCALE:	NO SCALE
DWG. TITLE:	6751-SL.DWG
JOB No.	6751
DATE:	5-21-10
C-3	
of	7

UNIVERSITY OF ANCHORAGE ALASKA  
UAA SCIENCE BUILDING-PH#2  
ANCHORAGE, ALASKA  
HAZARDS SAMPLE LOCATION DRAWING



AXX

ASBESTOS TEST LOCATION

AXX

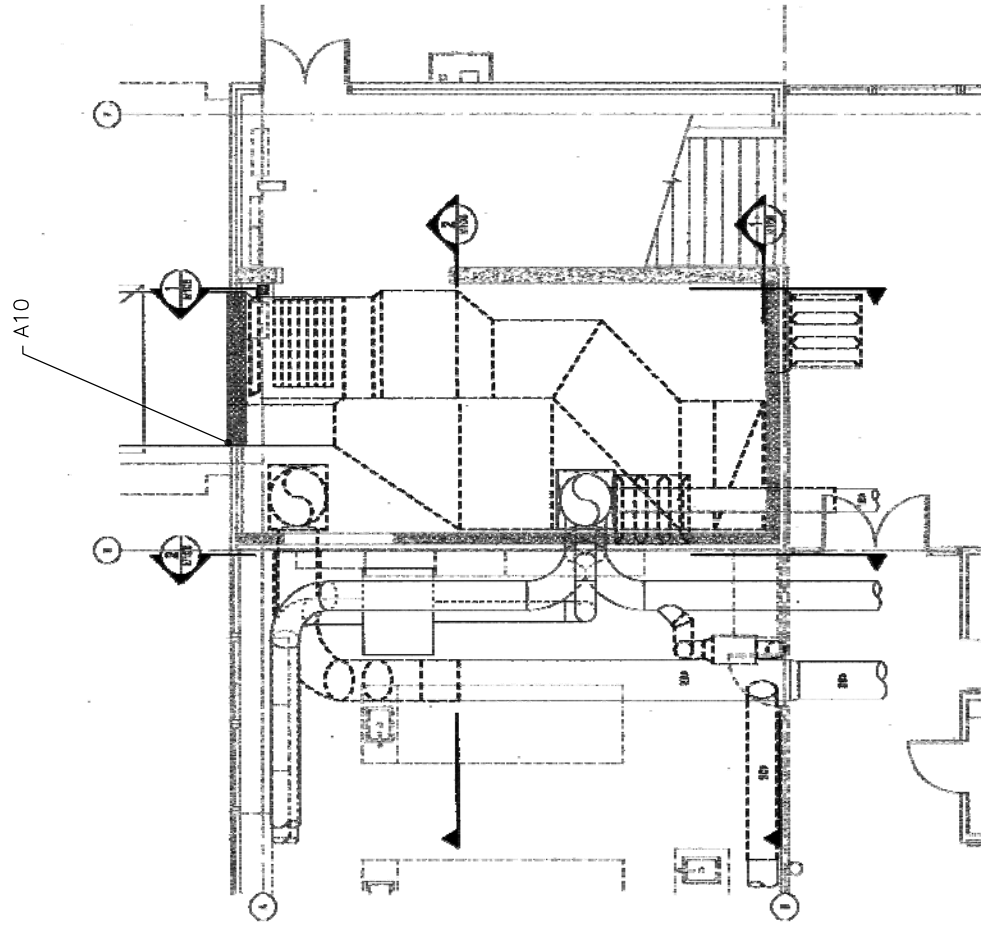
LAB TEST RESULTS POSITIVE FOR ASBESTOS

REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.

ALL SAMPLES HAVE A UAA510- PREFIX.

