

PART V

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
 - 1. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 2. Division 01 Section "Submittal Procedures" for administrative requirements governing the preparation and submittal of the submittal schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination:
 - 1. Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - a. Application for Payment forms with continuation sheets.
 - b. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703.
 - 3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section.

- b. Description of the Work.
- c. Change Orders (numbers) that affect value.
- d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
 5. Include a line item for retainage as defined in Article 8.6 of the General Conditions of the Contract between Owner and Contractor.
- E. **Stored Materials:** Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Materials previously stored and included in previous Applications for Payment.
 - b. Work completed for this Application utilizing previously stored materials.
 - c. Additional materials stored with this Application.
 - d. Total materials remaining stored, including materials with this Application.
- F. **Transmittal:** Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. **Waivers of Mechanic's Lien:** With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. **Waiver Forms:** Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- H. **Initial Application for Payment:** Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Schedule of unit prices.
 5. Certificates of insurance and insurance policies.
 6. Performance and payment bonds.

- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Updated final statement, accounting for final changes to the Contract Sum.
 - 3. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 - 4. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 - 5. AIA Document G707, "Consent of Surety to Final Payment."
 - 6. Evidence that claims have been settled.
 - 7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 - 8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Site mobilization meeting.
- C. Progress meetings.
- D. Construction progress schedule.
- E. Progress photographs.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

- A. Project Representative will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner- Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing the parties to Contract , Project Representative and Architect.
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Scheduling.
- D. Architect shall document minutes and distribute copies within two days after meeting to participants, with copies to Owner, participants, and those affected by decisions made.

3.02 SITE MOBILIZATION MEETING

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's Superintendent.
 - 5. Major Subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Owner's requirements and occupancy prior to completion.
 - 3. Construction facilities and controls provided by Owner.
 - 4. Temporary utilities provided by Owner.
 - 5. Survey and building layout.
 - 6. Security and housekeeping procedures.
 - 7. Schedules.
 - 8. Application for payment procedures.

9. Procedures for testing.
 10. Procedures for maintaining record documents.
 11. Requirements for start-up of equipment.
 12. Inspection and acceptance of equipment put into service during construction period.
- D. Architect shall document minutes and distribute copies within two days after meeting to participants, with copies to Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required:
1. Contractor.
 2. Owner.
 3. Architect.
 4. Contractor's Superintendent.
 5. Major Subcontractors.
- D. Agenda:
1. Review minutes of previous meetings.
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Maintenance of progress schedule.
 7. Corrective measures to regain projected schedules.
 8. Planned progress during succeeding work period.
 9. Maintenance of quality and work standards.
 10. Effect of proposed changes on progress schedule and coordination.
 11. Other business relating to Work.
- E. Architect shall document minutes and distribute copies within two days after meeting to participants, with copies to Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.05 PROGRESS PHOTOGRAPHS

- A. Photography Type: Digital; electronic files.
- B. Take photographs of major progress on a daily basis.
- C. Take photographs as evidence of existing project conditions as follows: interior and exterior views.

END OF SECTION 01 30 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.
- B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently. Partial submittals will be returned to the Contractor without review.
 - 3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for re-submittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the

Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.

1. Initial Review: Allow 10 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Re-submittal Review: Allow calendar 10 days for review of each re-submittal.
- D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Include the following information for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - f. Name of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Re-submittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-06100.01.A).
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.

- k. Location(s) where product is to be installed, as appropriate.
 - l. Related physical samples submitted directly.
 - m. Other necessary identification.
 5. Include the following information as keywords in the electronic file metadata:
 - a. Project name.
 - b. Number and title of appropriate Specification Section.
 - c. Manufacturer name.
 - d. Product name.
- F. Options: Identify options requiring selection by the Architect.
- G. Deviations: Identify deviations from the Contract Documents on submittals.
- H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 1. Submit three copies of submittal to Architect plus the quantity of copies required by the Contractor for his use and distribution. Architect will retain three copies and return all additional copies to the Contractor.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 1. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Submittal purpose and description.
 - g. Specification Section number and title.
 - h. Drawing number and detail references, as appropriate.
 - i. Transmittal number[, numbered consecutively].
 - j. Submittal and transmittal distribution record.
 - k. Remarks.
 - l. Signature of transmitter.
 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- J. Re-submittals: Make re-submittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. In lieu of paper submittals, Contractor may, at his option, submit electronic submittals via email as PDF electronic files.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file and forward one annotated to the Owner for the Owner's Project file.
 - 2. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
 - 3. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications for final warranty documents and elsewhere as indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - 4. Submit Product Data before or concurrent with Samples.
 - 5. Submit Product Data in the following format:
 - a. Paper or PDF electronic file at Contractor's Option.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Compliance with specified standards.
 - c. Notation of dimensions established by field measurement.
 - d. Relationship and attachment to adjoining construction clearly indicated.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches .
 3. Submit Shop Drawings in the following format:
 - a. Paper or PDF electronic file at Contractor's option.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Submit two sets of each sample. One set will be retained by the Architect for the Project record documentation and the other will be returned to the Contractor.
 2. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 3. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 5. Samples for Initial Selection: Submit sets of manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit two full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one set of submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."

- F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Submit subcontract list in the following format:
 - a. Paper or PDF electronic file at Contractor's option.
- I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- J. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- K. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- L. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- M. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- N. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- O. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- P. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate required action, as follows:
- C. Partial submittals prepared for a portion of the Work will be reviewed only when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

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SECTION 01 35 33- INFECTION CONTROL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes policies and procedures required for the Contractor to prevent transmission of infectious agents to vulnerable patient population, health care workers, and visitors within the hospital environment.

1.3 DEFINITIONS

- A. Negative Pressure: The relative air pressure difference between two areas in a healthcare facility. A space that is at negative pressure has a lower pressure than adjacent areas, ensuring that any directional air movement is from the clean air environment into the contained area and preventing contaminated air from escaping into adjacent rooms or areas through doors, opening and cracks.
- B. HEPA: An acronym that stands for high efficiency particulate air. A HEPA filter is an air filter capable of capturing 99.97% of particles as small as 0.3 microns.
- C. Multi-Stage Filtering: Successive filtering that prevents early loading of filters with contaminants and thereby delaying reduced airflow. Typical multi-stage filters might consist of a large particulate filter (10 microns), a smaller particulate filter (5 microns), an activated charcoal filter (odors), and a HEPA filter (0.3 microns).
- D. Negative Pressure Machine: Freestanding, portable device that removes airborne contaminants by recirculating air through a HEPA filter. Portable air scrubbers can also serve as negative pressure machines by exhausting the recirculated air from the containment area.
- E. Containment: The process of isolating a contaminated area from the rest of the facility. Depending on the work to be done and the equipment required, airlocks, pass throughs, and equipment rooms may be necessary. Full containment always requires that negative pressure be maintained inside the containment area.
 - 1. Containment Requiring Activities include, but are not limited to the following:
 - a. Demolition and removal of walls, floors, ceiling, ceiling tile, and other building finish materials.
 - b. Demolition of plumbing, mechanical and electrical systems and equipment.
 - c. Finish operations such as sanding, painting, application of special surface coatings.
 - d. All routine construction activity that can generate dust.
 - 2. Source containment can also be used with localized negative pressure if a very small area is involved. A small piece of plastic sheet can be taped around the area to be

removed. A small HEPA vacuum is used for the purpose by inserting the inlet nozzle inside this small containment to create a negative pressure and to vacuum up released particles.

- F. Containment Area: The construction activity area, adjacent staging and storage areas, passages for construction personnel to access to the project site and delivery and removal of supplies and waste. It includes the entire volume of the project area including ceiling spaces above and adjacent to the construction area. Containment areas are determined by the owner's representative and the hospital's infection control committee.
- G. Pressure Differential: The difference in magnitude between a reference pressure and a variable pressure.
- H. Protection Area: The designated project limits, hospital areas adjacent to containment area, either occupied or used for passage and areas connected to construction areas by mechanical system intake, exhaust and ductwork. Protection areas are determined by the owner's representative and the hospital's infection control committee.
- I. Thorough Cleaning: Cleaning of surfaces and that become exposed to dust shall be accomplished by the use of either a HEPA-filtered vacuum cleaner or a wet mop.
- J. Infection Control Risk Assessment (ICRA): A broad, long-range involvement of a hospital's infection control/epidemiology leadership to assess the risk to patients and the hospital environment to airborne contamination.

1.4 POLICY

- A. The intent of this policy is to minimize nosocomial infections in patients that may arise as a result of exposure to organisms released into the environment during construction and renovation activities. Controlling the dispersal of airborne or waterborne infection agents concealed within building components is critical to the South Peninsula Hospital.
- B. Patient Care Objectives: All construction and renovation activities shall be defined and managed in such a way that occupants exposure to dust, moisture, and their accompany hazards is limited.
 - 1. Aspergillosis and related nosocomial fungal infections are caused through inhalation by immunocompromised patients of aspergillus spores, or other related spores, that can be present in the construction environment. The spores are known to be prolifically present in construction dust, debris and earthwork excavation dust. Outbreaks are associated with unfiltered air, contaminated ventilation systems at intake and exhaust ducts, and dust that is dislodged by renovation and construction. Control of construction dust, debris and excavation dust is imperative to help prevent outbreaks of aspergillosis or related nosocomial fungal infections in immunocompromised patients.
 - a. Inhalation of aspergillus spores or other fungal spores by immunocompromised patients can lead to serious complications and death.
 - b. Aspergillus and other related spores are present in the natural environment and are not a risk to healthy construction workers. Refer to individual Sections for specific coordination drawing requirements for products and equipment.
 - 2. Airborne contaminant control is critical in all hospital areas. Contractor shall limit dissemination of airborne contaminants produced by construction-related activities, in order to provide protection of immunocompromised patients, other patients, staff,

diagnostic operations and sensitive procedures and medical equipment from possible undesirable effects of exposure to such contaminants.

3. Dust in ceilings and construction debris contains fungus spores. Construction activities causing disturbance of existing dust, or creating new dust, or other airborne contaminants, must be conducted in tight enclosures cutting off any flow of particles into patient areas.
4. Ceilings and walls in protected areas and other areas within hospital as indicated on Drawings must be secure from airborne transmissions at all times. If access into the ceiling in occupied areas is required, procedures described within this Section shall be followed.
5. Enclosed carts must be used when transporting construction debris and materials throughout the hospital environment. The owner's representative and infection control committee shall approve the transportation path and destination terminus prior to commencing the work.

1.5 PROCEDURES

- A. The owner's representative in conjunction with the hospital's infection control committee will:
 1. Determine the infection control project classification using the matrices located below.
 2. Coordinate the relocation of affected patients and pedestrian traffic routes to areas where there is less potential for exposure to airborne contaminants with the responsible departments.
 3. Coordinate the preparation of the project area, including the removal of medical supplies, waste, and equipment, prior to commencement of project activities with the responsible departments.
- B. Infection Control Risk Assessment (ICRA) Guidelines

STEP 1: Identify the Construction Project Activity Type (Types A-D) by selecting the appropriate construction activity type from the table below. Construction activity type is determined by the amount of dust that is generated, the duration of the activity and the involvement with HVAC systems

Construction Project Activity by Type (A-D)	
TYPE A	<p>Inspection and Non-Invasive Activities. Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet ▪ painting (but not sanding) ▪ wallcovering, electrical trim work, minor plumbing, and activities that do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	<p>Small scale, short duration activities which create minimal dust Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ installation of data, telephone and computer cabling ▪ access to chase spaces ▪ cutting of walls or ceiling where dust migration can be controlled.
TYPE C	<p>Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ sanding of walls for painting or wall covering ▪ removal of floorcoverings, ceiling tiles and casework ▪ new wall construction ▪ minor duct work or electrical work above ceilings ▪ major cabling activities ▪ any activity that cannot be completed within a single workshift.
TYPE D	<p>Major demolition and construction projects Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ activities which require consecutive work shifts ▪ requires heavy demolition or removal of a complete cabling system ▪ new construction.

STEP 2: Identify the Patient Risk Group that will be affected by selecting the appropriate Patient Risk Group from the table below. The Patient Risk Groups defined are based on project location and occupancy. If more than one risk group will be affected, select the higher risk group. For all construction classes, patients must be removed from the room while work is performed.

Patient Risk Group			
Low Risk	Medium Risk	High Risk	Maximum Risk
<ul style="list-style-type: none"> ▪ Office areas 	<ul style="list-style-type: none"> ▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy 	<ul style="list-style-type: none"> ▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Medical Units ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units 	<ul style="list-style-type: none"> ▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

STEP 3: Match the Patient Risk Group (Low (L), Medium (M), High (H), Maximum Risk (X)) with the Construction Project Type (A, B, C, D) to find the Class of Precautions (I – IV). Using the Construction Activity Type and the Patient Risk Group selected from the tables above, use the infection control matrix below to determine Construction Classification (Class). Construction Classification (Class) determines the procedures to be followed during construction and renovation projects.

Patient Risk Group/Construction Project Type Comparison				
Patient Risk Group	TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
MAXIMUM Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that Class III or Class IV control procedures are necessary.

STEP 4: Description of Required Infection Control Precautions by Class. Implement the appropriate Construction Guideline based on the project classification selected from the Construction Activity matrix above (STEP 3). Construction Classification (Class) Guidelines are procedures to control release(s) of airborne contaminants resulting from construction, demolition, or renovation activities.

During Project Construction		Upon Project Completion
CLASS I	<ol style="list-style-type: none"> 1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection 	<ol style="list-style-type: none"> 1. Clean work area upon completion of task.
CLASS II	<ol style="list-style-type: none"> 1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed. 	<ol style="list-style-type: none"> 1. Wipe work surfaces with cleaner/disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Upon completion, restore HVAC system where work was performed.
CLASS III	<ol style="list-style-type: none"> 1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid. 	<ol style="list-style-type: none"> 1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with cleaner/disinfectant. 5. Upon completion, restore HVAC system where work was performed.

CLASS IV	<ol style="list-style-type: none"> 1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 	<ol style="list-style-type: none"> 1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Dept. 2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 3. Contain construction waste before transport in tightly covered containers. 4. Cover transport receptacles or carts. Tape covering unless solid lid. 5. Vacuum work area with HEPA filtered vacuums. 6. Wet mop area with cleaner/disinfectant. 7. Upon completion, restore HVAC system where work was performed.
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C. Infection Control Risk Assessment (ICRA) has been categorized the project as follows:

1. Construction Project Activity Type: D
2. Patient Risk Group Type: X
3. Infection Control Precautions Class: IV

1.6 PERFORMANCE REQUIREMENTS

A. Owner's Representative Responsibilities:

1. Determine that the containment and protection areas are properly defined and adequately enclosed by the contractor.
2. Issue a statement of requirements in both graphic and written form to communicate the above, based upon an evaluation of the construction area and the impact of the project on patient care.
3. Approve all enclosures constructed by the contractor.

B. Owner's Responsibilities:

1. Assist Owner's Representative to determine the containment and protection areas.
2. Coordinate access to infection control risk manager.

C. Contractor's Responsibilities:

1. Comply with applicable codes and referenced controls using installation procedures and methods that satisfy code requirements and reference infection control procedures.

2. Determine specific means and methods of achieving and maintaining control of airborne contaminants during construction.
3. Propose work plan and procedures for control of airborne contaminants.
4. Submit contractor's work plan for control of contamination for review in advance of performing any construction activities. Follow procedures established for product shop drawing submittals.
 - a. Owner's representative and architect shall review work plan submittal for general compliance.
5. Conform to notification requirements in quality assurance article.
6. Provide and maintain all dustproof enclosures, measurement devices, warning signs, and warning lighting to protect patients, hospital staff, and public. Contractor shall remain responsible for compliance with all contamination control requirements.
7. Verify that all construction personnel have reviewed infection control procedures by using sign-in method. Provide a copy of attendees.

1.7 PRECONSTRUCTION CONFERENCE

- A. Pre-Construction Conference: Conduct conference at project site. Review methods and procedures related to infection control risk assessment (ICRA) including, but not limited to, the following:
 1. Identify Infection Control Risk Assessment
 2. Review infection control policy
 3. Review infection control procedures.
- B. Attendees shall include the owner's representative, the hospital infection control coordinator, architect, construction manager, contractor, major subcontractors, and any other parties involved with the project.

1.8 SUBMITTALS

- A. Progress Schedule: Submit work and procedure schedules for temporary containment construction. Incorporate infection control milestones within the master project schedule.
- B. Work Plan: Submit drawings and construction details of temporary barriers, descriptions of procedures to be used to achieve and maintain control of construction-related airborne contaminants
- C. Product Data: Include standard specifications, materials descriptions, furnished specialties and accessories, rated capacities and capabilities of individual components for achieving containment.
- D. Special Reports:
 1. Provide written report of infection control procedures, including locations, exit routes, details of dust barriers, and means of creating negative pressure prior to commencing the project.

2. Provide written report confirming specified air velocity whenever enclosure is erected or modified in designated protection area.

1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified for testing indicated.
- B. Testing: Engage a qualified independent testing agency to test air quality and pressure for compliance with specified requirements for performance and test methods.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. Products identified below are recommended as appropriate to the task at hand. Other manufacturers than those listed may be submitted for approval, but it the contractor's responsibility to provide effective documentation that adequately support a substitute material.

2.2 INFECTION CONTROL PRODUCTS

- A. Adhesive-faced contamination control mats: Sanitary walk-off mat consisting of multi-layered, disposable, 2 mil, non-allergenic, non-odorous, polyethylene sheets with non-drying solid adhesive and anti-microbial germicide.
- B. Portable enclosures: Construct a temporary enclosure whenever work is performed outside containment area. Provide an enclosure of polyethylene sheet described below, enclosing ladder and sealing off opening at the ceiling system, or provide a pre-fabricated enclosure unit.
- C. Portable Pre-Fabricated Environmental Enclosure: A temporary enclosure for work in sterile environment outside of the Containment Area. A heavy-duty vinyl enclosure and adjustable, spring-loaded top frame to accommodate variabilities in ceiling height; provide ceiling mechanism for snug fit that will not damage ceiling panels. Furnish with inspection window, pressure differential porthole for a HEPA-filtered vacuum device capable of 300-800 CFM and manometer.
- D. Polyethylene Sheet: Provide 6 mil, internally reinforced polyethylene laminate, fire-retardant sheet, NFPA-approved, sealed with fire-retardant tape at joints and penetrations above the ceiling.

2.3 ACCESSORIES

- A. Protective Clothing: The contractor shall provide disposable paper jumpsuits, head and shoe coverings for use by construction personnel.
- B. Respiratory Gear: Provide respiratory gear as required by OSHA regulation 29 CFR 1926 (Construction Safety Regulations).

2.4 EQUIPMENT

- A. Portable air scrubbers and negative air machines: Multi-filtered, including 99.9% efficient HEPA filter, variable-speed motor, static pressure-monitored, equipped with electrical or mechanical lockout to prevent fan from operating without a HEPA filter, powered mechanical equipment utilized to create a dust-free environment.

- B. HEPA-Filtered Vacuum Machine: Multi-stage, 99.9% efficient HEPA filtration system, grounded, interference suppressed, 110/120V or 220/240V motor, minimum 10-gallon, minimum 500-1000 CFM capacity, powered mechanical equipment utilized to negatively pressurize small temporary dust enclosures to create a dust-free environment or in use to clean surfaces or construction personnel.
- C. Air Pressure Monitor: Differential switch/gauge to monitor differential pressure between the containment area and the protection area. Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background and front recalibration adjustment with a range of plus/minus 0- to .50-inches water gauge and high-low adjustable set points.
 - 1. Install the differential pressure switch/gauge in a NEMA-rated enclosure. Provide all necessary power wiring, transformers and relays to operate the system. Provide a switch that will enable activation of audio, visual, or both alarms that activates upon sensing pressure differences beyond the range set points. Provide a manual reset gauge after an alarm condition.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine containment and protection area with owner representative present, for compliance with infection control requirements.
 - 1. For the record, prepare written report, endorsed by owner representative listing conditions detrimental to infection control performance.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 MONITORING

- A. Before commencing any demolition or construction in occupied areas, a complete review of all airborne containment control policies shall be conducted. The owner's representative and infection control risk manager shall confirm that the area is ready for work to begin.
- B. Owner will monitor conditions in the vicinity of project in protection areas. Whenever unsafe conditions are observed, contractor will be notified to correct conditions immediately to avoid work stoppage.
 - 1. All work shall be stopped immediately whenever a hazardous containment control deficiency exists on the project.
 - 2. The contractor shall take immediate action to correct all deficiencies.

3.3 PROTECTION

- A. Contractor shall install dust proof enclosure for work as directed by the owner's representative and when required to protect areas occupied by the owner from dust, debris, and damage.
- B. Provide a temporary work surface to provide a safe working platform and protect the ceiling and the spaces below from falling objects and materials. Construction must be conducted in tight enclosures cutting off any flow of dust particles into patient areas.
 - 1. Airborne contaminant control requirements: Floor to structure, airtight enclosures, drywall barriers, using tape and foam padding to seal all joints and penetrations.

2. Keep enclosure door closed at all times.
 3. Traffic between Containment Area and open areas shall be kept to a minimum.
 4. Transport materials and refuse into an area from an external site without violating patient care areas by transporting in covered containers.
 5. Provide negative pressure in construction area.
 6. Provide adequate forced ventilation of enclosed areas to cure installed materials, to prevent excessive humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
 7. Ductwork Dust Caps: Block off all existing ventilation ducts within the construction area. Method of capping ducts shall be dust-tight and withstand airflow pressures.
- C. Dust proof enclosures:
1. Full height, noncombustible construction with minimum 5/8" fire-rated gypsum board both sides with 3-1/2 inch R-11 insulation batts to reduce noise. Use tape to tightly seal top, bottom, penetrations and seams, to prevent spread of dust to occupied areas, including above ceiling. Secure all tape with spray adhesive. Dust proof enclosures adjacent to or in public areas shall be taped and painted on the side exposed to public view.
 2. Enclosure Doors: 4'-0" minimum width, unless shown otherwise, solid core wood with metal frame and hardware, closer and tightly weather-stripped to prevent flow of dust. Locate as indicated on drawing and swing out of the construction area. Keep enclosures locked outside of working hours. Coordinate with the Owner for access.
 3. Install disposable, multi-layered tacky floor mats on both sides of construction entrance prior to commencing demolition or construction. Remove old tacky surface as needed to prevent tracking, daily as minimum.
 4. Obtain Owner's approval of exact location and details of enclosure construction.
 5. Materials for enclosure shall be precut in unoccupied areas before delivering to project site. No explosive or pneumatic drive fasteners permitted, unless authorized by Owner.
 6. Provide entrance vestibules as described. Provide floor mats inside vestibule and inside enclosures at door to vestibule.
- D. Enclosure outside of work area (including spaces above ceilings): Whenever work is necessary outside of the construction enclosures (containment area), the space where work is being done, including ladders, shall be contained within a full-height portable enclosure. At Contractor's option, a prefabricated unit may be used.
1. All work performed shall be performed outside of normal working hours and shall be scheduled in advance with Owner, except where specified otherwise.
 2. At no time shall any construction equipment or material be stored outside the construction enclosure.
 3. Any dust tracked outside of construction area shall be cleaned up immediately. Contractor shall have the necessary personnel and equipment (HEPA-filtered vacuum,

dust and wet mops, brooms, and clean wiping cloths) to keep adjacent occupied areas clean at all times

- E. Power and Lighting: Provide sufficient temporary lighting and power ventilating equipment to ensure proper workmanship and safety.
- F. Access Provisions: Provide ramps, stairs, ladders and similar temporary access elements as reasonably required to perform the work and facilitate its inspection during installation.
- G. Airborne dust generation of significant quantities of dust will not be tolerated. Clean the work area prior to starting work to minimize existing dust becoming airborne during construction. Provide drop cloths and dust partitions as necessary to contain dust and debris generated by the work.
- H. Demolition material, dust and dirt shall be removed in covered, tightly sealed, rubber tired, polyethylene dump carts. Containers shall be fitted with clean polyethylene covers, completely sealed at perimeter by wire tying or taping. Before leaving area, all containers shall be wiped clean with biocide to prevent tracking of dust. Provide debris chutes if required.
- I. If work is being performed above an accessible ceiling and if work must be performed while the space below is occupied, spray top of ceiling panels to be removed and surrounding affected panels, with fine detergent/water mist to settle dust prior to removal.
- J. A portable plastic fabric tunnel or a polyethylene enclosure for larger openings shall be used for each single ceiling access outside of the Containment Area. The enclosure's opening shall have a 3-foot overlap of polyethylene to decrease risk of airborne dust. The portable plastic fabric tunnel, or portable enclosure, shall remain in place until the ceiling is secured (all accesses closed). In patient care areas, the apparatus (tunnel or enclosure) shall be dismantled and access panels replaced or remodeling of access completed at the end of each day.
- K. If the contractor needs to crawl about pipes, ducts, or other building infrastructure to investigate a condition, the Contractor shall use additional procedures, (e.g. put on a mask, disposable coverall and disposable shoe covers) before going into the access. The surfaces that will be disturbed shall be vacuumed with a HEPA-filtered vacuum before proceeding. Afterwards the contractor shall strip off the coverall, and shoe covers carefully, turning the coverall "inside-out" and deposit the mask, coverall, and shoe covers into a plastic trash bag inside the enclosure. This plastic trash bag shall be secured (tied off) and discarded as directed by Owner's Representative and may not be discarded within any patient care area.
- L. Exercise caution when handling fluids, or piping systems, in the space above ceilings and other hospital operations. When working with fluids, provide a watertight barrier beneath the work area to catch and retain all spillage before it reaches the ceiling below.
- M. Water leaks must be cleaned up and repaired as soon as possible, but within 72 hours to prevent mold proliferation in floor and wall coverings, ceiling panels and cabinetry in patient care areas. If cleanup and repair are delayed more than 72 hours after the water leak, the involved materials must be assumed to contain fungi and handled accordingly. Use of a moisture meter to detect water penetration of walls should be used whenever possible to guide decision-making. If the wall or other component does not have less than 20% moisture content more than 72 hours after water penetration, it shall be removed.
- N. Contractor is responsible for determining when a dust proof enclosure is required to protect any adjoining area; however, the Contractor shall provide a dust proof enclosure where indicated and whenever requested by the owner's representative. Take all necessary precautions to protect the people and spaces below from injury or damage due to contractor's operations.

3.4 CONTAINMENT AREA

- A. Maintain levels of airborne contaminants within Containment Area and Protective Area limits as defined by the Owner's Representative and Infection Control Risk Manager.
- B. Portable Air Scrubbers and Negative air machines shall remove airflow from construction area at not less than 100 FPM at enclosure entrances with all doors fully open. As an alternative, provide adequate exhaust air volume to provide 6 air changes per hour.
- C. Dust Control: The Contractor shall take appropriate steps throughout the term of the Project to prevent airborne dust due to work under this contract. Water shall be applied wherever practical to settle and hold dust to a minimum, particularly during demolition and moving of materials. Care must be taken to prevent the accumulation of standing water or the saturation of any materials. No chemical palliatives shall be used without permission of the Owner's Representative.
 - 1. Spray surfaces with water during dust-producing interior demolition activities. Hard surface floors in work area, adjacent hallways and passage areas require vacuuming with HEPA-filtered vacuum cleaners and frequent wet-mopping during demolition and construction; protect adjacent carpeted areas with plastic and plywood and vacuum with HEPA-filtered vacuum cleaners.
 - 2. Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent airborne dust from dispersing into atmosphere.
 - 3. Any dust tracked outside enclosure shall be removed immediately, using HEPA-filtered vacuum.
 - 4. All cleaning outside enclosure shall be by HEPA-filtered vacuum or other approved method.
- D. The following procedure shall be implemented when construction personnel are required to pass through a Protected Area to enter the Containment Area:
 - 1. Provide airlock entry vestibules to dustproof enclosures when shown on Drawings or required by owner's representative
 - 2. Construction personnel shall wear protective clothing when passing through the Protective Area or when directed by the Owner's Representative. The protective clothing shall be removed in the airlock
 - 3. Construction personnel shall wear protective clothing at all times when passing through the Protective Area and while working in the Containment Area.
- E. Construction Personnel: Instruct personnel to refrain from tracking dust into adjacent hospital areas or opening windows or doors allowing airborne contaminants into the adjacent hospital area.
- F. Exterior Work: Direct exhaust from equipment away from building air intakes; assure that filters on building air intakes are operational and protected from excessive amounts of airborne contaminants.
- G. Any ceiling panels opened for investigation beyond sealed areas shall be replaced immediately when unattended or covered with an appropriate temporary barrier.

- H. Removal of construction barriers and ceiling protection shall be done carefully outside of normal working hours.

3.5 EQUIPMENT

- A. A. Connect portable air scrubbers and negative air machines to emergency power and run continuously.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing and inspecting of completed phases of the work shall take place in successive stages, in areas of extent and using methods described in Quality Assurance article. Do not proceed with removal or construction of each enclosure for the next area until owner's Representative is satisfied that work is completed and clean up procedure has been performed.
- C. Repair or replace construction enclosures where test results indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of repaired or replaced work with specified requirements.

3.7 CLEANING

- A. Provide thorough cleaning of existing surfaces that become exposed to dust each day. Thoroughly clean each temporary access when work is completed or at the end of each work shift, using approved methods.
- B. Provide a final thorough construction cleaning of area before turning space over to Owner for final cleaning.
- C. Final cleaning of construction (to medically clean standards) shall be performed by the Owner's own housekeeping forces.

3.8 ENFORCEMENT

- A. Failure to maintain containment areas will result in issuance of a written warning. If the situation is not corrected within (8) eight hours of receipt of warning, Owner will have cause to stop the work as provided in the General Conditions.
 - 1. Failure of Contractor to correct deficiencies in containment will result in corrective action taken by Owner and all costs deducted from the Contractor.
- B. The Owner's Representative will perform periodic inspections to determine compliance with infection control procedures. Written documentation shall be filed as part of the project documentation. Photographs may be taken to document work site conditions.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's Representative, Architect, testing agencies, and authorities having jurisdiction.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Schematically show temporary facilities, utility hookups, staging areas, roof access points, and parking areas for construction personnel.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Security of tools and stored materials is the responsibility of the Contractor. At the Contractor's option and as required for security of stored materials, Contractor's equipment, and facilities provide minimum 2-inch, 0.148-inch- thick, galvanized

steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide galvanized steel bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: If required by Contractor's operations, provide prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Contractor's Field Office: If required by Contractor's operation, of sufficient size to accommodate needs of construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work and approved by Owner. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities. The Owner's existing facilities will not be available for use by the Contractor's personnel.
- C. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- D. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:

1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- D. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.
- E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- B. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 1. Prohibit smoking in construction areas.
 2. Supervise combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may

have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor.

END OF SECTION 015000

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 9 Sections and Division 22 & 23 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- C. This Section includes removal and reinstallation patching of existing concrete walls and floors, existing interior wood stud partitions, wood stud furring at exterior walls, and other interior and exterior wall, floor, ceiling and roof assemblies.

1.3 RELATED DOCUMENTS

- A. NOT USED.

1.4 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
 - 6. Owner's Project Representative's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio. Obtain approval of the cutting and patching proposal before cutting and patching the following elements:
1. Bearing walls
 2. Lintels
 3. Structural decking
 4. Miscellaneous structural metals
 5. Equipment supports
 6. Piping, ductwork, vessels, and equipment
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Obtain approval of the cutting and patching proposal before cutting and patching the following elements:
1. Primary operational systems and equipment.
 2. Water, moisture, or vapor barriers
 3. Fire protection systems
 4. Noise and vibration control elements and systems
 5. Control systems
 6. Electrical wiring systems
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching after application of final finish. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the Owner's Project Representative's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.
 2. Re-use of existing materials for patching existing Work is prohibited unless specifically permitted in Division 1 Section "Selective Demolition" or elsewhere.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
 - 3. If existing materials are to be used for patching, inspect the materials to assure they are suitable. Reinstallation of broken or visually damaged materials is not permitted.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- E. Avoid cutting existing pipe, conduit, or ductwork serving the building.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 4. Proceed with patching after construction operations requiring cutting are complete.

- C. Patching: Patch construction by filling, repairing, refinishing (unless entire surface is indicated to be refinished elsewhere), closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather-tight condition.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017310

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Sections:
 - 1. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 2. Divisions 02 through 07 Sections and Divisions 21 through 26 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 4. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 5. Complete final cleaning requirements, including touchup painting.
 - 6. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy

of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - a. Project name.
 - b. Date.
 - c. Name of Contractor.
 - d. Page number.
2. Submit list of incomplete items in the following format:
 - a. Paper or PDF electronic file and Contractor's option.

1.6 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Clean coping and other surfaces exposed to view from ground level to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
- c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- d. Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Remove debris and surface dust from limited access spaces, including roofs, and similar spaces.
- f. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

END OF SECTION 017700

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
- B. Related Sections:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
 - 2. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Changes made by Change Order or Construction Change Directive.
 - d. Changes made following Architect's written orders.
 - e. Details not on the original Contract Drawings.
 - f. Field records for variable and concealed conditions.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Salvage of existing items to be reused.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove for Reuse: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- 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. Review Proposed Protection Measures

2. Inspect and discuss condition of construction to be selectively demolished.
3. Review and finalize selective demolition schedule, phasing, disruptions to 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 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Use of elevator and stairs.
 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Predemolition Photographs or Video: Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.8 QUALITY ASSURANCE

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

1.9 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.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. Computers & monitors
 - b. Carts, bins, furnishing.
 - c. All items from cabinets & lockers.

Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

- C. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
 - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 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. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. 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 Engineer.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.

2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 1. 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.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. 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.
 4. Maintain adequate ventilation when using cutting torches.
 5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 7. Dispose of demolished items and materials promptly and in legal manner.
- B. 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.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 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.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch 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, then remove masonry between saw cuts.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

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

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Items to Be Removed and Salvaged:
 - 1. Door hardware
 - 2. All other items indicated on construction documents.
- B. Existing Items to Be Removed and Reinstalled:
 - 1. Sharps containers
 - 2. Universal precaution cabinet
 - 3. Fire extinguisher cabinets
 - 4. Glove boxes
 - 5. Clocks
 - 6. Computer mounts
 - 7. Lockers
 - 8. Cabinets
 - 9. Signage

10. View Box
11. All other items indicated on construction documents.

END OF SECTION

SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Plastic-Laminate-Faced Architectural Cabinets
 - 2. Solid-Surface-Material Countertops

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including high-pressure decorative laminate, solid-surfacing, metal standards, shelf brackets, and cabinet hardware and accessories
- B. Samples for Initial Selection:
 - 1. Plastic laminates.
 - 2. PVC edge material.
 - 3. Thermoset decorative panels.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
- D. Samples for Verification:
 - 1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 2. Wood-grain plastic laminates, 12 by 12 inches, for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
 - 3. Thermoset decorative panels, 12 by 12 inches, for each color, pattern, and surface finish, with edge banding on one edge.
 - 4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver interior finish carpentry until painting and similar operations that could damage woodwork have been completed in installation areas. If interior finish carpentry must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom
- C. Type of Construction: Frameless
- D. Cabinet, Door, and Drawer Front Interface Style: Full overlay
- E. Reveal Dimension: 1/8 inch
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 - 1. Horizontal Surfaces: Grade HGS
 - 2. Vertical Surfaces: Grade HGS

3. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish
 4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As indicated by laminate manufacturer's designations.

2.2 SOLID-SURFACE-MATERIAL COUNTERTOP

- A. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. E. I. du Pont de Nemours and Company.
 2. Colors and Patterns: As indicated by manufacturer's designations.
- B. Configuration: Provide countertops with the following front and backsplash style:
1. Front: Straight, slightly eased at top
 2. Backsplash: Straight, slightly eased at corner
 3. Endsplash: Matching backsplash
- C. Countertops: 1/2 inch thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2 inch thick, solid surface material
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing
1. Fabricate with loose backsplashes for field assembly.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Composite Wood and Agrifiber Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
2. Softwood Plywood: DOC PS 1, medium-density overlay.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Drawer Slides: BHMA A156.9.
 1. Grade 1HD-100: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
- G. Door and Drawer Silencers: BHMA A156.16, L03011.
- H. Tempered Float Glass for Cabinet Doors: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 1. Satin Stainless Steel: BHMA 630
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

- A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- B. Fabricate cabinets to dimensions, profiles, and details indicated.

- C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- E. Install glass to comply with applicable requirements in GANA's "Glazing Manual."

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- G. Counters: Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent

surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in horizontal assemblies.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."
 - 2) FM Global in its "Building Materials Approval Guide."
- C. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

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. 3M Fire Protection Products.
 2. Firesafe AS.
 3. Hilti, Inc.
 4. Tremco, Inc.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-

resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- B. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
 - 1. Horizontal assemblies include floors.
 - 2. F-Rating: At least 2 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 2 hour, but not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:

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

3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

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

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing up to 3-1/2 inch diameter through Concrete Floor
 - 1. UL Classified System: C-AJ-1303
 - 2. F-Rating: 2 hours
 - 3. T-Rating: 2 hours
 - 4. Type of Fill Materials: As required to achieve rating.
- C. Firestopping for Openings up to 7 inch diameter in Concrete Floor with No Penetrating Items.
 - 1. UL Classified System: C-AJ-0059
 - 2. F-Rating: 2 hours
 - 3. T-Rating: 2 hours
 - 4. Type of Fill Materials: As required to achieve rating

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 08 71 00 "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.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.

8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work 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 work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

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. Ceco Door; ASSA ABLOY.
 2. Curries Company; ASSA ABLOY.
 3. Steelcraft; an Allegion brand.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2..
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches.
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - f. Core: Kraft-paper honeycomb.
 - 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
 - b. Construction: Face welded.
 - 4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z 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.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. 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.
- E. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Fire Door Cores: As required to provide fire-protection ratings indicated.
 - 2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
 - 3. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
 - 4. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Four anchors per jamb from 60 to 90 inches high.
- 5. 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.
- 6. Terminated Stops: Terminate stops 6 inches above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with [butted] or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Provide loose stops and moldings on inside of hollow-metal work.
 - 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.7 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 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and 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. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

- d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
- 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
- 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. 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.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with plastic-laminate faces.
- B. Related Requirements:
 - 1. Section 08 11 13 "Hollow Metal Doors and Frames" for door frames.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Doors to be factory finished and finish requirements.
 - 6. Fire-protection ratings for fire-rated doors.
- C. Samples for Verification:
 - 1. Plastic laminate, 6 inches (150 mm) square, for each color, texture, and pattern selected.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.
- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.8 WARRANTY

- A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

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. Construction Specialties, Inc.
 - 2. Graham Wood Doors; ASSA ABLOY Group company.
 - 3. VT Industries Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
 - 1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 - 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
- C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
- E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- F. Particleboard-Core Doors:
 - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
 - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
- G. Mineral-Core Doors:
 - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

2.3 PLASTIC-LAMINATE-FACED DOORS

- A. Interior Solid-Core Doors:
 - 1. Grade: Premium.
 - 2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
 - 3. Colors, Patterns, and Finishes: As indicated.
 - 4. Exposed Vertical Edges: Hardwood edges for staining to match faces.
 - 5. Core: Particleboard.
 - 6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces and crossbands are applied. Faces are bonded to core using a hot press.
 - 7. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES

- A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.

2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
1. Install fire-rated doors according to NFPA 80.
 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - b. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 71 11 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Electrified door hardware.
- B. Related Sections:
 - 1. Section 08 11 13 "Hollow Metal Doors and Frames".
 - 2. Section 08 14 16 "Flush Wood Doors".

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Pre-installation Meeting: Convene a pre-installation meeting one week prior to commencing work of this section; require attendance by all affected installers.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- B. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.
- C. Keying: Permanent keying will be done by the owner. Ship all uncombined permanent core to the owner's representative as directed.

- D. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
 - 1. Submit manufacturer's parts lists and templates.
- F. Keys: Provide brass construction cores for each lock and cylinder, plastic cores are unacceptable. Provide 10 construction keys for contractors use during construction.
- G. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with 10 years of experience. Supplier shall be a factory direct authorized distributor of all products specified.
- C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.7 WARRANTY

- A. Provide 10 year warranty for door closers and three years for exit devices.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by descriptive titles corresponding to requirements specified in Part 2.

2.2 HINGES

- A. Hinges: BHMA A156.1.