1 MECH ROOM PLAN

C-4 VENTILATION (LOWER)

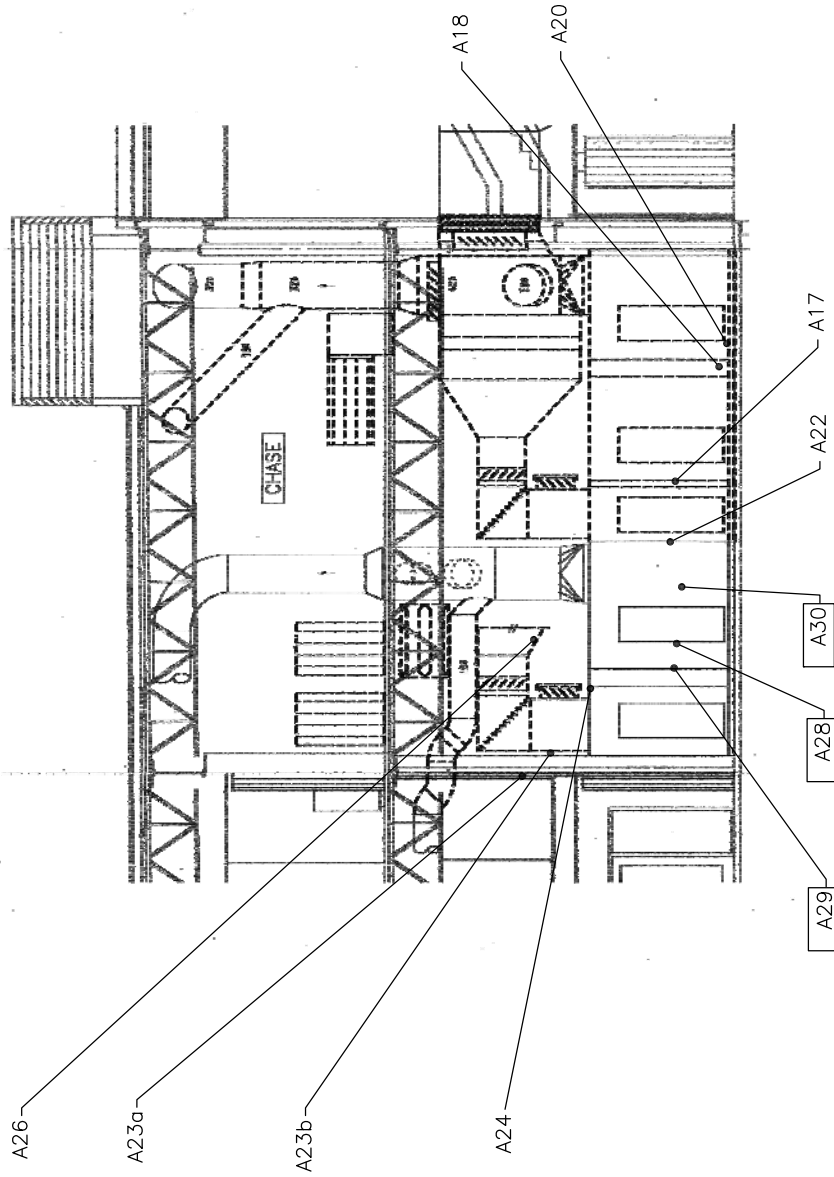


LEGEND

- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
 ALL SAMPLES HAVE A UAA510- PREFIX.