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. Ives; an Allegion brand.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
2. Hinges:
 - a. Mounting: Full mortise (butts).
 - b. Bearing Material: Ball bearing.
 - c. Grade:
 - 1) Doors less than or equal to 36" in width: Grade 2 standard weight)
 - 2) Doors greater than 36" in width: Grade 1 (heavy weight).
 - d. Base and Pin Metal: Stainless steel with stainless-steel pin.
 - e. Pins: Nonremovable.
 - f. Tips: Flat button.
 - g. Corners: Square.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Manufacturer: Allegion, Schlage
- B. Lock Functions: As indicated in door hardware schedule.
- C. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- D. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- E. Lock Trim: Match existing trim in facility.
 1. Dummy Trim: Match lever lock trim and escutcheons.
 2. Operating Device: Lever with escutcheons (roses).
- F. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

- G. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.
- H. Lock Cylinder: Corbin

2.4 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.
 - 1. Material: Stainless steel.
 - 2. Mounting: Mortised.
 - 3. Fire-Rated Door Assemblies: Use fail-secure electric strikes with fire-rated devices.

2.5 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. Surface Closers: Grade 1; Traditional Type with mechanism enclosed in cast-aluminum alloy shell.
 - 1. Backcheck: Adjustable, effective between 60 and 85 degrees of door opening.

2.6 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

2.7 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
- B. Armor Plates: 36 inches high by door width with allowance for frame stops.
- C. Kick Plates: 16 inches high by door width with allowance for frame stops.
- D. Mop Plates: 8 inches high by 1 inch less than door width.

2.8 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.

- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames[; use threaded-to-the-head wood screws for wood doors and frames].
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.9 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are

acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
 2. Furnish permanent cores to Owner for installation.
- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
1. Configuration: Provide [one power supply for each door opening] [least number of power supplies required to adequately serve doors] with electrified door hardware.
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

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

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.7 DOOR HARDWARE SCHEDULE

<u>GROUP</u>	<u>QTY</u>	<u>DESCRIPTION</u>	<u>MANUFACTURER</u>	<u>PRODUCT NUMBER</u>
<u>HW-1</u>	1 EA	PUSH/PULL LATCH	GLYNN-JOHNSON	HL6-US32D
	3 EA	HINGE	MCKINNEY	T4A3386
	1 EA	WALL STOP	ROCKWOOD	404 26D
	2 EA	DOOR EDGES	ABH MFG. INC.	A538, PREP FOR HARDWARE
	1 EA	ARMOR PLATE	ROCKWOOD	K1050 B4E 36" X 2" LTDW
	1 EA	KICK PLATE	ROCKWOOD	K1050 B4E 16" X 2" LTDW
	3 EA	SILENCER	ROCKWOOD	608
	1 EA	ELECTRIC STRIKE		

**South Peninsula Hospital
Operating Room HVAC Renovations**

**Section 08 71 11
DOOR HARDWARE**

2 EA DOOR ACTUATOR
1 EA AUTOMATIC DOOR OPERATOR

HW-2 1 EA LATCHSET SCHLAGE
3 EA HINGE MCKINNEY TA2314
1 EA WALL STOP ROCKWOOD 404 26D
1 EA MOP PLATE ROCKWOOD K1050 B4E 8" X 2" LTDW
1 EA KICK PLATE ROCKWOOD K1050 B4E 16" X 2" LTDW
3 EA SILENCER ROCKWOOD 608
1 EA CLOSER SARGENT 281-0

HW-3 1 EA OFFICE LOCK SCHLAGE
1 EA LOCK CYLNDER CORBIN
3 EA HINGE MCKINNEY TA2314
1 EA WALL STOP ROCKWOOD 404 26D
1 EA MOP PLATE ROCKWOOD K1050 B4E 8" X 2" LTDW
1 EA KICK PLATE ROCKWOOD K1050 B4E 16" X 2" LTDW
3 EA SILENCER ROCKWOOD 608

HW-4 1 EA STOREROOM LOCK SCHLAGE
1 EA LOCK CYLNDER CORBIN
3 EA HINGE MCKINNEY T4A3386
1 EA WALL STOP ROCKWOOD 404 26D
2 EA DOOR EDGES ABH MFG. INC. A538, PREP FOR HARDWARE
1 EA ARMOR PLATE ROCKWOOD K1050 B4E 36" X 2" LTDW
1 EA KICK PLATE ROCKWOOD K1050 B4E 16" X 2" LTDW
1 SET GASKET PEMKO S88BL
1 EA CLOSER SARGENT 281-0-DEL

END OF SECTION

SECTION 08 88 16 – VISION CONTROL GLASS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Glass with integral blinds.
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames"

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of the following products; 12 inches square.
 - 1. Vision Control Glass

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store glass units in upright position, on blocks, in dry and safe location.
- B. Do not place units in direct sunlight.
- C. Handle units using corner protectors.

1.8 WARRANTY

- A. Furnish manufacturer's 10 year warranty providing coverage against material obstruction of glass units by dust or film formation due to failure of hermetic seal.

PART 2 - PRODUCTS

2.1 PRODUCT

- A. Provide glazing units with integral blinds sandwiched between glass in hermetically sealed cavity. Subject to compliance with contract documents provide Vision Control Mini as manufactured by UniceL Architectural.

2.2 MATERIALS

- A. Clear Tempered Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind FT fully tempered.
- B. Manual Operator: Knob type
- C. Louvers: Hollow extruded aluminum, interlocking profile, 1/4 inch thick x 1-3/8" deep, Duracron, K-1285 Glossy White
- D. Glass Frame: Extruded aluminum, factory glazed, sized to accept 1-3/4 inch thick glass for insertion into hollow metal frame; clear anodized finish to match hollow metal frame.

2.3 ACCESSORIES

- A. Setting Blocks: ASTM C864, neoprene or EPDM
- B. Spacers: ASTM C865, neoprene or EPDM
- C. Glazing Gaskets: ASTM C864, neoprene or EPDM
- D. Glazing Sealant:
 - 1. ASTM c920, Type S, Grade NS, Class 25; single component silicone type, low modulus, non-sag
 - 2. Sealant backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.
 - 3. Compatible with glass unit edge seals tested to ASTM C1294

2.4 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having

jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.2 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type GL-1
 - 1. Outer lite: 1/4 inch tempered glass.
 - 2. Airspace: 1-1/4 inch

3. Inner lite: 1/4 inch tempered glass
4. Safety glazing required.

END OF SECTION

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. 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 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 or Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
 - 1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch.

- b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 - 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.033 inch.
 - 2. Depth: As indicated on Drawings.
- H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings.
 - 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
 - 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that

imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

- a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.
 2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
1. Depth: 2-1/2 inches.
- E. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.033 inch.
 - b. Depth: 2-1/2 inches.
 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
 - a. Minimum Base-Metal Thickness: 0.033 inch.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.

- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c.
 - 2. Carrying Channels (Main Runners): 48 inches o.c.
 - 3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Do not attach hangers to steel roof deck.
 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
- B. Related Requirements:
 - 1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 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.

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. 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. Thickness: 5/8 inch.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
 - 1. Thickness: 1 inch.
 - 2. Long Edges: Double bevel

2.5 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. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
 - 2. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 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 drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. 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.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Vertical and horizontal 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.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 3. Fastening Methods: Fasten base layers and face layers separately to supports with 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.

3.5 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, rounded or beveled edges, 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 5: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

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

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
 - 2. Suspension System: Obtain each type from single source from single manufacturer.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

- A. Manufacturer: Subject to compliance with specifications provide DUNE, 1773 as manufactured by Armstrong World Industries.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Type: AP

- 2. Composition: Mineral fiber
- 3. Surface Texture: Fine
- 4. Fire Class: A
- C. Color: White.
- D. LR: Not less than 0.83.
- E. NRC: Not less than 0.50.
- F. CAC: Not less than 33.
- G. Edge/Joint Detail: Square.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 48 inches.
- J. Dimensional Stability: HumiGuard Plus

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion or Postinstalled bonded anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.
- D. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- E. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

2.5 METAL SUSPENSION SYSTEM

- A. Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching. Structural Classification: Heavy-duty system.
1. Structural Classification: ASTM C 635 Heavy Duty dutyCap Material: Steel cold-rolled sheet.
 2. Color: White
 3. Basis of Design Product: Prelude XL 15/16", Exposed Tee as manufactured by Armstrong World Industries.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
 3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 3. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 4. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 5. Do not attach hangers to steel deck tabs.
 - 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Compliance of seismic design.
- B. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F, in spaces to receive resilient products during the following time 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 or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE (B2)

- A. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous), Style B (cove).
- B. Thickness: 0.125 inch.

- C. Height: 4 inches.
- D. Lengths: Coils in manufacturer's standard length.
- E. Outside Corners: Job formed or preformed.
- F. Inside Corners: Job formed or preformed.
- G. Colors: Match existing rubber base.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

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. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the 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.
- E. 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. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches 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 exposed surfaces.
- 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

SECTION 09 65 16 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes vinyl sheet flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of resilient sheet flooring required.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for resilient sheet flooring installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following time 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 or more than 95 deg F.
- C. Close spaces to traffic during resilient sheet flooring installation.
- D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.
- E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. FloorScore Compliance: Resilient sheet flooring shall comply with requirements of FloorScore certification.
- C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 SHEET VINYL (F1)

- A. Manufacturer: Subject to compliance with requirements, provide Mannigton Commercial heterogeneous sheet flooring.
- B. Product Standard: ASTM F 1303.
 - 1. Type (Binder Content): Type II, minimum binder content of 34 percent.
 - 2. Wear-Layer Thickness: Grade 2.
 - 3. Overall Thickness: As standard with manufacturer.
 - 4. Backing Class: Class B (nonfoamed plastic).
- C. Wearing Surface: Smooth.

- D. Sheet Width: As standard with manufacturer.
- E. Seamless-Installation Method: Heat welded.
- F. Colors and Patterns: Relay RE, 23016 Deep Wedgewood

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.
 - 1. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: 842409.
- D. Integral-Flash-Cove-Base Accessories:
 - 1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
 - 2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

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 sheet flooring.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.
 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
 1. Maintain uniformity of flooring direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
 3. Match edges of flooring for color shading at seams.
 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.
- H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
- J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
 - 1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.
 - 1. Apply three coat(s).
- E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes modular, tufted carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written specifications and lab documents for any physical testing.
 - 2. Include installation recommendations for each type of substrate as specified in carpet manufacturer's installation guidelines and/or Carpet & Rug Institute Installation Standard 2011, where applicable.
 - 3. Include carpet maintenance recommendations as outlined by the carpet manufacturer.
 - 4. Carpet Manufacturer shall also submit a plan for recycling the specified carpet at the end of the useful life of the carpet.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.
- C. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified independent testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with carpet manufacturer's installation recommendations and the Carpet & Rug Institute Installation Standard 2011 where applicable.

1.7 FIELD CONDITIONS

- A. Comply with carpet manufacturer's installation recommendations and the Carpet & Rug Institute Installation Standard 2011 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. HVAC system should be operational and running prior to carpet installation and remain running after carpet installation.
- D. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to allow bond between adhesive and concrete. Concrete slabs should have moisture and pH readings that are within the specified tolerance of the adhesive to be used.
- E. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.8 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 2. Failures include, but are not limited to, more than 10 percent face fiber loss, edge raveling, dimensional instability, excess static discharge, loss of tuft bind strength, delamination, and where face fiber is 100 percent solution dyed, inability to remove acid based stains, lack of colorfastness to atmospheric contaminants.
 3. Carpet must be manufactured and warranted by same manufacturer.
 4. Warranty Period: Lifetime Commercial Limited Warranty.

PART 2 - PRODUCTS

2.1 CARPET TILE (F2)

- A. Product: Subject to compliance with requirements, provide Patcraft; Big Splash I0166.
- B. Color: 003 Pop.
- C. Pile Characteristics: Pattern Loop

- D. Fiber Content Nylon - 100 percent trilobal, minimum 24 denier per filament DPF nylon 6. Fiber must contain a minimum of 45 percent recycled content 20 percent pre consumer recycled content and 25 percent post consumer recycled content.
- E. Fiber Name: Eco Solution Q Nylon
- F. Dye Method: Solution Dye/Yarn Dye
- G. Gauge: 1/10
- H. Stitches: 10
- I. Pile Thickness: 0.100
- J. Surface Pile Weight: 26 oz
- K. Density: 9360
- L. Primary Backing: Nonwoven synthetic.
- M. Secondary Backing: High performance precoat laminated to a proprietary thermoplastic polyolefin compound with a fiberglass reinforced layer. Backing must contain a minimum of 40 percent recycled content and be SCS NSF 140 Platinum certified. Backing should be recyclable, PVC free, free of 4-PCH, brominated flame retardants, and phthalate plasticizers.
 - 1. Total Backing Weight: Not to exceed 80 oz./sq yd (339.1 g/sq m).
- N. Backing System: EcoWorx.
- O. Applied Soil-Resistance Treatment: SSP Shaw Soil Protection.
- P. Total Weight: 99 oz for finished carpet tile.
- Q. Size: 24 by 24 inches
- R. Texture Appearance Retention Rating (T.A.R.R.):
 - 1. Texture Appearance Retention Rating (T.A.R.R.): Severe
- S. Recycling Requirements:
 - 1. Total Carpet Product Recycled Content:
 - a. Pre-Consumer Recycled Content: 32.0 percent.
 - b. Post-Consumer Recycled Content: 12.5 percent.
 - c. Total Recycled Content: 44.5 percent.
 - 2. Recycled Content: Preference will be given to manufacturer's recycling 100 percent of reclaimed carpet tile back into carpet tile with recycled content.
 - 3. Carpet Disassembly and Recycling: Carpet capable of disassembly and recycling, with nylon being recycled into nylon and backing being recycled into backing.

4. Carpet product must meet guidelines of Presidential Executive Order 13101, and must meet the spirit of section 6002 of the Resource and Recovery Act (RCRA).
- T. Performance Characteristics: As follows:
1. Critical Radiant Flux Classification, Flooring Radiant Panel ASTM E 648: Not less than 0.45 W/sq. cm.
 2. Smoke Density: Less than 450 per ASTM E662.
 3. Methanamine Pill Test CPSC FF1-70: Must pass pill test.
 4. Tuft Bind: Not less than 8 lbf (36 N) according to ASTM D 1335.
 5. Delamination: Not less than 3.5 lbf/in. according to ASTM D 3936.
 6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
 7. Dimensional Stability: 0.119 percent or less according to ISO 2551 (Aachen Test).
 8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 129 and AATCC 164.
 9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
 10. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
 11. Emissions: Provide carpet tile that complies with testing and product requirements of Carpet & Rug Institute's "Green Label Plus" program.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Trowelable Adhesives: Water-resistant, mildew-resistant, nonstaining, premium grade, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation such as Shaw 5000 or Shaw 5100 or available equivalent where slab moisture does not exceed 85 percent per ASTM F 2170 or 5 lbs per ASTM F 1869. Where slab moisture does not exceed 85 percent and antimicrobial protection is needed to pass AATCC 174, use Shaw 5036. Where moisture exceeds 85 percent or 5 lbs but does not exceed 90 percent or 10 lbs, use Shaw 5900 or available equivalent.
1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
 3. Adhesives shall comply with the testing and product requirements of the Carpet and Rug Institute Green Label Plus Program.

- C. Non-Trowelable Adhesive: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation such as LokDots where slab moisture does not exceed 95 percent per ASTM F 2170 or 10 lbs per ASTM F 1869. Each carpet tile must be adhered to the subfloor.
- D. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects prior to installation. See manufacturer's requirements for substrate conditions and ambient conditions.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing moisture and pH tests as recommended by carpet tile manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 4. Lightweight concrete and gypcrete subfloors may require a primer such as Shaw 9050 or equivalent to reduce surface porosity.
 - 5. Where previous surface treatments are unknown, or where other concerns exist as to the ability of the adhesive to bond to the substrate, a 24 hour bond test is recommended.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with Carpet & Rug Institute Installation Standard 2011, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds that contain a cementitious base with a latex additive, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with Carpet & Rug Institute installation Standard 2011, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive, such as LokDots. Any non-spreadable adhesive system must adhere the carpet to the substrate.
- C. Maintain dye lot integrity. Do not mix dye lots in same area unless the specific carpet style is manufactured as a merge-able dye lot product.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.
- I. Roll the entire installation with a 75 lb roller once installation is completed.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with Carpet & Rug Institute Installation Standard 2011, "Protecting Indoor Installations."
- C. When construction or move-in activities will continue where new carpet is installed, provide non-staining building material paper to protect carpet. Do not use plastic sheeting as it can trap moisture, and self-sticking plastic sheeting can transfer adhesive residue to carpet that will attract soil.
- D. When heavy objects are moved over carpet within 24 hours of installation, use plywood over carpet to prevent buckling and wrinkling.

- E. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Steel.
 - 2. Galvanized metal.
 - 3. Gypsum board.
- B. Related Requirements:
 - 1. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings.

1.3 DEFINITIONS

- A. Gloss Level 5: 35 to 70 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.
- B. 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 square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

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. 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.
 - 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.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. PPG Architectural Coatings.
 - 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Color: Sherwin Williams, SW 7012 Creamy

2.3 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

2.4 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.

2.5 WATER-BASED PAINTS

A. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.

2.6 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 coatings 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.

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.
- 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 Manual" applicable to substrates 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[,] but not less than the following:
 - 1. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

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.

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. Steel Substrates:
 - 1. Latex over Alkyd Primer System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- B. Galvanized-Metal Substrates:
 - 1. Latex over Waterborne Primer System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
- C. Gypsum Board Substrates:
 - 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.

END OF SECTION

SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Gypsum board.
- B. Related Requirements:
 - 1. Section 099123 "Interior Painting" for special-use coatings and general field painting.

1.3 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- B. 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 indicated. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

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. Coatings: 5 Insert number percent, but not less than 1 gal. 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.
 - 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 coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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. PPG Architectural Finishes, Inc.
 - 2. Sherwin-Williams Company (The).

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. Colors: Sherwin Williams, SW 7012 Creamy

2.3 INTERIOR PRIMERS/SEALERS

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

2.4 EPOXY COATINGS

- A. Epoxy, Gloss: MPI #77.

2.5 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating 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 coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

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.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Gypsum Board: 12 percent.
- B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Remove 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.
- C. Clean substrates of substances that could impair bond of coatings, 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 coating systems indicated.
- D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

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

2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating 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 coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
 1. Epoxy System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy, gloss, MPI #77.
 - c. Topcoat: Epoxy, gloss, MPI #77.
- B. Galvanized-Metal Substrates:
 1. Epoxy System:
 - a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Epoxy, gloss, MPI #77.
 - c. Topcoat: Epoxy, gloss, MPI #77.
- C. Gypsum Board Substrates:
 1. Epoxy System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Epoxy, gloss, MPI #77.
 - c. Topcoat: Epoxy, gloss, MPI #77.

END OF SECTION

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall protection.
 - 2. Corner guards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
 - 2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.
- B. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Wall Protection: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.
 - 2. Corner Guards: 12 inches long. Include example top caps.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of exposed plastic material.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
 - 2. Keep plastic materials out of direct sunlight.
 - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
 - a. Store corner-guard covers in a vertical position.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards as manufacturer by IPC Door and Wall Protection Systems, InPro Corporation: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - 1. Cover: Extruded rigid plastic, minimum 0.080-inch wall thickness; as follows:

- a. Profile: Nominal 3-inch-long leg.
 - b. Height: 4 feet.
 - c. Color: Clam Shell.
2. Continuous Retainer: Minimum 0.070-inch-thick, one-piece, extruded aluminum.
 3. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.4 WALL PROTECTION (WP)

- A. Subject to compliance with specification provide rigid vinyl sheet as manufacturers by IPC Door and Wall Protection Systems, InPro Corporation.
 1. Size: 48 by 96 inches for sheet.
 2. Sheet Thickness: 0.040 inch.
 3. Color: Clam Shell.
 4. Height: 4'-0"
 5. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
 6. Mounting: Adhesive.

2.5 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection-product manufacturer and with a VOC content of 70 g/L or less.

2.6 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using cleaner recommended by manufacturer.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wet Pipe Sprinkler System.
- B. System Design, Materials, Installation, and Certification.

1.2 SCOPE DESCRIPTION

- A. Provide a complete wet automatic fire sprinkler system, hydraulically calculated to protect the entire remodeled area of the facility, complete and in operating order. This fire protection system shall be in compliance with the contract documents, applicable codes and standards, as well as the Authority having jurisdiction.

1.3 SPECIAL REQUIREMENTS

- A. Provide complete interface with building smoke and fire alarm system.

1.4 CODES AND STANDARDS

- A. IBC Latest Adopted Edition.
- B. NEC Latest Adopted Edition.
- C. UPC Latest Adopted Edition.
- D. IMC Latest Adopted Edition.
- E. IFC Latest Adopted Edition.
- F. NFPA 13 Standard for the Installation of Sprinkler Systems, latest adopted edition.
- G. NFPA 25 Water-Based Fire Protection Systems, latest adopted edition.
- H. ASCE Standard 7, Minimum Design Loads for Buildings and Other Structures, latest adopted edition.

1.5 RELATED WORK

- A. Section 22 05 00, Common Work Results for Plumbing.
- B. Section 23 05 00, Common Work Results for HVAC.
- C. Section 28 31 00, Fire Detection and Alarm.

1.6 QUALITY ASSURANCE

- A. Unless otherwise noted, this is substantially a "performance" specification.
- B. Minimum qualifications of the contractor/subcontractor shall include the following:

1. Specialist Firm: Company specializing in automatic fire protection/sprinkler systems, possessing a minimum of five (5) years of documented experience working in Health Care Facilities in the State of Alaska. Contractor shall provide list with a minimum of 5 successful Health Care projects completed in the last 5 years prior to any on-site work.
 2. Design Certification: Shop drawings shall be prepared by a person with a minimum certification of level II designer, supervised by a Licensed Professional Engineer or a level III or IV Fire Sprinkler Designer, certified by the National Institute for Certification in Engineering Technologies (NICET), in Fire Protection Engineering Technology Automatic Fire Sprinkler System Layout.
 3. Equipment and components: Bear the "UL" label or the "FM" approval marking.
 4. Maintain a complete stock of replacement parts.
 5. Remain on 24 hour call for emergency service.
 6. Maintain an office and telephone, with authorized representatives of the Fire Protection Contractor's firm, including the Designated Project Mechanical Sprinkler Supervisor, with a physical presence and address in Alaska.
 7. Bids of wholesalers, contractor or any firm whose principal business is not that of manufacturing and/or installing fire protection systems is not acceptable.
- C. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:
1. List of 5 successful Health Care Facilities projects in the State of Alaska with names, addresses, and phone numbers of Owners. Include a brief description and scope of plumbing work complete in each project.

1.7 SUBMITTALS

- A. Submit under provisions of General Conditions of the Contract.
- B. Submit contractor's qualifications, proof of 5 years' experience under this contractor's firm name, and references for at least 5 projects in Alaska of similar type, size, and complexity.
- C. Submit a copy of designer's NICET certification and resume', or Alaska P.E. license number.
- D. Submit shop drawings and hydraulic calculations concurrently to the engineer and the State Fire Marshal for review. Submit one set of stamped approved shop drawings and hydraulic calculations to the Architect/Engineer when available from AHJ. Engineer will retain 1 set of "stamped approved" shop drawings. These sets must include the NICET certification or stamp of a licensed professional engineer as described above.
- E. Submit all written reviews and contractor responses to reviews to the Architect/Engineer.
- F. Submit product data, and sprinkler head layout. Sprinkler head layout shall be reviewed by the Architect/Engineer. All other approvals shall be secured prior to materials fabrication. Additional sprinklers as required shall be added at no additional cost to the contract.
- G. Shop Drawings shall include the following information in compliance with NFPA 13:
 1. Name of Owner, occupant and Building Permit Number.

2. Location, including street address and legal description.
3. Point of compass.
4. Fire Department Connections.
5. All necessary controlling equipment.
6. Location of water source, type, routing, depth of bury and size of supply piping. Identify location and size of city main and whether it is dead-end or circulating loop, and distance to the flow data test hydrant.
7. All distribution system piping and outlets. Include pipe and fitting types.
8. Reflected ceiling plan showing ceiling heights, construction type, proposed location and type of sprinkler heads, and other ceiling devices such as HVAC diffusers, loud speakers, type and location of light fixtures, etc.
9. Interference control between sprinkler system and other trades.
10. Full height cross section.
11. Location of partitions. Identification of full height walls and draft stops.
12. Location and size of unsprinklered concealed spaces.
13. Identification of unheated areas.
14. Water Flow Test Results; include testing agency; time, date and location of test; actual pitot reading at flow hydrant; and equipment used to perform the test.
15. Make, model, Type, orifice, finish and Temperature rating of sprinklers and their respective locations.
16. On systems that are hydraulically calculated, indicate the square footage area protected by each system.
17. Hydraulic node points.
18. Identify low point drain and inspector test stations.
19. Indicate the type and location of all piping hangers and equipment supports.
20. Indicate the type and location of all seismic bracing and restraint.
21. Make, model, size, and locations of all pipe couplings, fittings and flanges.
22. Provisions for flushing.
23. When the equipment to be installed is an addition or renovation to an existing sprinkler system, enough of the existing system shall be shown on the shop drawings to indicate the total number of sprinklers and the total square foot area protected by the entire system.

24. Name, address and telephone number of the contractor. If design is by a separate firm, include the name address and telephone number of the design facility.
25. Complete legend of all abbreviations and symbols indicated.
26. Complete schedule of all room occupancies.
27. Location of all unit heaters.
28. Location of all structural penetrations.
29. Note the location of all "exposed" piping.

1.8 MAINTENANCE INFORMATION, FRAMED BUILDING PLAN AND RECORD DRAWINGS

- A. Submit under provisions of General Conditions of the Contract.
- B. Install one copy of the record hydraulic calculations and shop drawings in a metal sleeve box on the wall near the fire sprinkler riser.
- C. The contractor shall maintain current and up-to-date "Record Drawings" of the fire protection system at the job site, in accordance with General Conditions of the Contract. Significant changes in piping due to onsite coordination with other trades will require recalculation to confirm adequate pipe sizing.

1.9 REVIEWS, APPROVALS, AND PERMITS

- A. Obtain written review and/or approval of the entire fire protection system design and arrangement from the following authorities:
 1. Architect/Engineer.
 2. State of Alaska Fire Marshal.
- B. Comply with all review comments, revising the system design as required, and resubmitting in a timely manner, so as not to hinder the construction schedule.
- C. Obtain and pay for all required permits, inspections, tests, and approvals as required by authorities having jurisdiction.

1.10 WATER FLOW INFORMATION, HYDRAULIC CALCULATIONS, SEISMIC CALCULATIONS

- A. Obtain and verify the water supply Static Pressure, Residual Pressure, at full flow of the test hydrant, at a time of day, during the peak demand on the system, at the point of connection to the water utility system or at a nearby point acceptable to the approval authority. Obtain this data from actual flow test. Identify the testing agency and the source of the test data.
- B. The test shall be conducted by the designated project Design Supervisor, or Field Superintendent. The test shall be conducted in accordance with NFPA 291, Recommended Practice for Fire Flow Testing and Marking of Hydrants.
- C. Hydraulic Calculations shall be accomplished in compliance with the procedures established in NFPA 13. In addition to minimum NFPA 13 standards, a minimum 15% pressure buffer is required to be designed into the system. Where local authorities require additional buffer, the contractor shall comply with the more demanding requirement.

- D. Hydraulic Calculations accomplished by computer program for submittal shall be accompanied by a complete legend of the abbreviations, nodes, and symbols utilized on the computer readout.
- E. Hydraulic Calculations shall clearly identify the following:
 - 1. System type, sprinkler "K" factor, and "C" factor.
 - 2. Pipe and fittings type.
 - 3. Fitting Equivalent Length chart which complies with the "C" factor and pipe type.
 - 4. NFPA hazard designation, Design Density and size of the Design Remote Area.
 - 5. The Elevation of the "highest" sprinkler.
 - 6. The available water supply and system demand at the point of connection to the water supply, indicated on a logarithmic graph. Include hose demands.
- F. Seismic Calculations shall clearly identify the following:
 - 1. Type, length and size of brace.
 - 2. Angle allowed of brace.
 - 3. Maximum horizontal load of brace.
 - 4. Brace attachment to structure and load rating.
 - 5. Brace attachment to pipe and load rating.
 - 6. Calculated load to be braced.

1.11 COORDINATION REQUIRED

- A. The contractor shall examine the structural, architectural, mechanical, electrical and all other drawings relating to the building and plan his work accordingly. He shall check and verify all dimensions at the site before fabricating any portion of the system. Any discrepancies in piping and head locations resulting from failure to do so shall be corrected expeditiously to provide proper coordination of all trades.
- B. Coordinate work with that of other trades to ensure that adequate space is provided for all work, including requirements for serviceability and accessibility. Locate sprinkler heads to avoid conflict with light fixtures and other installed equipment.
- C. Sprinklers shall be "centered" or quarter centered in both directions in units of the ceiling suspension system. Adjust the final location of the sprinklers in the field to accomplish these requirements.

1.12 MATERIALS HANDLING AND STORAGE

- A. Deliver, store, protect, and handle products to the site under provisions of General Conditions of the Contract. Deliver and store valves in manufacturer packaging with labeling in place. Prior to installation, piping onsite shall be wrapped with protective wrapping. Valves, piping, materials, and equipment shall be clean and new when system is accepted by the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide only new materials and equipment, which are standard products of a manufacturer regularly engaged in the manufacture of fire protection equipment.
- B. All products shall bear the "UL" label or "FM" listing and be specifically approved for fire protection application where they are used.

2.2 PIPING

- A. Wet Pipe Sprinkler Systems:
 - 1. Black steel piping, ASTM A135 schedule 10 or ASTM A795 schedule 40, UL Listed or FM Approved for fire sprinkler service.
 - 2. Piping may be roll-grooved, threaded, flanged, or welded for connection. All threaded pipe shall be schedule 40. No plain-end piping fitting connections are allowed.

2.3 GROOVED FITTINGS, COUPLINGS, AND MECHANICAL TEES

- A. Grooved Fittings shall be Victaulic, Gruvlok, or equal. Galvanized fittings shall accompany galvanized piping. Couplings and mechanical tees shall be standard painted Victaulic, Gruvlok, or equal.
- B. Slip-Fit fittings and couplings utilized for joining branch piping to new main piping shall not be allowed.
- C. Contractor shall follow the manufacturer's suggested methods to prepare, carefully, the ends for these fittings to prevent leakage or system breakdown.

2.4 THREADED PIPE FITTINGS

- A. Threaded pipe fitting for this system shall be cast iron 125# ANSI B16.4 or malleable iron 150# ANSI B16.3.

2.5 PIPE FLANGES

- A. Pipe flanges for this system shall be Cast Iron Class 125# ANSI B16.5.

2.6 PIPING HANGERS AND SUPPORTS

- A. Pipe hangers shall conform to NFPA 13 standards.

2.7 FLEXIBLE SPRINKLER HOSE FITTINGS

- A. FM approved and UL listed for use in fire protection service.
- B. Seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
- C. Composition: 100% Type 304 Stainless Steel. 175 or 300 PSI minimum rated pressure as appropriate for installed system.

- D. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch true-bore internal corrugated hose diameter.
- E. Ceiling bracket of G90 galvanized steel with snap-on clip ends positively attached to the ceiling using tamper-resistant screws. Flexible hose attachment shall be removable hub type with set screw.

2.8 SPRINKLERS

- A. Provide sprinklers as required by NFPA 13 standards and in compliance with the IBC chapter 9 for the entire project. Sprinkler finish and style as follows:
 - 1. In all areas with surface mounted light fixtures attached to finished suspended ceilings, provide standard spray pendant sprinklers, and extended escutcheons to position the sprinkler deflector below the light fixture. Sprinklers and escutcheons to be white finish. Tyco TY-FRB or equal.
 - 2. In all areas with recessed lighting flush to the suspended ceiling finish, provide recessed standard spray pendant sprinklers. Sprinklers and escutcheons to be white finish. Tyco TY-FRB or equal.
 - 3. Sprinklers above ceilings and throughout shop and mechanical service areas shall be bronze finish, standard spray, upright or pendant type as required by the drawings.
 - 4. Sidewall sprinklers shall be bronze finish in all service areas, and white throughout all public areas.
 - 5. Concealed sprinklers shall be used where indicated for architectural considerations. Cover plate shall screw over the recessed sprinkler head and be almost flush with the ceiling. Cover plate shall be white.
 - 6. Sprinkler Guards shall be of the same manufacturer and finish as the sprinkler which they are to be installed on. Red guards are acceptable for bronze sprinklers only. Chrome finish guards are required for chrome sprinkler heads.
 - 7. Sprinklers of correct temperature rating shall be installed according to NFPA 13.
 - 8. Sprinklers for new additions of existing facilities shall match Make, Model, and finish for existing sprinklers, while complying with NFPA 13 standards, provided those sprinklers are still being manufactured.
 - 9. Provide sprinkler wrenches for each type of sprinkler.
 - 10. Spare sprinkler cabinet to be red sheet steel manufactured by the same company that made the sprinklers. Size the cabinet in accordance with NFPA 13 standards. Provide sprinklers for the cabinet representative of the assortment provided for the system. Mount cabinet on the wall within 60" of the sprinkler control riser.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. The fire protection contractor shall coordinate his work with the work of all other trades to assure timely installation and efficient use of mechanical areas including but not limited to boiler rooms, fan rooms, and ceiling spaces.

- B. Any work installed without proper coordination shall be promptly removed and reinstalled in a manner to allow for a good practical arrangement of all items which need to be installed by all crafts involved.
- C. In case of coordination dispute, the Architect/Engineer shall be consulted and his decision shall be binding.
- D. All costs associated with coordination and arranging or rearranging of the fire protection system shall be borne by the affected contractor, without causing any additional expense to the Owner.

3.2 PIPING INSTALLATION

- A. Install piping to conserve building space and route piping around access panels and openings. Piping shall not restrict any access opening.
- B. Install low point drain stations in accordance with NFPA 13 standards. Identify the location of drain and test stations with signs on access panels, ceiling panels, or walls adjacent to the station, visible from the floor. Discharge all test pipes and system main drain to outside. Coordinate discharge point with Owner's field representative.
- C. Provide seismic protection for the piping system in accordance with NFPA 13 standards. Attach bracing to structure with through bolts, washers, and nuts. Provide clearance at all structural penetrations. Provide oversized escutcheon plates or flexible connections where sprinklers penetrate non-frangible ceiling membranes.
- D. Piping shall be concealed in all areas with finished ceilings.
- E. Piping concealed in walls shall be secured to studs 48" - 60" above the floor.
- F. Pipe penetrations through rated fire walls shall be sealed by a "UL" listed system utilizing fire rated caulking. Submit data under paragraph 1.8 (Submittals) of this specification.
- G. When piping is supported from manufactured structural members, the installation of pipe hangers shall comply with truss manufacturer's recommendations for hanger attachments and loading.
- H. Pipe hangers shall be "Rod and Ring" type hangers throughout. Piping hangers shall have a minimum of ½" of adjustment on each side of the hanger ring nut, to allow for piping grade adjustment in the future.
- I. All "beam clamp" type fasteners shall be installed with retainer straps and locking nuts.
- J. All Trapeze members shall be fastened to truss chords or structural members.
- K. Installation of all valves and equipment shall comply with manufacturer's suggested installation practices and directions.
- L. Provide service access around all equipment.

3.3 SYSTEM TEST

- A. Hydrostatically test the entire system in accordance with NFPA 13 standards.
- B. Test all system alarm actuations and alarms and supervisory valve alarm system.

- C. 48-hour advance notice required for all tests to allow Owner's field representative to witness these tests.

3.4 PAINTING

- A. Refer to Division 09.

3.5 PROJECT CLOSEOUT

- A. The fire protection contractor shall submit a written affidavit at the completion of the system, stating that the fire protection system as installed complies with all referenced codes and standards and the State Fire Marshal's Office.
- B. Furnish Written Guarantee to the Owner, that materials installations are free from mechanical defects and guaranteeing to replace and repair any and all unsatisfactory and defective work and items, to the satisfaction of the Owner, in a timely manner, for a period of one year after final acceptance of the building by the Owner, and to be responsible for any damage caused to the premises for any such unsatisfactory work.
- C. The contractor shall respond within reasonable time, to repair or replace latent or hidden defects at such time as they are discovered.
- D. Provide hydraulic placard on system riser. Placard shall indicate sprinkler demand and hose demand as separate numbers.
- E. Contractor shall fully train the Owner's designated maintenance engineer in the operation and maintenance of the entire fire protection system.

END OF SECTION

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SCOPE

- A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.2 WORK INCLUDED

- A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.
- B. General Conditions of the Contract of the specifications is to be specifically included as well as all related drawings.

1.3 RELATED WORK

- A. Related Work Specified Elsewhere:
 - 1. Fire Suppression Specifications: Division 21.
 - 2. Heating, Ventilating and Air Conditioning (HVAC) Specifications: Division 23.
 - 3. Electrical Specifications: Division 26.
- B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electric switches, electrical components, wiring and any other miscellaneous Division 22 controls.
- C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.4 REFERENCED CODES - LATEST ADOPTED EDITION

- A. NFPA 13 Installation of Sprinkler Systems.
- B. NFPA 70 National Electrical Code (NEC).
- C. IMC International Mechanical Code.
- D. UPC Uniform Plumbing Code.
- E. IECC International Energy Conservation Code.
- F. IFC International Fire Code.
- G. IFGC International Fuel Gas Code.
- H. IBC International Building Code.

1.5 QUALITY ASSURANCE

- A. Plumbing Contractor Qualifications:
 - 1. The Plumbing Contractor shall have a minimum of five (5) years of documented experience working in Health Care Facilities in the State of Alaska. Contractor shall provide list with a minimum of 5 successful Health Care projects completed in the last 5 years prior to any on-site work.
- B. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:
 - 1. List of 5 successful Health Care Facilities projects in the State of Alaska with names, addresses, and phone numbers of Owners. Include a brief description and scope of plumbing work complete in each project.

1.6 PROJECT RECORD DRAWINGS

- A. In addition to other requirements of General Conditions of the Contract, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.
- B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.
- C. Show the location of all valves and their appropriate tag identification.
- D. At completion of project, deliver these drawings to the Owner and obtain a written receipt.

1.7 SUBMITTALS

- A. See General Conditions and the General Requirements in General Conditions of the Contract regarding submittals.
- B. Submit by specification section complete and all at one time; partial submittals will not be considered. The data shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.
- C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.
- D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.
- E. Submit product data for:
 - 1. Hangers and Supports for Plumbing Piping and Equipment.
 - 2. Vibration and Seismic controls for Plumbing Piping and Equipment.
 - 3. Identification for Plumbing Piping and Equipment.
- F. Provide plumbing contractor qualifications submittal to include list of health care projects.

1.8 OPERATING AND MAINTENANCE MANUALS

- A. Submit maintenance manuals to the Engineer covering all equipment, fixtures, devices, etc. installed by the Contractor.
- B. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The data shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications. The manual shall contain, but not limited to, the following types of information:
 - 1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
 - 2. Catalog cuts of all equipment, fixtures, etc. installed (Marked to identify the specific items used).
 - 3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
 - 4. Identification numbers of all parts and nearest sources for obtaining parts and services.
 - 5. Reduced scale drawings of the control system and a verbal description of how these controls operate.
 - 6. A copy of the final test and balance report.
 - 7. A copy of valve schedule and reduced scale drawings showing valve locations.
 - 8. Written summary of instructions to Owner.
 - 9. All manufacturers' warranties and guarantees.
 - 10. Contractors Warranty Letter.
- C. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.9 HANDLING

- A. See General Conditions and the General Requirements in General Conditions of the Contract regarding material handling.
- B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.10 SUBSTITUTIONS

- A. See General Conditions and the General Requirements in General Conditions of the Contract for substitution request procedures.
- B. In accordance with the General Conditions and the General Requirements in General Conditions of the Contract, Substitution and Product Options, all substitute items must fit in the

available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment. The Owner shall be the final authority regarding acceptability of substitutes.

1.11 DIMENSIONS

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.
- B. Any differences, which may be found, shall be submitted to the Owner and Engineer for consideration before proceeding with the work.

1.12 MANUFACTURER'S DIRECTIONS

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.13 PERMITS, FEES, ETC.

- A. The Contractor under each Division of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.14 TESTING

- A. The Contractor under each section shall at his own expenses perform the various tests as specified and required by the Architect and as required by applicable code, the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests.

1.15 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.
- D. "This section" refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.
- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.16 SCHEDULE OF WORK

- A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times

as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade. The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.17 COOPERATION AND CLEANING UP

- A. The contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.
- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.18 WARRANTY

- A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warranted for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Guarantee shall be in accordance with General Conditions of the Contract.