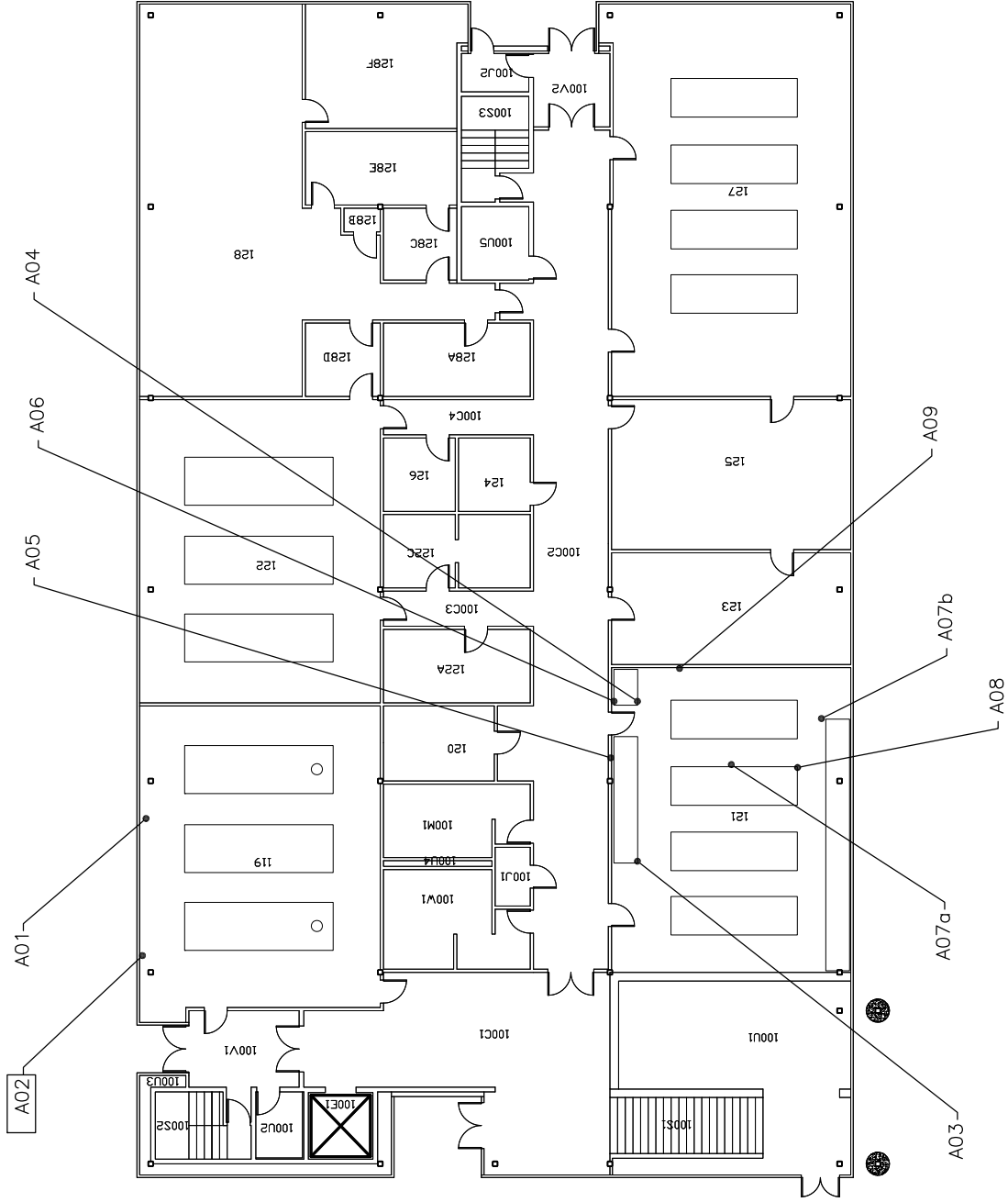
1 MECH. ROOM PLAN  
 C-5 VENTILATION (UPPER)



# LEGEND

- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
ALL SAMPLES HAVE A UAA510- PREFIX.