1.19 COMPLETION REQUIREMENTS

- A. In accordance with the General Conditions and the General Requirements in General Conditions of the Contract, Project Closeout; before acceptance and final payment, the Contractor shall furnish:
 - 1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
 - 2. Contractors One Year Warranty.
 - 3. All Manufacturers' Guarantees.
 - 4. Test and Balance Reports.
 - 5. Operation and Maintenance Manuals.

1.20 INSPECTION OF SITE - REMODEL PROJECTS

- A. The accompanying plans do not indicate completely the existing mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.21 RELOCATION OF EXISTING INSTALLATIONS

- A. There are portions of the existing mechanical systems, and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of his particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

1.22 SALVAGE MATERIALS

- A. The Contractor shall remove existing fixtures, equipment and other items associated with the plumbing systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.
- B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the contractor and shall be removed from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All equipment shall be regularly cataloged items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.
- B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.2 RESTRICTED MATERIALS

- A. No materials containing asbestos in any form shall be allowed.
- B. No solder or flux containing lead shall be used on this project.
- C. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be "lead free" in accordance with the Safe Drinking Water Act, Section 1417. "Lead free" materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.
- D. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.3 ELECTRICAL MOTORS

- A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.
- B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.
- C. Size motors for 1.15 service factor and not to exceed 40° C temperature rise above ambient.
- D. Fractional horsepower motors to have self-resetting thermal overload switch.
- E. Provide NEMA Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.4 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

- A. Plastic Nameplates: Laminated plastic with engraved letters.
- B. Plastic Tags: Laminated plastic with engraved letters, minimum 1-1/2 inches diameter.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, for direct burial service.
- F. Label ceiling grid for mechanical equipment, valves and control components located above ceiling. Description: 3/4" x 3" vinyl label, 3.0 Mil self-adhesive vinyl similar to Dura Label Pro. Label color shall be black text on a white background. The label shall contain the equipment tag, valve tag or identification tag for control component.

2.5 PIPE HANGERS AND SUPPORTS

- A. Acceptable Manufacturers:
 - 1. Anvil.
 - 2. B-Line Systems, Inc.
 - 3. Erico.
 - 4. PHD Manufacturing, Inc.
 - 5. Tolco.
- B. Plumbing Piping - DWV:
 - 1. Conform to ANSI/MSS SP58.

2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.
- C. Plumbing Piping - Water:
1. Conform to ANSI/MSS SP58.
 2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 5. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 6. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 7. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 8. Vertical Support: Steel riser clamp.
 9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.
 12. Design hangers to allow installation without disengagement of supported pipe.
 13. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe, except hanger rings with factory-applied 1/16 inch minimum thick plastic or tape cushion strip over all contact surfaces.

14. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A 570 GR33, one side of channel shall have a continuous slot with inturred lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.
- D. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180° segments, minimum 12 inches long at pipe support.
- E. Shield for Insulated Piping 2 Inches and Larger: Hard block, calcium silicate insert, 180° segment, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.
- F. Shields for Vertical Copper Pipe Risers: Galvanized steel pipe.

2.6 HANGER RODS

- A. Steel Hanger Rods: Mild steel, threaded both ends, threaded one end, or continuous threaded. Minimum Hanger Rod Sizes:

PIPE AND TUBE SIZE (INCHES)	ROD SIZE (INCHES)
¼-4	3/8
5-8	1/2
10-12	5/8

2.7 INSERTS

- A. Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.8 ANCHOR BOLTS

- A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.9 EQUIPMENT CURBS

- A. Fabricate curbs of concrete or steel beam, unless specifically called out otherwise.

2.10 FLASHING

- A. Metal Flashing: 26-gauge minimum galvanized steel.
- B. Metal Counter Flashing: 22 gauge minimum galvanized steel.
- C. Flexible Flashing: 47-mil thick sheet butyl, compatible with roofing.
- D. Caps: Steel, 22-gauge minimum; 16 gauge at fire resistant elements.

2.11 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed caulking system.
- D. Fire Stopping Insulation: Mineral fiber type, non- combustible.
- E. Caulk: Fire stop sealant in compliance with ASTM E814, UL 1479 and Division 07.
- F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.12 ACCEPTABLE MANUFACTURERS: VIBRATION ISOLATORS AND SEISMIC RESTRAINT

- A. Vibration isolators and Seismic Restraint shall be manufactured by:
 - 1. Amber/Booth.
 - 2. Cooper Industries.
 - 3. International Seismic Application Technology.
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibro-Acoustics.
- B. Substitutions: Items of same function and performance are acceptable in conformance with General Conditions of the Contract.

2.13 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.
 - 2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
 - 4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.

5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.14 SEISMIC BRACING COMPONENTS

- A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.
1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.
 2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.
 3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.
 4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS, Gr.33.
 5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.

PART 3 - EXECUTION

3.1 DRAWINGS

- A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping and ducts, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.2 INSTALLATION

- A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NEC, NFPA, IECC, IFGC and IFC Standards; all local and state amendments to all codes and standards.
- B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.
- C. Compliance with codes and ordinances shall be at the Contractor's expense.

3.3 MEASUREMENTS

- A. Verify all measurements on the job site.
- B. Locate all equipment and fixtures on the centers of walls, openings, spaces, etc., unless specified otherwise.
- C. Check all piping, equipment, etc. to clear openings.

- D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.4 OPERATING INSTRUCTIONS

- A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Mechanical Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.
- B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of four hours of onsite instruction to the owner designated personnel.
- C. When required by individual specification sections provide additional training on plumbing systems and equipment as indicated in the respective specification section.
- D. Provide schedule for training activities for review prior to start of training.

3.5 SYSTEM ADJUSTING

- A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all plumbing systems. Test all plumbing equipment, fixtures and piping for proper water distribution, drainage, pressure and flow, adjust systems as required to eliminate splashing, noise and vibration.

3.6 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for piping.
- C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.7 PAINTING

- A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of mechanical work:
 - 1. Factory applied prime and finish coats on mechanical equipment.
 - 2. Factory applied prime and finish coat on all air registers, grilles and diffusers, unless otherwise specified.
 - 3. Factory applied prime coat on access doors.
 - 4. Pipe identification where specified.
- B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.8 IDENTIFICATION

- A. Tag all valves with heat resistant laminated plastic labels or brass tags engraved with readily legible letters. Securely fasten to the valve stem or bonnet with beaded chain. Provide a framed, typewritten directory under glass, and installed where directed. Provide complete record drawings that show all valves with their appropriate label. Seton 250-BL-G, or 2961.20-G, 2" round or equal.
- B. Label all equipment with heat resistant laminated plastic labels having engraved lettering ½" high. If items are not specifically listed on the schedules, consult the Engineer concerning designation to use. Seton engraved Seton-Ply nameplates or equal.
- C. Identify piping to indicate contents and flow direction of each pipe exposed to view by a labeled sleeve in letters readable from floor at least once in each room and at intervals of not more than 20' apart and on each side of partition penetrations. Coloring scheme in accordance with ANSI A13.1-1981, Seton Opti-Code or equal.

3.9 PIPE HANGERS AND SUPPORTS

- A. Support plumbing piping in accordance with the latest adopted edition of the UPC.
- B. Support horizontal piping as follows:

MATERIALS	TYPES OF JOINTS	HORIZONTAL	VERTICAL
Cast-Iron Hub-less	Shielded Coupling	Every other joint, unless over 4 feet then support each joint ^{1,2,3,4}	Base and each floor, not to exceed 15 feet
Copper Tube and Pipe	Soldered or Brazed	1 ½ inches and smaller, 6 feet; 2 inches and larger, 10 feet	Each floor, not to exceed 10 feet ⁵
Copper Pipe for Gas	Threaded or Welded	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1 ¼ inches and larger, 10 feet	½ inch, 6 feet; ¾ inch and 1 inch, 8 feet; 1 ¼ inches every floor level
PVC Condensate Drains	Solvent Cemented	All sizes, 4 feet; allow for expansion every 30 feet _{3,6}	Base and each floor' provide mid-story guides; provide for expansion every 30 feet ⁶

Notes:

- ¹ Support adjacent to joint, not to exceed 18 inches.
 - ² Brace not to exceed 40 foot intervals to prevent horizontal movement.
 - ³ Support at each horizontal branch connection.
 - ⁴ Hangers shall not be placed on the coupling.
 - ⁵ Vertical water lines shall be permitted to be supported in accordance with recognized engineering principles with regard to expansion and contraction, where first approved by the Authority Having Jurisdiction.
 - ⁶ See the appropriate IAPMO Installation Standard for expansion and other special requirements.
- C. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
 - D. Place a hanger within 12 inches of each horizontal elbow.
 - E. Use hangers with 1-½ inch minimum vertical adjustment.

- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide transverse seismic support for all piping systems.

3.10 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.11 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete type where shown on plans.
- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. Anchor (Expansion) Bolts: Install anchor bolts for all plumbing piping and equipment as required. Tightly fit and clamp base-supported equipment anchor bolts at all equipment support points. Provide locknuts where piping and equipment is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or equipment, or to anchor stationary equipment from existing concrete slabs.

3.12 FLASHING

- A. Provide flexible flashing and metal counter-flashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent pipes projecting 3 inches minimum above finished roof surface with pre-manufactured butyl boot.
- C. Seal floor drains watertight to adjacent materials.

3.13 SLEEVES

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Set sleeves in position in construction. Provide reinforcing around sleeves.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- D. Where piping penetrates floor, ceiling, or wall, install sleeve, close off space between pipe and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where fire rated walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.14 SEISMIC RESTRAINT

- A. General:
 - 1. All piping and equipment shall be restrained to resist seismic/wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations. Additional requirements specified herein are included specifically for this project.
 - 2. Install seismic and wind restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
 - 3. Attachment to structure for suspended pipe and equipment: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
 - 4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.
 - 5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.
 - 6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.
 - 7. Where rigid restraints are used on equipment or piping, support rods for the equipment or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.
 - 8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.
- B. Piping Systems:
 - 1. Provide seismic cable restraints on the following:

- a. All piping systems with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).
 2. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:
 - a. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.
 - b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.
 3. Restraint spacing:
 - a. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.
 - b. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - c. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - d. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
 4. Brace a change of direction longer than 12' (3.7 m).
 5. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.
 6. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.
 7. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.
- C. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.
 - D. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
 - E. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
 - F. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

3.15 INSTALLATION OF EQUIPMENT

- A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.
- B. Maintain manufacture recommended minimum clearances for access and maintenance.
- C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.
- D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.
- E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.
- F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION

SECTION 22 07 00 – PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Equipment Insulation.
- C. Jackets and Accessories.

1.2 RELATED WORK

- A. Section 22 05 00 - Common Work Results for Plumbing.
- B. Section 22 10 00 - Plumbing Piping.
- C. Section 22 40 00 - Plumbing Fixtures.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- D. ANSI/ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- E. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
- F. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
- G. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
- H. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- I. ANSI/ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- K. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- L. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- M. ASTM C1427 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

- N. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Tim of Burning of Plastics in a Horizontal Position.
- O. ASTM E84 - Surface Burning Characteristics of Building Materials.
- P. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
- Q. NFPA 255 - Surface Burning Characteristics of Building Materials.
- R. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include product description, thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723, ASTM E84, or NFPA 255.
- D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.6 DELIVERY STORAGE AND HANDLING

- A. General Conditions of the Contract - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Shipment of materials from manufacturer to installation location shall be in weather tight transportation.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. General Conditions of the Contract- Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armacell.
- B. Certain-Teed.
- C. Johns Manville.
- D. Knauf.
- E. Owens-Corning.
- F. Nomaco.
- G. Pittsburgh - Corning.
- H. K-Flex USA.
- I. Substitutions: Under provisions of General Conditions of the Contract.

2.2 INSULATION - PIPING

- A. Type A: Glass fiber, rigid, molded, non-combustible insulation; ANSI/ASTM C547; 'k' value of 0.23 at 75° F, rated from 0° F to 850° F, vapor retarder jacket of Kraft paper bonded to aluminum foil, self-sealing lap and butt strips; Johns Manville "Micro-Lok" or approved equal.

2.3 FIELD APPLIED JACKET

- A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
- B. PVC Jackets and solvent welding adhesive: One piece, pre-molded type, Johns Manville "Zeston 2000", fitting covers and jacketing material. Johns Manville "Perma-Weld" solvent welding adhesive.

2.4 INSULATION ACCESSORIES

- A. Adhesives: Waterproof and fire-retardant type.
- B. Canvas Lagging Adhesive: Fire resistive to NFPA 255.
- C. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.
- D. Joint Tape: Glass fiber cloth, open mesh.

- E. FSK Joint Tape; ASTM C1136 Foil-Scrim-Kraft (FSK) lamination coated with solvent acrylic pressure sensitive adhesive; capable of adhering to fibrous and sheet metal surfaces; tri-directionally reinforced 2x3 squares per inch fiberglass scrim; 9.5 mils thick, -40 to 240° F service temperatures; Venture Tape "1525CW" or approved equal.
- F. Tie Wire: Annealed steel, 16 gauge.
- G. Insulated pipe supports: Calcium silicate with galvanized steel jacket (min. 24 gauge); ANSI/ASTM C533; rigid white; 'k' value of 0.37 at 100° F, rated to 1,200° F; Thermal Pipe Shields "T-1000 Calsil" or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install materials after piping and equipment has been tested and approved.
- B. Clean surfaces for adhesives.
- C. Prepare surfaces in accordance with manufacturer's recommendations.

3.2 INSTALLATION - PIPING

- A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
- B. Continue insulation vapor barrier through penetrations except where prohibited by code.
- C. Locate insulation and cover seams in least visible locations.
- D. Neatly finish insulation at supports, protrusions, and interruptions.
- E. Provide insulated pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system, including under fitting jackets.
- F. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions. Insulate complete system, including under fitting jackets.
- G. Provide insulated piping supports suitable for temperature between support shield and piping on piping 1-½ inches diameter to 3" diameter for insulated piping supports or larger. Insulated piping supports shall not be less than the following lengths:

1-½" to 2-½" pipe size	10" long
3" to 6" pipe size	12" long
- H. Fully insulate all piping including all spaces under jacketing.
- I. Jackets:
 - 1. Indoor, Concealed Applications: Insulated pipes shall have vapor barrier jackets, factory-applied. Vapor barrier PVC fittings may also be used provided joints are sealed with solvent welding adhesive approved by the jacket manufacturer.

2. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet above finished floor, finish with PVC jacket and fitting covers or metal jacket.
3. Insulate all exposed trap arms, drains, and hot water supplies for handicap protection on handicap accessible fixtures.

3.3 SCHEDULE - PIPING

PIPING	TYPE	PIPE SIZE Inch	MINIMUM INSULATION THICKNESS Inch
Domestic Water	A	All Sizes	1"
Rain Leaders	A	All Sizes	1"
Cold Condensate Drains	A	All Sizes	1"
Vent Through Roof	A	All Sizes	1"
Piping Exposed to Freezing	A	All Sizes	2"

END OF SECTION

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Sanitary Sewer Piping.
- B. Domestic Water Piping.
- C. Storm Drain Piping.
- D. Valves.
- E. Water Hammer Arrestors.
- F. Dielectric Connections.
- G. Cleanouts.

1.2 RELATED WORK

- A. Section 22 05 00 – Common Work Results for Plumbing.
- B. Section 22 07 00 - Plumbing Insulation.
- C. Section 22 40 00 - Plumbing Fixtures.

1.3 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Any pipe or plumbing fitting or fixture, any solder, or any flux utilized on this project shall be "lead free" in accordance with the Safe Drinking Water Act, Section 1417. "Lead free" materials utilized in domestic water system shall not contain more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures. All materials utilized in domestic water system shall be certified by an ANSI accredited organization to conform to ANSI/NSF Standard 61.

1.4 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include data on pipe materials, pipe fittings, valves and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies, Husky Series 4000 or approved equal.
- B. Copper Pipe: ASTM B306, DWV. Fittings: ASME B16.3, cast bronze, or ASME B16.29, wrought copper. Joints: ASTM B32, solder, Grade 95TA; Flux: ASTM B813, or Press-Fit.

2.2 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn. Fittings: ASME B16.18, cast copper alloy, or ASME B16.22, wrought copper. Joints: ANSI/ASTM B32, solder, Grade 95TA; Flux: ASTM B813 or Press-Fit.

2.3 STORM DRAIN PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless, service weight. Fittings: Cast iron. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies, Husky Series 4000 or approved equal.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping: 1/16 inch thick preformed neoprene bonded to fiber.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; "C" shape composition sealing gasket; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

- A. Apollo.
- B. FNW.
- C. Hammond.
- D. Milwaukee.
- E. Nibco.
- F. Substitutions: Under provisions of General Conditions of the Contract.

2.6 GATE VALVES

- A. Not permitted. Use ball valves for isolation service.

2.7 GLOBE VALVES

- A. Not permitted. Use ball valves for throttling service.

2.8 BALL VALVES

- A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle, solder, threaded or press-fit ends.
- B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged, solder, threaded or press-fit ends.

2.9 BUTTERFLY VALVES

- A. Not permitted, use ball valves for isolation service.

2.10 ACCEPTABLE MANUFACTURERS - WATER HAMMER ARRESTORS

- A. J.R. Smith.
- B. Zurn.
- C. Mifab.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.11 WATER HAMMER ARRESTORS

- A. ANSI A112.26.1; sized in accordance with PDI WH-201, pre-charged suitable for operation in temperature range -100°F to 300°F and maximum 250 psig working pressure; Series 5000 manufactured by J.R. Smith or approved equal.

2.12 ACCEPTABLE MANUFACTURERS - DIELECTRIC CONNECTIONS

- A. Elster Perfection - Clearflow.
- B. Substitutions: Under provisions of General Conditions of the Contract.

2.13 DIELECTRIC CONNECTIONS

- A. Dielectric Connections: ASTM standard F-1545 for continuous use at temperatures up to +225°F and for pressures up to 300 psi. IAPMO, UPC listed. Thread connections.

2.14 DRAIN VALVES

- A. Bronze body, chrome plated brass ball, RPTFE seals and stuffing box ring, stainless steel handle with vinyl cover. 3/4" NPT x 3/4" Hose thread, with duct cover and chain, sweat ends. Apollo 78-100 Series or approved equal.

2.15 ACCEPTABLE MANUFACTURERS - CLEANOUTS

- A. J.R. Smith.
- B. Zurn.

- C. Mifab.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.16 CLEANOUTS

- A. Exterior Surfaced Areas: Round cast iron access frame and non-skid cover, bronze plug, vandal resistant screws. J.R. Smith Model 4251 or approved equal.
- B. Interior Finished Floor Areas: Enamel paint coated cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar, bronze plug, and adjustable round nickel bronze scoriated cover in service areas and round with depressed cover to accept floor finish in finished floor areas. J.R. Smith Model 4021 or approved equal.
- C. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated gasketed cover, bronze plug, and round stainless steel access cover secured with machine screw. J.R. Smith Model 4022 or approved equal.
- D. Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.
- H. Slope water piping and arrange to drain at low points.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- J. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09.
- K. Establish invert elevations, slopes for drainage to 1/4" per foot, 1/8" per foot if 4" or over, minimum. Maintain gradients.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with Teflon™ based thread lubricate. Ensure clearance at cleanout for rodding of drainage system.
- N. Install water hammer arrestors complete with accessible isolation valve.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment connections.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install ball valves for throttling, bypass, or manual flow control services. (No globe valves permitted.)
- D. Use grooved mechanical couplings and fasteners only in accessible locations.

3.4 TESTING

- A. Test all water piping in accordance with Section 609 of the UPC. Submit a signed statement to the Engineer stating testing dates, procedure and initials of tester.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Flush, clean and disinfect the potable water system in accordance with Section 609 of the UPC. Submit a signed statement to the Engineer stating disinfection dates, procedure and initials of tester.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Sinks.

1.2 RELATED WORK

- A. Section 22 05 00 - Common Work Results for Plumbing.
- B. Section 22 10 00 – Plumbing Piping.

1.3 REFERENCES

- A. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- B. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

1.4 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.
- B. Trim: By same manufacturer for each product specified throughout.

1.5 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include sizes, rough-in requirements, service sizes, and finishes.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Include fixture trim exploded view and replacement parts lists.
- C. Provide Manufacturer's parts list and maintenance information on specialties.

1.7 WARRANTY

- A. Provide manufacturer's warranty under provisions of General Conditions of the Contract.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS –FIXTURES

- A. Kohler.
- B. American Standard.
- C. Just.

- D. Elkay.
- E. Fiat.
- F. Substitutions: Under provisions of General Conditions of the Contract.

2.2 ACCEPTABLE MANUFACTURERS - FIXTURE CARRIERS

- A. J.R. Smith.
- B. Zurn.
- C. Mifab.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.3 ACCEPTABLE MANUFACTURERS -FIXTURE TRIM

- A. Delta.
- B. Chicago.
- C. Just.
- D. T&S Brass and Bronze Works, Inc.
- E. Fiat.
- F. Substitutions: Under provisions of General Conditions of the Contract.

2.4 SCRUB SINK

- A. Sink: 16 gauge, type 304 (18-8), stainless steel double station slant front scrub-up sink with sensor faucet, coved corners, keyed access door, wall hanger, full length backsplash, full enclosure and removable acrylic compartment partition. Exposed surfaces shall be polished to a satin finish. Underside shall be sound deadened.
- B. Faucet: Quantity two (2), Sensor-operated, deck-mounted, non-mixing gooseneck faucet with adjustable sensor eyes. Chrome-plated solid brass construction with 2.0 gpm laminar flow control on spout end. Include water-resistant sensor control module and power cables. AC plug-in power supply. Slow-closing piston operated solenoid valve, in-line filter with clean out trap and flexible supply hose. Control circuit shall be solid state, with adjustable sensor range of 7/8" (22mm) to 6-3/4" (171mm), shut-off delay preset at 1 second and field adjustable to 2 seconds.
- C. Drain: Stainless steel perforated strainer grid, drain fitting with 1-1/2" (38 mm) O.D. x 4" (102mm) stainless steel tailpiece.
- D. Thermostatic Mixing Valve: Anti-scald thermostatic mixing valve with nickel plated brass body, 1/2" (13mm) union SWT inlets and outlet connection. Comes with internal check valves on inlets and mixed temperature range of 80° – 120 °F.

2.5 SERVICE SINK

- A. Sink: 24 x 24 x 10 inch high heat molded resin basin, floor mounted, with one inch wide shoulders, combination dome strainer and stainless steel lint basket. Fiat MSB-2424 or equal.
- B. Trim: ANSI A112.18.1; chrome plated, exposed wall type faucet with, vacuum breaker, integral stops, adjustable wall brace, pail hook and 3/4 inch hose thread on spout. Body inlets on 8 inch centers, four arm handles. 2-1/2 feet of 1/2 inch diameter plain end reinforced plastic hose, wall mounted stainless steel hose clamp, three position stainless steel mop hanger. Fiat 830-AA or equal.

2.6 SINK

- A. Bowl: ANSI A112.19.3; single compartment, 18 gauge thick, Type 304 stainless steel, self-rimming with sound deadening undercoating, ledgeback drilled for trim.
- B. Trim: ANSI A112.18.1; Lead free, chrome plated brass, two-handle deck mounted faucet, 4-1/4 long x 10-5/8 inch high gooseneck swing spout, 4 inch wrist blade handles, 2.2 GPM vandal resistant aerator, grid drain.

2.7 P-TRAP

- A. P-trap shall be chrome plated cast brass body, with 17 gauge seamless tubular wall bend, cast brass slip nuts. Reducing washers shall be used with reducing cast brass nut, chrome plated brass escutcheons.

2.8 ANGLE STOPS AND SUPPLY RISERS

- A. Quarter-turn lead free brass ball valve with convertible loose key handle, chrome plated copper, or braided stainless supply risers and chrome plated brass escutcheons.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate cutting of floor construction to receive drains to required invert elevations.

3.2 INSPECTION

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- B. Verify adjacent construction is ready to receive rough-in work of this Section.

3.3 INSTALLATION

- A. Install each fixture with removable p-trap for servicing and cleaning.
- B. Provide angle stop and supply risers at each fixture. Provide chrome plated escutcheons for both hot and cold water supplies and waste piping.
- C. Install components level and plumb
- D. Install and secure fixtures in place with wall or floor carriers, supports as per the manufacturers instructions.

- E. Seal fixtures to wall and floor surfaces with silicone sealant, color to match fixture.
- F. Mount fixtures above finished floor in accordance with Architectural.
- G. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- H. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- I. Encase exterior cleanouts in concrete flush with grade.
- J. Install water hammer arrestors complete with accessible isolation valve.

3.4 ADJUSTING AND CLEANING

- A. Adjust stops, valves or flow control valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Remove and clean all aerators and filters from faucets and other plumbing fixtures after the domestic water system has been tested, flushed and disinfected as per Section 22 10 00.
- C. At completion remove all visible stickers and tags not intended to be left in place, thoroughly clean all surfaces of plumbing fixtures.

END OF SECTION

SECTION 22 60 13 - MEDICAL GAS AND VACUUM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Medical Gas Piping.
2. Valves.
3. Pipe Hangers and Supports.
4. Piping Specialties.
5. Medical Gas Outlets.
6. Area Alarm Panel.
7. Labeling and Identification.
8. Installer Performed Tests.
9. System Verification Tests.

B. Related Sections:

1. Section 22 05 00 - Common Work Results for Plumbing.
2. Section 22 10 00 – Plumbing Piping.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.

B. American Society of Sanitary Engineering:

1. ASSE 6010 - Professional Qualification Standard for Medical Gas and Vacuum System Installers.
2. ASSE 6030 - Medical Gas Verifiers Professional Qualification Standard.

C. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
2. AWS B2.2 - Standard for Brazing Procedure and Performance Qualifications.

3. AWS D1.1 - Structural Welding Code - Steel.
- D. ASTM International:
1. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 2. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 3. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
 4. ASTM A536 - Standard Specification for Ductile Iron Castings.
 5. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 6. ASTM B32 - Standard Specification for Solder Metal.
 7. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 8. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 9. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems.
 10. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 11. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- E. Compressed Gas Association:
1. CGA G-4.1 - Cleaning Equipment for Oxygen Service.
 2. CGA C-7 - Guide to the Preparation for Cautionary Labeling and Marking for Compressed Gas Containers.
 3. CGA V-1 - Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections.
 4. CGA V-5 - Diameter-Index Safety System (Non-Interchangeable Low Pressure Connections for Medical Gas Applications).
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 2. MSS SP 67 - Butterfly Valves.
 3. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.

4. MSS SP 73 - Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings.
 5. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- G. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association:
1. NFPA 99 - Health Care Facilities.
- I. Underwriters Laboratories Inc.:
1. Electrical Construction Equipment.

1.3 SYSTEM DESCRIPTION

- A. Medical Gas Systems include the following gas types, piping systems and equipment.
- B. Gases:
1. Oxygen.
 2. Medical air.
 3. Medical-surgical vacuum.
 4. Waste anesthetic gas disposal.
- C. Piping Systems:
1. Positive pressure medical gas system piping.
 2. Medical-surgical vacuum system piping.
 3. Waste anesthetic gas disposal (WAGD) piping.
- D. Equipment:
1. Valve cabinets.
 2. Medical gas outlets.
 3. Area alarm panels.

1.4 SUBMITTALS

- A. Under provisions of General Conditions of the Contract.
- B. Shop Drawings:

1. Indicate piping system schematic with electrical and connection requirements general assembly of components, mounting and installation details.
 2. Indicate general layout of control and alarm panels.
 3. Indicate detailed medical wall assembly drawings.
- C. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. System Components: Submit manufacturers catalog information including capacity, component sizes, rough-in requirements, and service sizes. When applicable, include electrical characteristics and connection requirements.
- D. Product Data: Submit manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
- E. Qualifications Data: Submit documentation verifying qualifications for the following:
1. Brazers and brazing procedures.
 2. Welders and welding procedures.
 3. Medical gas and vacuum system installer.
 4. System verifier.
- F. Installer's Test Reports:
1. Submit documentation indicating completion of Installer Performed Tests.
 2. Submit list of each test and when test was completed.
 3. Include documentation required by NFPA 99.
- G. Verifier's Test Reports:
1. Submit testing and inspection report of System Verification Tests.
 2. Submit list of each test and when test was completed.
 3. Include documentation required by NFPA 99.

1.5 CLOSEOUT SUBMITTALS

- A. Under provisions of General Conditions of the Contract.

- B. Project Record Documents: Record actual locations of equipment piping, valves, outlets and components.
- C. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.

1.6 QUALITY ASSURANCE

- A. Furnish piping, valves, outlets and other piping components cleaned for oxygen service by manufacturer in accordance with CGA G-4.1.
- B. Furnish documentation certifying installed piping materials comply with CGA G-4.1 cleaning requirements.
- C. Perform Work in accordance with NFPA 99 for installation of piping systems and for brazing materials and procedures.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.
- C. Brazers and Brazing Procedures: ASME Section IX or AWS B2.2 qualified within previous 12 months for medical gas and vacuum systems.
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months for medical gas and vacuum systems.
- E. System Verifier: Company specializing in performing medical gas system verification with minimum three years documented experience.
- F. Perform system verification using one of the following System Verifiers:
 - 1. ZoJen LLC, Medical Gas Specialists, 208-209-2331 or 509-210-2637.

1.8 INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.
- B. Convene meeting minimum one week prior to commencing the following:
 - 1. Installer performed tests.
 - 2. System verification tests.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept equipment on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.

- C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 POSITIVE PRESSURE MEDICAL GAS SYSTEM PIPING

- A. Piping All Sizes, Below Gage Pressure of 185 psig:
- B. Copper Tubing: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
 - 1. Fittings: ASME B16.22, wrought copper and bronze or MSS SP 73 wrought and cast copper.
- C. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.2 MEDICAL-SURGICAL VACUUM SYSTEM PIPING

- A. Copper Tubing: ASTM B88, Type L drawn temper.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.3 WASTE ANESTHETIC GAS DISPOSAL (WAGD) PIPING

- A. Copper Tubing: ASTM B88, Type L drawn temper.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.4 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Copper Piping: Class 150, bronze unions with brazed joints.
 - 2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Copper Piping: Class 150, slip-on bronze flanges.
 - 2. PVC Piping: PVC flanges.

3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.5 BALL VALVES

- A. Manufacturers:
 1. Tri-Tech Medical.
 2. Allied Health Care.
 3. Amico Corporation.
 4. Substitutions: Under provisions of General Conditions of the Contract.
- B. Furnish valves cleaned for oxygen service in accordance with CGA G-4.1 by manufacturer and labeled, sealed, and packed for shipping.
- C. MSS SP 110, 300 psi non-shock working pressure, bronze, three piece body, chrome plated bronze ball, full port, teflon seats, blow-out proof stem, solder ends with extensions for brazing, locking lever handle.

2.6 PIPE HANGERS AND SUPPORTS

- A. Conform to MSS SP 58.
- B. Furnish hangers for copper piping system with copper finish and sized for copper pipe.

2.7 AREA ALARM AND ZONE VALVE ISOLATION PANEL

- A. Manufacturers:
 1. Tri-Tech Medical.
 2. Substitutions: Under provisions of General Conditions of the Contract.
- B. Comply with NFPA 99. ETL Listed to UL-1069. Audio and visual alarm indicators. L.E.D. displays – clearly visible in both day and night lighting conditions. Constant display and monitoring of each gas. User programmable high/low set points
- C. All area alarm zone valve panels shall be installed and tested in strict accordance with NFPA 99 standards and or any other local codes before use. The alarm/ zone valve shall be an Medical Integrated Area Alarm/ Zone Valve Panel. The panel shall be microprocessor controlled and designed to comply with NFPA 99. The panel shall be 100% digital and shall not require re-calibration. The unit shall be enclosed in a steel box and shall be designed to accept an electrical input range of 120-240 volts AC – 50-60 hertz. The source voltage shall be stepped down with a self-contained transformer. The panel shall contain audible and visual alarm indicators. The audible alarm may be silenced by pressing the alarm silence button, but the visual alarm indicator can only be cancelled by fault correction. The alarm shall detect and filter out transient (less than 0.6 seconds) signals created by R.F.I. The alarm shall be capable of displaying alarm history for all possible alarm conditions. The alarm shall be capable of monitoring and displaying up to 7 gases per alarm panel. Dry contacts for remote monitoring of all alarm conditions on each gas module and on the CPU module for the entire panel Gas modules can be arranged in accordance with the customer's requirements. Basis of design is Tri-Tech Medical In. ZD Series Integra Area Alarm/Zone Valve Box.

- D. Valves shall be dual gauge port, cast bronze, ball-type, with Teflon (TFE) seats and seals. All valves shall be rated at a working pressure of 600 psi (29 inHg vacuum) and shall be operated by a lever-type handle, requiring only a quarter turn from a fully open position to a fully closed position. Valves shall incorporate an adjustable packing and a blow-out proof stem. Only full port valves having flow rates comparable to equivalent size of pipe shall be used. Valves shall be piped from left to right. All valves shall be provided with type K copper tubing extensions to facilitate installation. Valves shall be 3 piece in-line repairable type. Each valve assembly shall be supplied cleaned for oxygen service in accordance with current CGA standards. The valve tube ends shall be capped and sealed in a protective container to prevent contamination prior to installation.
- E. Gauges shall be 1 ½" diameter for monitoring pressure and vacuum, and shall state: "USE NO OIL". Dual scale gauges are not acceptable for the U.S.A. installations.
- F. The valve box shall be 18 gauge sheet steel construction painted to prevent rust. A single box shall house from one to seven valves. Box shall be supplied with an adjustable plaster flange ½" to 1 1/8" for easy mounting.
- G. Window – Valve box assembly shall be supplied with a formed steel decorative frame painted white which encloses an easily removable flexible window. The window shall be a "smoked" translucent flexible plastic with a pull-out ring pre-mounted to the center of the window. The window shall not be replaceable while any valve is in a closed position. Window shall be silk screened with the following statement "CAUTION: MEDICAL GAS SHUTOFF VALVES. CLOSE ONLY IN EMERGENCY."

2.8 MEDICAL GAS OUTLETS

- A. Manufacturers:
 - 1. Tri-Tech Medical.
 - 2. Substitutions: Under provisions of General Conditions of the Contract.
- B. UL Listed to UL 1331 and CSA Z9170-1. Conforms to NFPA 99 and CGA standards
- C. Style: Diameter Index Safety System (DISS) in accordance with CGA V-5.
- D. Location: Wall.
- E. Mounting: recessed.
- F. Furnish outlets with the following features:
 - 1. Non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch tubing stubs for supply connections, color coded and labeled for intended service.
 - 2. The outlet nameplate shall be permanently color-coded with a durable scratch resistant and protective label. The outlet trim plate shall be durable plastic, attached with the nameplate to the rough-in assembly, and provide automatic plaster adjustment from 1/2 to 1 1/4 of an inch (1.3 cm to 3 cm). The name of the gas service shall be permanently marked on the outlet bracket and the chrome plated brass outlet body. The outlet's rough-in supply tube shall be a 7 inch (18 cm) length of 1/2 OD copper Type K, and labeled with the name of the gas service

3. Latch mechanisms designed for one handed, single thrust mounting and one handed fingertip release of secondary equipment.
 4. Furnish outlets cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.
- G. Vacuum Bottle Brackets: Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.

2.9 LABELING AND IDENTIFICATION

- A. Furnish labeling and identification in accordance with NFPA 99.
- B. Pipe Labels:
1. Furnish pipe labels or stenciling identifying the medical gas or vacuum system. Furnish with name of gas or vacuum system or chemical symbol.
 2. Furnish pipe labels with colors in accordance with NFPA 99.
 3. When gas system operates at other than standard pressures, include operating pressure in addition to gas name.
- C. Valve Labels:
1. Label service valves in accordance with NFPA 99.
 2. Furnish valve with name of gas or vacuum system or chemical symbol. Label with room or area served. Label with caution to not open or close valve in an emergency.
 3. When gas system operates at other than standard pressures, label valve with operating pressure in addition to gas name.
- D. Outlets and Inlets:
1. Furnish with name of gas or vacuum system or chemical symbol.
 2. When gas system operates at other than standard pressures, include operating pressure in addition to gas name.
- E. Alarm Panels:
1. Label indicating condition monitored.
 2. Label each panel for area of surveillance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare soldered joints in accordance with ASTM B828.
- B. Ream pipe and tube ends. Remove burrs.
- C. Remove scale and dirt on inside and outside before assembly.

- D. Prepare piping connections to equipment with flanges or unions.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with MSS SP 69.
- B. Install hangers and supports at maximum spacing in accordance with NFPA 99.
- C. Support horizontal piping in accordance with NFPA 99.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Place hangers within 12 inches of each horizontal elbow.
- F. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- G. Support vertical piping at every floor; maximum 15 feet on center. Support riser piping independently of connected horizontal piping.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- I. Install pipe hangers and supports in accordance with Section 22 05 00.

3.3 INSTALLATION - ABOVE GROUND PIPING - MEDICAL GAS SYSTEMS

- A. Install medical gas systems in accordance with NFPA 99.
- B. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- C. Cut pipe and tubing accurately and install without springing or forcing.
- D. Slope piping in direction of flow.
- E. Make branch connections in accordance with NFPA 99.
- F. Pressure Gages:
 - 1. Install at locations identified in NFPA 99.
 - 2. Install capable of being read from standing position.
- G. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions.
- H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- I. Install pipe identification in accordance with this Section.

- J. Except where indicated or in flush wall mounted cabinets, install manual shut off valves with stem vertical and accessible for operation and maintenance.

3.4 LABELING AND IDENTIFICATION

- A. Piping:
 - 1. Install pipe labels at intervals of not more than 20 feet.
 - 2. Install minimum of one pipe label in each room.
 - 3. Install label on each side of wall when penetrated by piping.
 - 4. Risers: Install minimum of one label for each story traversed by piping.

3.5 FIELD QUALITY CONTROL

- A. Installer Performed Tests:
 - 1. Complete installer performed tests for each system in accordance with procedures specified in NFPA 99.
 - 2. Perform the following installer performed tests in accordance with procedures specified in NFPA 99:
 - a. Initial blow down.
 - b. Initial pressure test.
 - c. Cross connection test.
 - d. Piping purge test.
 - e. Standing pressure test for positive pressure medical gas systems.
 - f. Standing pressure test for vacuum systems.
- B. System Verification Tests:
 - 1. Perform after completion of Installer Performed Tests.
 - 2. Conduct test by agency independent of system installer.
 - 3. Complete system verification tests for each system in accordance with procedures specified in NFPA 99.
 - 4. Perform the following system verification tests in accordance with procedures specified in NFPA 99:
 - a. Standing pressure test.
 - b. Cross connection test.
 - c. Individual system pressurization.

- d. Valve test.
- e. Alarm test.
- f. Piping purge test.
- g. Piping particulate test.
- h. Piping purity test.
- i. Final tie-in test.
- j. Operational pressure test.
- k. Medical gas concentration test.
- l. Medical air purity test.
- m. Labeling verification.
- n. Source equipment verification:
 - 1) Gas supply sources.
 - 2) Medical air compressor system.
 - 3) Medical-surgical vacuum systems.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

- A. All provisions of the Contract including the General and Supplementary Conditions and the General Requirements apply to this work.

1.2 WORK INCLUDED

- A. The work to be included in these and all other mechanical subsections shall consist of providing, installing, adjusting and setting into proper operation complete and workable systems for all items shown on the drawings, described in the specifications or reasonably implied. This shall include the planning and supervision to coordinate the work with other crafts and to maintain a proper time schedule for delivery of materials and installation of the work.
- B. General Conditions of the Contract of the specifications is to be specifically included as well as all related drawings.

1.3 RELATED WORK

- A. Related Work Specified Elsewhere:
 - 1. Fire Suppression Specifications: Division 21.
 - 2. Plumbing Specifications: Division 22.
 - 3. Electrical Specifications: Division 26.
- B. Unless otherwise indicated on the electrical drawings or the electrical schedules, provide all mechanical equipment motors, motor starters, thermal overload switches, control relays, time clocks, thermostats, motor operated valves, float controls, damper motors, electric switches, electrical components, wiring and any other miscellaneous Division 23 controls. Disconnect switches are included in the electrical work, unless specifically called out on mechanical plans.
- C. Carefully coordinate all work with the electrical work shown and specified elsewhere.

1.4 REFERENCED CODES - LATEST ADOPTED EDITION

- A. NFPA 13 Installation of Sprinkler Systems.
- B. NFPA 70 National Electrical Code (NEC).
- C. IMC International Mechanical Code.
- D. UPC Uniform Plumbing Code.
- E. IECC International Energy Conservation Code.
- F. IFC International Fire Code.
- G. IFGC International Fuel Gas Code.

- H. IBC International Building Code.