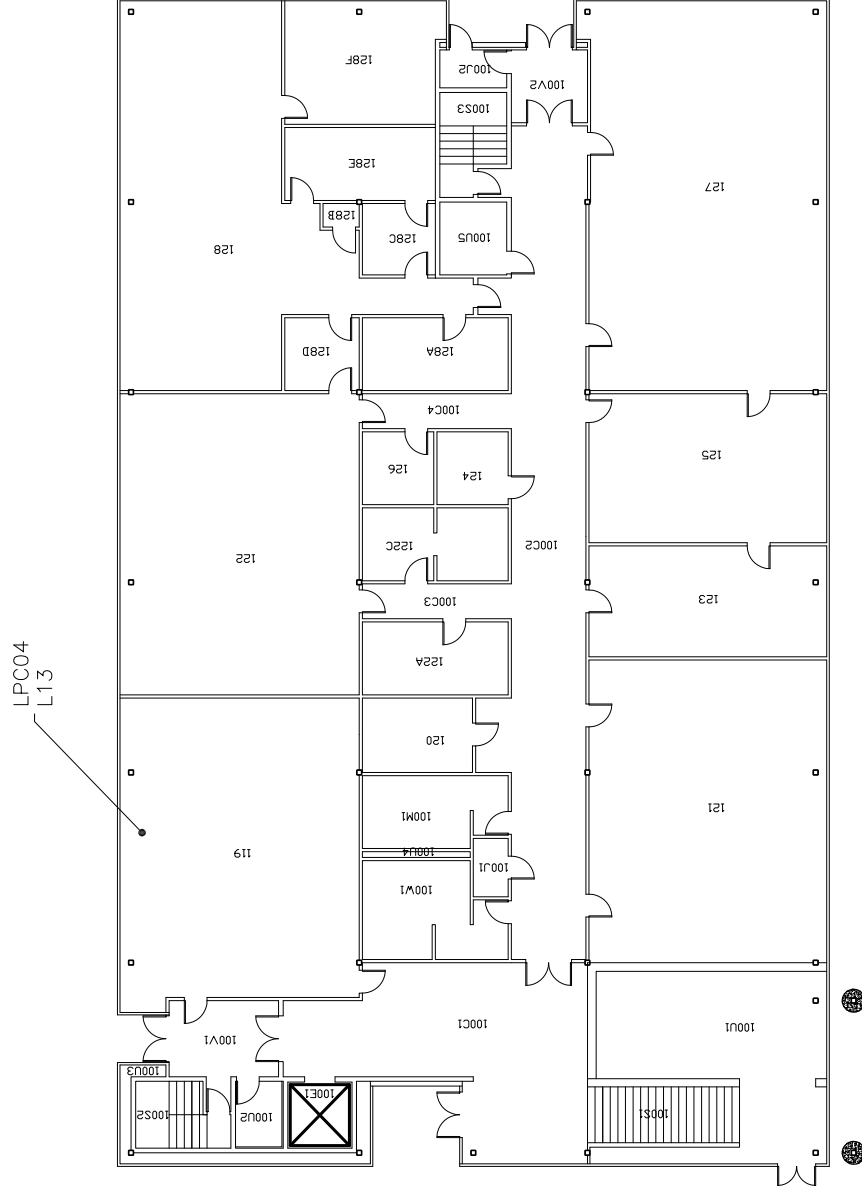


# LEGEND

- AXX ASBESTOS TEST LOCATION
  - AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
ALL SAMPLES HAVE A UAA510- PREFIX.



1 FIRST FLOOR PLAN  
C-7 SCIENCE BLDG.



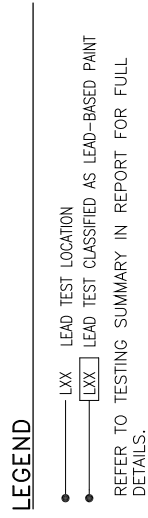
LEGEND

- LXX LEAD TEST LOCATION
  - LXX LEAD TEST CLASSIFIED AS LEAD-BASED PAINT
- REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.