1.5 QUALITY ASSURANCE

- A. HVAC Contractor Qualifications:
1. The HVAC Contractor shall have a minimum of five (5) years of documented experience working in Health Care Facilities in the State of Alaska. Contractor shall provide list with a minimum of 5 successful Health Care projects completed in the last 5 years prior to any on-site work.
- B. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:
1. List of 5 successful Health Care Facilities projects in the State of Alaska with names, addresses, and phone numbers of Owners. Include a brief description and scope of HVAC work complete in each project.

1.6 PROJECT RECORD DRAWINGS

- A. In addition to other requirements of General Conditions of the Contract, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all mechanical work which will become permanently concealed. Show routing of work in concealed blind spaces within the building. Show exact dimensions of buried piping off of columns or exterior walls.
- B. Maintain record documents at job site in a clean, dry and legible condition. Keep record documents available for inspection by the Project Manager.
- C. Show the location of all valves and their appropriate tag identification.
- D. At completion of project, deliver these drawings to the Owner and obtain a written receipt.

1.7 SUBMITTALS

- A. See General Conditions and the General Requirements in General Conditions of the Contract regarding submittals.
- B. Submit by specification section complete and all at one time; partial submittals will not be considered. The data shall be arranged and indexed under basic categories in order of the Specification Sections. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications.
- C. Catalog sheets shall be complete and the item or model to be used shall be clearly marked, and identified as to which item in the specifications or on the drawings is being submitted and with drawing fixture number where applicable.
- D. Only submit on items specifically required by each specification section. If a submittal has not been requested, it will not be reviewed.
- E. Submit product data for:
1. Hangers and Supports for HVAC Piping and Equipment.
 2. Identification for HVAC Piping, Ductwork and Equipment.
- F. Provide HVAC contractor qualifications submittal to include list of health care projects.

1.8 OPERATING AND MAINTENANCE MANUALS

- A. Submit maintenance manuals to the Engineer covering all equipment, devices, etc. installed by the Contractor.
- B. The operation and maintenance manuals shall be submitted by specification section complete and all at one time; partial operations and maintenance manual submittals will not be considered. The data shall be arranged and indexed under basic categories. An index shall be included with bookmarks and identifying tabs between sections and references to sections of specifications. The manual shall contain, but not limited to, the following types of information:
 - 1. Cover sheet with name, address, telephone number of Contractor, General Contractor and major equipment suppliers.
 - 2. Catalog cuts of all equipment, etc. installed (Marked to identify the specific items used).
 - 3. Manufacturer's maintenance and overhaul instruction booklets including exploded views.
 - 4. Identification numbers of all parts and nearest sources for obtaining parts and services.
 - 5. Reduced scale drawings of the control system and a verbal description of how these controls operate.
 - 6. A copy of the final test and balance report.
 - 7. A copy of valve schedule and reduced scale drawings showing valve locations.
 - 8. Written summary of instructions to Owner.
 - 9. All manufacturers' warranties and guarantees.
 - 10. Contractors Warranty Letter.
- C. A periodic maintenance form that includes all of the equipment shall be provided with the maintenance manual. The form shall list each piece of equipment and how often maintenance is required (daily, weekly, monthly, annually). Opposite each task shall be squares for check-off for a full year (initials) to verify that the tasks are being done.

1.9 HANDLING

- A. See General Conditions and the General Requirements in General Conditions of the Contract regarding material handling.
- B. Deliver packaged materials to job site in unbroken packages with manufacturer's label, and store to facilitate inspection and installation sequence. All items must be labeled and identified as to make, size and quality.

1.10 SUBSTITUTIONS

- A. See General Conditions and the General Requirements in General Conditions of the Contract for substitution request procedures.
- B. In accordance with the General Conditions and the General Requirements in General Conditions of the Contract, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and

weight, and must be compatible with existing equipment. The Owner/Engineer shall be the final authority regarding acceptability of substitutes.

1.11 DIMENSIONS

- A. Before ordering any material or doing any work, the Contractor shall verify all dimensions, including elevations, and shall be responsible for the correctness of the same. No extra charge or compensation will be allowed on account of differences between actual dimensions and measurements indicated on the drawings.
- B. Any differences, which may be found, shall be submitted to the Owner/Engineer for consideration before proceeding with the work.

1.12 MANUFACTURER'S DIRECTIONS

- A. All manufactured articles shall be applied, installed and handled as recommended by the manufacturer, unless specifically called out otherwise. Advise the Architect/Engineer of any such conflicts before installation.

1.13 PERMITS, FEES, ETC.

- A. The Contractor under each Division of these specifications shall arrange for a permit from the local authority. The Contractor shall pay for any inspection fees or other fees and charges required by ordinance, law, codes and these specifications.

1.14 TESTING

- A. The Contractor under each section shall at his own expenses perform the various tests as specified and required by the Architect and as required by applicable code, the State and local authorities. The Contractor shall furnish all fuel and materials necessary for making tests.

1.15 TERMINOLOGY

- A. Whenever the words "furnish", "provide", "furnish and install", "provide and install", and/or similar phrases occur, it is the intent that the materials and equipment described be furnished, installed and connected under this Division of the Specifications, complete for operation unless specifically noted to the contrary.
- B. Where a material is described in detail, listed by catalogue number or otherwise called for, it shall be the Contractor's responsibility to furnish and install the material.
- C. The use of the word "shall" conveys a mandatory condition to the contract.
- D. "This section" refers to the section in which the statement occurs.
- E. "The project" includes all work in progress during the construction period.
- F. In describing the various items of equipment, in general, each item will be described singularly, even though there may be a multiplicity of identical or similar items.

1.16 SCHEDULE OF WORK

- A. The work under the various sections must be expedited and close coordination will be required in executing the work. The various trades shall perform their portion of the work at such times as directed so as to meeting scheduled completion dates, and to avoid delaying any other trade.

The Architect will set up completion dates. Each contractor shall cooperate in establishing these times and locations and shall process his work so as to ensure the proper execution of it.

1.17 COOPERATION AND CLEANING UP

- A. The contractor for the work under each section of the specifications shall coordinate his work with the work described in all other sections of the specifications to the end that, as a whole, the job shall be a finished one of its kind, and shall carry on his work in such a manner that none of the work under any section of these specifications shall be handicapped, hindered or delayed at any time.
- B. At all times during the progress of the work, the Contractor shall keep the premises clean and free of unnecessary materials and debris. The Contractor shall, on direction at any time from the Architect, clear any designated areas or area of materials and debris. On completion of any portion of the work, the Contractor shall remove from the premises all tools and machinery and all debris occasioned by the work, leaving the premises free of all obstructions and hindrances.

1.18 WARRANTY

- A. Unless a longer warranty is hereinafter called for, all work, materials and equipment items shall be warranted for a period of one year after acceptance by the Owner. All defects in labor and materials occurring during this period, as determined by the Architect/Engineer, shall be repaired and/or replaced to the complete satisfaction of the Architect/Engineer. Guarantee shall be in accordance with General Conditions of the Contract.

1.19 COMPLETION REQUIREMENTS

- A. In accordance with the General Conditions and the General Requirements in General Conditions of the Contract, Project Closeout; before acceptance and final payment, the Contractor shall furnish:
 - 1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
 - 2. Contractors One Year Warranty.
 - 3. All Manufacturers' Guarantees.
 - 4. Test and Balance Reports.
 - 5. Operation and Maintenance Manuals.

1.20 INSPECTION OF SITE - REMODEL PROJECTS

- A. The accompanying plans do not indicate completely the existing mechanical installations. The bidders for the work under these sections of the specifications shall inspect the existing installations and thoroughly acquaint themselves with conditions to be met and the work to be accomplished in removing and modifying the existing work, and in installing the new work in the present building and underground serving to and from that structure. Failure to comply with this shall not constitute grounds for any additional payments in connection with removing or modifying any part of the existing installations and/or installing any new work.

1.21 RELOCATION OF EXISTING INSTALLATIONS

- A. There are portions of the existing mechanical systems, and electrical systems, which shall remain in use to serve the finished building in conjunction with the indicated new installations. By actual examination at the site, each bidder shall determine those portions of the remaining present installations, which must be relocated to avoid interference with the installations of new work of his particular trade and that of all other trades. All such existing installations, which interfere with new installations, shall be relocated by the Contractor.

1.22 SALVAGE MATERIALS

- A. The Contractor shall remove existing equipment, duct, grilles and other items associated with the mechanical systems where no longer required for the project. Where such items are exposed to view or uncovered by any cutting or removal of general construction and has no continuing function (as determined by the Architect/Engineer), they shall be removed.
- B. All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the contractor and shall be removed from the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All equipment shall be regularly cataloged items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications along with any optional items required for proper installation unless otherwise noted. Maintain manufacturer's identification, model number, etc. on all equipment at all times.
- B. Where more than one of an item is to be provided, all of the items shall be identical manufacture, make, model, color, etc.

2.2 RESTRICTED MATERIALS

- A. No materials containing asbestos in any form shall be allowed.
- B. No solder or flux containing lead shall be used on this project.
- C. Where materials or equipment provided by this Contractor are found to contain restricted materials, such items shall be removed and replaced with non-restricted materials items. Entire cost of restricted materials removal and disposal and cost of installing new items shall be the responsibility of the Contractor for those restricted materials containing items installed by the Contractor.

2.3 ELECTRICAL MOTORS

- A. Motors: Furnish electric motors designed for the specific application and duty applied, and to deliver rated horsepower without exceeding temperature ratings when operated on power systems with a combined variation in voltage and frequency not more than + 10% of rated voltage. Motors for pumps and fans shall be selected to be non-overloading.
- B. Verify from the drawings and specifications the available electrical supply characteristics and furnish equipment that will perform satisfactorily under the conditions shown and specified.

- C. All motors for use with equipment with variable frequency drives shall be inverter ready motors. Verify compatibility and sizing of motor with variable frequency drive.
- D. Size motors for 1.15 service factor and not to exceed 40° C temperature rise above ambient.
- E. Fractional horsepower motors to have self-resetting thermal overload switch.
- F. Provide Premium Efficiency, motors for all three phase motors one horsepower and larger. Standard efficiency motors will not be acceptable.

2.4 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

- A. Plastic Nameplates: Laminated plastic with engraved letters.
- B. Plastic Tags: Laminated plastic with engraved letters, minimum 1-1/2 inches diameter.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- E. Plastic Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, for direct burial service.
- F. Label ceiling grid for mechanical equipment, valves and control components located above ceiling. Description: 3/4" x 3" vinyl label, 3.0 Mil self-adhesive vinyl similar to Dura Label Pro. Label color shall be black text on a white background. The label shall contain the equipment tag, valve tag or identification tag for control component.

2.5 PIPE HANGERS AND SUPPORTS

- A. Acceptable Manufacturers:
 - 1. PHD Manufacturing, Inc.
 - 2. Michigan Hanger Company.
 - 3. B-Line Systems, Inc.
- B. Hydronic Piping:
 - 1. Conform to ANSI/MSS SP58.
 - 2. Hangers for Pipe Sizes ½ to 1-½ Inch: Malleable iron, adjustable swivel, split ring for steel pipe, copper swivel for copper pipe.
 - 3. Hangers for Hot Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Wall Support for Pipe Sizes to 3 Inches: Strut triangular bracket with pipe clamp and cushion insulator.
 - 5. Vertical Support: Steel riser clamp.

6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with felt isolation pad or all copper ring or swivel.
- C. Steam and Steam Condensate Piping:
1. Conform to ANSI/MSS SP58.
 2. Hangers for Pipe Sizes ½ to 1 ½ Inch: Malleable iron or carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers for Pipe Sizes to 4 inches: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Vertical Support: Steel riser clamp.
 7. Floor Support for Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated with neoprene isolation pad.
- D. Shield for Insulated Piping 1-½ Inches and Smaller: 18 gauge galvanized steel shield over insulation in 180° segments, minimum 12 inches long at pipe support.
- E. Shield for Insulated Piping 2 Inches and Larger: Hard block, calcium silicate insert, 180° segment, 12 inch minimum length, block thickness same as insulation thickness, flame resistant vapor barrier covering and 18 gauge galvanized shield.
- F. Shields for Vertical Copper Pipe Risers: Galvanized steel pipe.
- G. Design hangers to allow installation without disengagement of supported pipe.
- H. Copper Plating: All hanger elements in metal-to-metal contact with copper pipe, except hanger rings with factory-applied 1/16 inch minimum thick plastic or tape cushion strip over all contact surfaces.
- I. Strut Type Pipe Hanging System: Unistrut P-1000 series; framing members shall be No. 12 gage formed steel channels, 1-5/8 inch square, conforming to ASTM A 570 GR33, one side of channel shall have a continuous slot with inturned lips; framing nut with grooves and spring 1/2 inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A 307; fittings conforming to ASTM A 575; all parts enamel painted or electro-galvanized.
- J. Fixed Strut Rooftop Pipe Supports: Foam bottom, UV stabilized thermoplastic base, with hot dip galvanized strut support. Size as required for pipe. Minimum 6" Height, utilize adjustable height as required. Erico Caddy Pyramid ST or approved equal.
- K. Fixed Roller Rooftop Pipe Supports for Pipe Sizes to 6 Inches and smaller: Foam bottom, UV stabilized thermoplastic base, with polymeric rollers and hot dip galvanized retraining strap. Size as required for pipe. Minimum 6" Height, utilize adjustable height as required. Erico Caddy Pyramid RL or approved equal.

2.6 HANGER RODS

- A. Steel Hanger Rods: Threaded both ends, or continuous threaded.

2.7 ANCHOR BOLTS

- A. Anchor (Expansion) Bolts: Shall be carbon steel to ASTM A 307; nut shall conform to ASTM A194; shall be drilled-in type. Design values for shear and tension shall be not more than 80 percent of the allowable load.

2.8 FLASHING

- A. Metal Flashing: 26-gauge minimum galvanized steel.
- B. Metal Counter Flashing: 22 gauge minimum galvanized steel.
- C. Flexible Flashing: 47-mil thick sheet butyl, compatible with roofing.
- D. Caps: Steel, 22-gauge minimum; 16 gauge at fire resistant elements.

2.9 EQUIPMENT CURBS

- A. Fabricate curbs of steel beam, unless specifically called out otherwise.

2.10 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: Form with 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Form with steel pipe or 18 gauge galvanized steel for 4 inch diameter and larger, 22 gauge up to 3" diameter.
- C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: [Prefabricated fire rated sleeves including seals,] UL listed caulking system.
- D. Fire Stopping Insulation: Mineral fiber type, non- combustible.
- E. Caulk: Fire stop sealant in compliance with ASTM E814, UL 1479 and Division 07.
- F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.11 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division
 - 4. Unistrut Corp.
 - 5. Substitutions under provisions of General Conditions of the Contract.
- B. Product Description: Galvanized 12 gauge (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.

PART 3 - EXECUTION

3.1 DRAWINGS

- A. The drawings are partly diagrammatic, not necessarily showing all offsets or exact locations of piping and ducts, unless specifically dimensioned. The contractor shall provide all materials and labor necessary for a complete and operable system. Complete details of the building which affect the mechanical installation may not be shown. For additional details, see Architectural, Structural, and Electrical Drawings. Coordinate work under this section with that of all related trades.

3.2 INSTALLATION

- A. All work shall comply with the latest adopted applicable codes and ordinances including, but not limited to, the IMC, UPC, IBC, NFPA, IECC, IFGC and IFC Standards; all local and state amendments to all codes and standards.
- B. Obtain and pay for all inspection fees, connection charges and permits as a part of the Contract.
- C. Compliance with codes and ordinances shall be at the Contractor's expense.
- D. Install in accordance with manufacturer's instructions.

3.3 MEASUREMENTS

- A. Verify all measurements on the job site.
- B. Locate all equipment on the centers of walls, openings, spaces, etc., unless specified otherwise.
- C. Check all piping, ducts, etc. to clear openings.
- D. Rough-in dimensions shall be per manufacturer's recommendations and in compliance with current ADA and ANSI 117.1 standards.

3.4 OPERATING INSTRUCTIONS

- A. Before the facility is turned over to the Owner, instruct the Owner or Owner's personnel in the operation, care and maintenance of all systems and equipment under the jurisdiction of the Mechanical Division. These instructions shall also be included in a written summary in the Operating Maintenance Manuals.
- B. The Operation and Maintenance Manuals shall be utilized for the basis of the instruction. Provide a minimum of eight hours of on-site instruction to the owner designated personnel.
- C. When required by individual specification sections provide additional training on HVAC systems and equipment as indicated in the respective specification section.
- D. Provide schedule for training activities for review prior to start of training.

3.5 SYSTEM ADJUSTING

- A. Each part of each system shall be adjusted and readjusted as necessary to ensure proper functioning of all controls, proper air distribution, and elimination of drafts, noise and vibration.

- B. Balance air and water systems for volume quantities shown and as required to ensure even temperature and the elimination of drafts. Balancing shall be done by a qualified firm acceptable to the Engineer. Provide balancing log to the Engineer before substantial completion.

3.6 CUTTING, FITTING, REPAIRING, PATCHING AND FINISHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where it is necessary to disturb such work to permit installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting, insofar as possible, by setting sleeves, frames, etc. and by requesting openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.
- C. Cut all holes neatly and as small as possible to admit work. Include cutting where sleeves or openings have been omitted. Perform cutting in a manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

3.7 PAINTING

- A. Perform all of the following painting in accordance with provisions of Division 09 with colors as selected by the Architect. Provide the following items as a part of mechanical work:
 - 1. Factory applied prime and finish coats on mechanical equipment.
 - 2. Factory applied prime and finish coat on all air registers, grilles and diffusers, unless otherwise specified.
 - 3. Factory applied prime coat on access doors.
 - 4. Pipe identification where specified.
- B. If factory finish on any equipment furnished is damaged in shipment or during construction, refinish to equal original factory finish.

3.8 IDENTIFICATION

- A. Tag all valves with heat resistant laminated plastic labels or brass tags engraved with readily legible letters. Securely fasten to the valve stem or bonnet with beaded chain. Provide a framed, typewritten directory under glass, and installed where directed. Provide complete record drawings that show all valves with their appropriate label. Seton 250-BL-G, or 2961.20-G, 2" round or equal.
- B. Label all equipment with heat resistant laminated plastic labels having engraved lettering ½" high. If items are not specifically listed on the schedules, consult the Engineer concerning designation to use. Seton engraved Seton-Ply nameplates or equal.
- C. Identify piping to indicate contents and flow direction of each pipe exposed to view by a labeled sleeve in letters readable from floor at least once in each room and at intervals of not more than 20' apart and on each side of partition penetrations. Coloring scheme in accordance with ANSI A13.1-1981, Seton Opti-Code or equal.

3.9 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

PIPE SIZE	MAX. HANGER SPACING	HANGER DIAMETER
½ to 1-¼ inch	6'-0"	3/8"
1-½ to 2 inch	10'-0"	3/8"
2-½ o 3 inch	10'-0"	½"

- B. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
- C. Place a hanger within 12 inches of each horizontal elbow.
- D. Use hangers with 1-½ inch minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide transverse seismic support for all piping systems.
- I. Support all piping on flat roofs using rooftop pipe supports. Install per manufacturer's instructions. Install piping minimum 6" above roof surface.

3.10 INSERTS

- A. Provide inserts for placement in concrete formwork.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.11 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of concrete type where shown on plans.
- B. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Division 03.
- C. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- D. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- E. Provide rigid anchors for pipes after vibration isolation components are installed.

- F. Anchor (Expansion) Bolts: Install anchor bolts for all mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at all equipment support points. Provide locknuts where equipment, piping, and ductwork is hung. Install anchor (expansion) bolts in holes drilled in concrete where necessary to hang piping or ductwork, or to anchor stationary equipment from existing concrete slabs.

3.12 FLASHING

- A. Provide flexible flashing and metal counter-flashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical flashing around ducts and pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control.
- C. Provide curbs for mechanical roof installations 16 inches minimum high above roofing surface. Flexible sheet flash and counter-flash with sheet metal; seal watertight.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.13 SLEEVES

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Set sleeves in position in construction. Provide reinforcing around sleeves.
- C. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, install sleeve, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk seal. Use fire rated caulking where fire rated walls are penetrated. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.14 INSTALLATION OF EQUIPMENT

- A. Unless otherwise indicated, mount all equipment and install in accordance with manufacturer's recommendations and approved submittals.
- B. Maintain manufacture recommended minimum clearances for access and maintenance.
- C. Where equipment is to be anchored to structure, furnish and locate necessary anchoring and vibration isolation devices.
- D. Furnish all structural steel, such as angles, channels, beams, etc. required to support all piping, ductwork, equipment and accessories installed under this Division. Use structural supports suitable for equipment specified or as indicated. In all cases, support design will be based upon data contained in manufacturer's catalog.
- E. Openings: Arrange for necessary openings in buildings to allow for admittance and reasonable maintenance or replacement of all equipment furnished under this Contract.