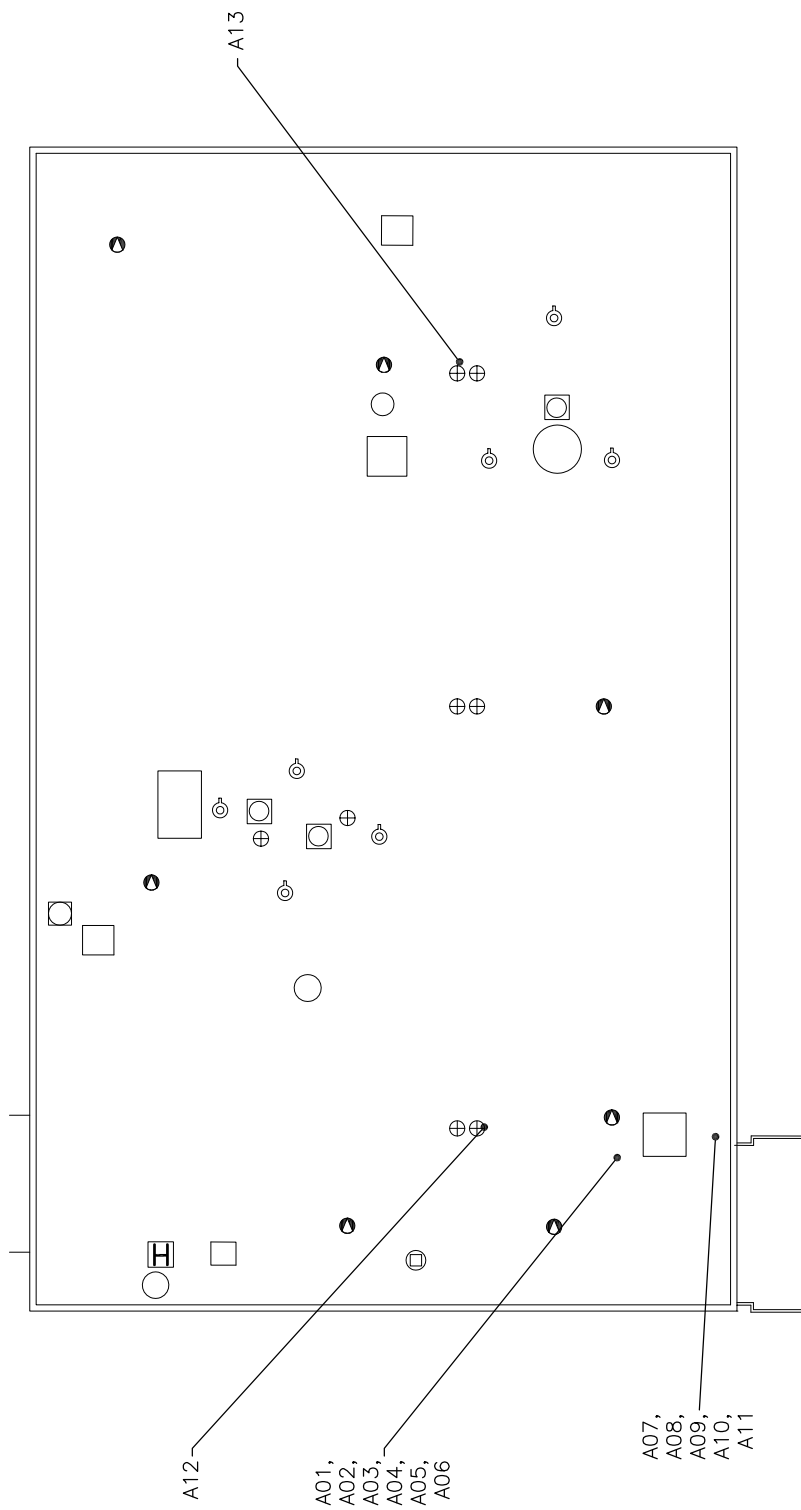
1 FIRST FLOOR PLAN

C-1



1 INTERSTITIAL PLAN  
c -2





**LEGEND**

● AXX ASBESTOS TEST LOCATION  
⊕ AXX LAB TEST RESULTS POSITIVE FOR ASBESTOS

REFER TO TESTING SUMMARY IN REPORT FOR FULL DETAILS.  
ALL SAMPLES HAVE A UAA0610- PREFIX.

1 ROOF PLAN  
C-1

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