- F. Access Doors: Provide as necessary for reasonable maintenance of all equipment valves, controls, etc.

END OF SECTION

**SECTION 23 05 05 – SELECTIVE DEMOLITION FOR HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work specified in this Section includes the demolition, removal, and disposition of certain mechanical work.
- B. Drawings, the provisions of the Agreement, and Administrative Specification Sections apply to all work of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 DEMOLITION, REMOVAL AND DISPOSITION

- A. Saw-cut concrete as shown or required.
- B. Piping, Ductwork, And Equipment To Be Removed: Remove all piping, ductwork, and equipment as indicated on the Drawings.
- C. Piping Removed: Drawings do not show all existing piping which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.
- D. Piping, Ductwork, Equipment, Control Wiring and Tubing To Be Removed: Remove all piping, ductwork, equipment, control wiring and tubing as indicated. Drawings do not show all existing piping, ductwork, equipment, control wiring and tubing which is to be removed. Unless indicated otherwise, where existing equipment has been removed, or its use replaced by new equipment, remove connecting piping and ductwork back to the branch in the main so that there will be no dead ends or unused pipe lines in mechanical spaces at completion.
- E. Materials to Owner: All items or materials removed from the project shall be made available for the Owner's inspection. The Owner retains the option to claim any item or material. The Contractor shall deliver any claimed item or material in good condition to the place designated by the Owner. All items not claimed become the property of the Contractor and shall be removed from the site by the Contractor.
- F. Materials to Owner: As indicated on the Drawings.
- G. Re-use of Materials: Only where indicated on Drawings.

- H. Materials to Contractor: Materials shown or specified to be removed, other than the materials indicated to be turned over to Owner.
- I. Protect any active piping and/or wiring encountered; remove, plug or cap utilities to be abandoned. Notify the Architect of utilities encountered whose service is not known.
- J. Debris Removal: Existing materials removed and not reinstalled or turned over to the Owner shall be immediately removed from the site and disposed of by the Contractor.
- K. Repairs: Any portion of the facility damaged, cut back or made inoperable by this Contractor shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Architect.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressure Gauges.
 - 2. Pressure Gauge Taps.
 - 3. Thermometers.
- B. Products furnished but not installed under the section:
 - 1. Section 23 21 13 - Hydronic Piping: Installation of thermometer wells, pressure gauge tapplings.
 - 2. Section 23 31 00 – HVAC Ducts and Casings: Installation of thermometers and static pressure gauges.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 09 23 – Direct Digital Control System for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- D. Section 23 21 16 - Hydronic Piping Specialties.
- E. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM E1 - Specification for ASTM Thermometers.
- B. ASTM E77 - Verification and Calibration of Liquid-in-Glass Thermometers.
- C. ASTM E1 - Standard Specification for ASTM Thermometers.

1.4 SUBMITTALS

- A. Product Data: Submit engineering data for each component, Include list which indicates use, operating range, total range and location for manufactured components.
- B. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.
- C. Manufacturer's Certificate Certify that products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual location of all instrumentation and gauges.
- B. Operation and Maintenance Data.

1.6 WARRANTY

- A. Furnish one year manufacturer warranty for HVAC instrumentation.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION FOR HVAC

- A. Manufacturers:
 - 1. Dwyer
 - 2. Trerice.
 - 3. Weiss.
 - 4. Marshalltown.
 - 5. Ashcroft.
 - 6. Enerpac.
 - 7. Peterson.
 - 8. Winters.
 - 9. Substitutions: In accordance with General Conditions of the Contract1.

2.2 PRESSURE GAUGES

- A. 4-1/2 inch diameter cast aluminum case, phosphor bronze bourbon tube, rotary bronze movement, brass socket, with silicone fluid dampening black figures on white background, one percent mid-scale accuracy, scale calibrated in psi. Model 600CB as manufactured by Trerice or approved equal.

2.3 PRESSURE GAUGE TAPS

- A. Gauge Isolation Valve: Lever handle ball valve, forged brass body, chrome plated brass ball, viton o-rings for maximum 150 psig. Model Mini T-82-M as manufactured by Jomar or equal.
- B. Needle Valve: Brass for maximum 150 psig. Model 735 as manufactured by Trerice or equal.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections. Series 870 as manufactured by Trerice.
- D. Coil Siphon: Brass, 1/4", male pipe thread each end. 885 series.

2.4 STEM TYPE THERMOMETERS

- A. Analog Thermometers: 9 inch scale, universal adjustable angle, red appearing mercury, lens front tube, cast aluminum case with blueblack metallic finish and clear Lexan window, extended brass stem, cast aluminum adjustable joint with positive locking device, 2 percent of scale accuracy to ASTM E77, scale calibrated in both degrees F and degrees C, range per schedule. BX9 series as manufactured by Trerice or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide two pressure gauges per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge with isolation valve to each tapping.
- C. Install thermometers in piping systems in sockets in short couplings Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Select bulb length to reach centerline of pipe. Coat thermometer stem with conductive compound.
- D. Install thermometer sockets and flanges adjacent to controls system thermostat, transmitter, or sensors. Refer to Section 23 09 23.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level.

3.2 PRESSURE GAUGE SCHEDULE

LOCATION	SCALE RANGE
Pumps less than 40' TDH	0 - 30 PSIG
Pumps more than 40' TDH	0 - 60 PSIG
Heating water system	0 - 30 PSIG
Chilled water system	0 - 30 PSIG
Glycol water system	0 - 30 PSIG
Condenser water system	0 - 30 PSIG
Others	As applicable

3.3 THERMOMETER SCHEDULE

LOCATION	SCALE RANGE
Heating water system	0 - 200° F
Chilled water system	0 - 100° F
Glycol Heating system	0 - 200° F
Condenser water system	0 - 200° F

LOCATION	SCALE RANGE
Domestic hot water supply and recirc.	0 - 200° F
Others	As applicable

END OF SECTION

SECTION 23 05 48 – VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section provides minimum acceptance requirements for vibration isolation and seismic/wind restraints for all HVAC piping, ductwork equipment and piping.

1.2 GENERAL

- A. The requirements for seismic protection measures to be applied to plumbing equipment and systems specified herein are in addition to any other items called for in other sections of these specifications.

1.3 HVAC PIPING, DUCTWORK AND EQUIPMENT

- A. This section provides minimum acceptance requirements for vibration isolation and seismic/wind restraints for all HVAC equipment, piping and ductwork. HVAC equipment shall include all items on mechanical plans or in other sections of the Division 23 specifications. Equipment shall include but not be limited to:
 - 1. Air Separators.
 - 2. Expansion tanks
 - 3. Glycol Tanks.
 - 4. Pumps.
 - 5. Hydronic Piping.
 - 6. Steam Piping.
 - 7. Ductwork.
 - 8. Fans.
 - 9. VAV Units.
 - 10. Air handling units.
 - 11. Chillers.
 - 12. Heat Exchangers.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Seismic restraints for fire suppression systems are provided in Division 21.
- B. Vibration isolation and seismic/wind restraints for plumbing systems are specified elsewhere in Division 22.
- C. Vibration isolation and seismic restraints for electrical systems are provided in Division 26.

1.5 QUALITY ASSURANCE

- A. The following codes and standards will apply:
 - 1. International Building Code.
 - 2. American Society of Civil Engineers (ASCE) 7-10.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control and wind restraint products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. The following guides may be used for supplemental information on typical seismic installation practices:
 - 1. Federal Emergency Management Agency (FEMA) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
 - 2. Sheet Metal and Air-conditioning Contractors' National Association's (SMACNA) Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 3. American Society for Heating, Refrigerating and Air-conditioning Engineers' (ASHRAE) A Practical Guide to Seismic Restraint.
 - 4. Manufacturers Standardization Society of the Valve and Fittings Industry MSS SP-127-2001, Bracing for Piping Systems, Seismic - Wind - Dynamic, Design, Selection, Application.

1.6 COMPONENT IMPORTANCE FACTOR

- A. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (I_p) on the basis of the following:

$I_p = 1.5$ All piping and equipment serving systems required for the continued operation of an essential facility (Occupancy Category IV). Occupancy Category IV, essential facilities required for post earthquake recovery - all "Designated Seismic Systems" per IBC Chapter 17 required for the continued operation of the facility.

All piping, or equipment associated with Life-safety systems which are required to function after a seismic event including fire protection sprinkler systems.

Components that contain hazardous or flammable materials.

Natural gas piping, medical gas piping, vacuum piping, petroleum based liquid piping, compressed air piping and any other piping carrying hazardous materials:
 $I_p=1.5$.

1.7 SUBMITTALS

- A. Submit shop drawings and manufacturer's data in accordance with General Conditions of the Contract.

- B. Provide calculations for selection of seismic/wind restraints in accordance with IBC and ASCE 7, certified by a qualified professional engineer, licensed in the state of the project.
- C. All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.
- D. Submit shop drawings for all devices specified herein and as indicated and scheduled on the drawings. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.
- E. Provide Finite Element Analysis (FEA) of all customized restraints, snubbers, and support structures such as equipment bases and roof curbs. A summary report from the analyses shall be made available to the Engineer and shall indicate compliance with the design forces for the project - including all gravity, wind and seismic loads. The report shall show locations of maximum stress and explain any allowances given for localized yielding along with safety factors.
- F. Provide Shop drawings along with catalog cuts, templates and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal; and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.
 - 1. Sway Braces.
 - 2. Snubbers.
 - 3. Flexible Couplings and Joints.
 - 4. Vibration Isolators.
 - 5. Seismic Cable Restraint.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Amber/Booth.
- B. Cooper Industries.
- C. International Seismic Application Technology.
- D. Kinetics Noise Control.
- E. Mason Industries.
- F. Vibro-Acoustics.

2.2 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Seismic restraint designer shall coordinate all attachments with the structural engineer of record.

2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
 4. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code and as summarized in installation requirements.
 5. The total height of the structure (h) and the height of the system to be restrained within the structure (z) shall be determined in coordination with architectural plans and the General Contractor.
- B. Friction from gravity loads shall not be considered resistance to seismic forces.

2.3 SEISMIC BRACING COMPONENTS

- A. Steel strut shall be 1-5/8 wide in varying heights and mig-welded combinations as required to meet load capacities and designs indicated. A material heat code, part number, and manufacturer's name shall be stamped on all strut and fittings to maintain traceability to material test reports.
1. Material for epoxy painted strut: ASTM A1011, SS, Grade 33.
 2. Material for pre-galvanized strut: ASTM A653, SS, Gr. 33.
 3. Material for Hot-Dip Galvanized strut: ASTM A1011, SS, Grade 33 and hot-dip galvanized after fabrication in accordance with ASTM A123.
 4. Material for fittings and accessories: ASTM A907 Gr. 33, Structural Quality or ASTM A1011, SS, Gr.33.
 5. Fittings and accessories: Products shall be of the same manufacturer as strut and designed for use with that product.
 6. Concrete Anchors: Post-installed anchors in concrete shall be qualified for seismic/wind restraint application.
 - a. Mechanical anchor bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. (In accordance with ACI 355.2 and ICC-ES AC193)
 - b. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. (In accordance with ACI 355.4 and ICC-ES AC308)

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.

- B. Coordinate locations and sizes of structural supports with locations of vibration isolators and seismic/wind restraints (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).
- C. Isolated and restrained equipment and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.2 SEISMIC/WIND RESTRAINTS

A. General:

1. All equipment and piping shall be restrained to resist seismic/wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations. Additional requirements specified herein are included specifically for this project.
2. Install seismic and wind restraint devices per the manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.
3. Attachment to structure for suspended equipment and pipe: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
4. Wall penetrations may be used as bracing locations provided the wall can provide adequate resistance without significant damage.
5. Coordinate sizes and locations of cast-in-place inserts for post-tensioned slabs with seismic restraint manufacturer.
6. Provide hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.
7. Where rigid restraints are used on equipment or piping, support rods for the equipment or piping at restraint locations must be supported by anchors rated for seismic use. Post-installed concrete anchors must be in accordance with ACI 355.2.
8. Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough to ensure adequate edge distance for restraint anchor bolts to avoid housekeeping pad breakout failure.

B. Concrete Anchor Bolts:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre- or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Mechanical Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
- C. Equipment Restraints:
1. Seismically restrain equipment as indicated on the schedule. Install fasteners, straps and brackets as required to secure the equipment.
 2. As indicated on the schedule, install seismic snubbers on HVAC equipment supported by floor-mounted, non-seismic vibration isolators. Locate snubbers as close as possible to vibration isolators and attach to equipment base and supporting structure as required.
 3. Install neoprene grommet washers on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 1/8" (3.2 mm).
 4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- D. Duct Systems:
1. Seismically restrain all ductwork listed below, using seismic cable restraints:
 - a. All ducts with cross-sectional area equal to or greater than 6 ft² (0.55 m²).
 - b. Any ductwork which if it were to fail would result in damage to a piece of equipment or building function that has a component importance factor of 1.5.
 - c. All ductwork weighing more than 17 lbs/ft (25 kg/m).
 - d. All ductwork in the operating rooms.
 2. "12-inch rule", where duct can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:
 - a. The hangers shall be detailed to avoid significant bending of the hangers and their attachments. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.
 - b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.
 3. Space lateral supports a maximum of 30' o.c. (9 m), and longitudinal supports a maximum of 60' (18 m) o.c.
 4. Duct risers shall be restrained at floor penetrations every 30' (9 m) maximum spacing.
 5. Fire damper locations may be used as restraint locations for all directions except away from the damper.
 6. Brace a change of direction longer than 12' (3.7 m).

7. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.
- E. Piping Systems:
1. Provide seismic cable restraints on the following:
 - a. All piping systems with a nominal pipe diameter greater than 1" (25 mm) or trapeze-supported piping with combined operating weight over 10 lbs/ft (15 kg/m).
 2. "12-inch rule", where pipe can be exempted from seismic restraint based on the length of the support rods, is accepted if one of the following conditions are met:
 - a. Hangers are detailed to avoid bending of the hangers and their attachment; and provisions are made for piping to accommodate expected deflections. The maximum stress due to combined loading including bending in the hangers must be less than 21.6 ksi.
 - b. Isolation hangers are added to hanger rod to provide swivel joint and to prevent bending moment in hanger.
 3. Restraint spacing:
 - a. For ductile piping, space lateral supports a maximum of 40' (12 m) o.c., and longitudinal supports a maximum of 80' (24 m) o.c.
 - b. For non-ductile piping (e.g., cast iron, PVC) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - c. For piping with hazardous material inside (e.g., natural gas, medical gas) space lateral supports a maximum of 20' (6 m) o.c., and longitudinal supports a maximum of 40' (12 m) o.c.
 - d. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
 4. Brace a change of direction longer than 12' (3.7 m).
 5. Longitudinal restraints for single pipe supports shall be attached directly to the pipe, not to the pipe hanger.
 6. For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.
 7. Piping on roller supports shall include a second roller support located on top of the pipe at each restraint location to provide vertical restraint.
 8. Install restraint cables so they do not bend across edges of adjacent equipment or building structure.
 9. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
 10. Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

11. Coordinate seismic restraints with thermal expansion compensators, guides and anchor points. Thermal expansion anchor points shall be designed to accommodate seismic forces.

3.3 INSPECTION AND CERTIFICATION

- A. After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.
- B. After installation, arrange and pay for the seismic restraint product manufacturer, or representative, to visit the site to verify that the seismic and wind restraint systems are installed properly, and shall submit a certificate so stating.

END OF SECTION

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

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Air Systems:
 - 1. Constant Volume Air Systems.
 - 2. Variable Air Volume Systems.
 - 3. Space Pressurization.
 - 4. Existing HVAC Systems.
- B. Hydronic Systems:
 - 1. Constant Volume Systems.

1.2 SCOPE

- A. Furnish the professional services of a qualified and approved balancing and testing firm to perform the work of this specification section.
- B. The work of this section includes but is not necessarily limited to:
 - 1. Testing and balancing existing hydronic heating and ventilation systems as indicated on drawings.
 - 2. Testing and balancing fans and air handling systems.
 - 3. Testing and balancing new variable air volume terminal units.
 - 4. Testing and balancing new liquid heat transfer systems.
 - 5. Working directly with the control subcontractor to obtain proper system adjustments.
 - 6. Domestic water distribution system adjustment.
- C. The work of this section does not include:
 - 1. Adjusting burners for proper combustion operation.
 - 2. Liquid waste transfer system adjustment.
 - 3. Fire protection systems.

1.3 APPLICABLE CODES AND STANDARDS

- A. SMACNA Manual for the Balancing and Adjustment of Air Distribution Systems.
- B. AMCA Publication 203, Field Performance Measurements.
- C. American Air Balancing Council (AABC) Recommended Procedures
- D. National Environmental Balancing Bureau (NEBB) Recommended Procedures

1.4 QUALIFICATION OF THE BALANCING FIRM OR COMPANY

- A. Subcontractor minimum qualifications include:
 - 1. Demonstrate satisfactory completion of five projects of similar scope in the State of Alaska during the past five years. Provide references if requested.
 - 2. NEBB Certified in Testing, Adjusting and Balancing of Air and Hydronic Systems.

1.5 TIMING OF WORK

- A. Do not begin balancing and testing until the systems, including controls, are completed and in full working order.
- B. Schedule the testing and balancing work in cooperation with other trades.
- C. Complete the testing and balancing at least one week before the date of substantial completion and before any occupancy occurs

1.6 CONTRACTOR RESPONSIBILITY TO BALANCING AGENCY

- A. Award the test and balance contract to an approved firm or company upon receipt of contract to allow the Balance and Testing Agency to schedule this work in cooperation with other trades involved and comply with completion date.
- B. Put all heating, ventilating and air conditioning systems, equipment and controls into full operation for the Balancing Agency and continue the operation of same during each working day of testing balancing.
- C. Provide scaffolding, ladders and access to each system for proper testing balancing.
- D. Ensure that the building enclosure is complete, including but not limited to, structural components, windows and doors installed, door hardware complete, ceilings complete, stair, elevator and mechanical shafts complete, roof systems complete, all plenums sealed, etc.
- E. Make any changes in pulleys, belts and dampers, or add any dampers as required for correct balance as recommended by the Balance and Testing Agency at no additional cost to the Owner.
- F. Complete installation, programming (including design parameters and graphics), calibration, and startup of all building control systems.

- G. Require that the building control system firm provide access to hardware and software, or onsite technical support required to assist the TAB effort. The hardware and software or the onsite technical support shall be provided at no cost to the TAB firm.

1.7 REPORT

- A. Certified Reports shall be included in project O & M manuals. Reports shall include: testing, adjusting, and balancing reports bearing the signature of the Test and Balance Agency Representative. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the system. Follow the procedures and format specified below:
 - 1. Draft Reports: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports.
 - 2. Final Reports: Upon verification and approval of the draft report; prepare final reports, typewritten, organized and formatted as specified below.
 - 3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the documents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary.
 - b. Air Systems.
 - c. Hydronic Systems.
 - d. Temperature Control Systems.
 - e. Special Systems.
 - f. System Deficiency Reports and Corrective Actions.
 - 4. Report Contents: Provide the following minimum information, forms and data:
 - a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency; contractor; owner, architect, engineer and project. Include addresses, contact names and telephone numbers. Also, include a certification sheet containing the name, address, telephone number and signature of the Certified Test and Balance Personnel. Include in this division a listing of the instrumentation used for the procedures along with the proof of calibration.

- b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form.
- c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.8 SUBMITTALS

- A. Submit in accordance with General Conditions of the Contract.
- B. Submit balancing agency qualifications and sample balancing forms.
- C. Provide list of equipment to be used and date of last calibration.
- D. Submit preliminary balance report a minimum of one week prior to balancing system.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

- A. Maintain all instruments accurately calibrated and in good working order. Use instruments with the following minimum performance characteristics.
 - 1. Air Velocity Instruments: Direct reading in feet per minute, 2% accuracy.
 - 2. Static Pressure Instruments: Direct reading in inches' water gauge, 2% accuracy.
 - 3. RPM Instruments: Direct reading in revolutions per minute, .5% accuracy; or revolution counter accurate within 2 counts per 1,000.
 - 4. Pressure Readout: Direct reading in feet of water or PSI, .5% accuracy.
 - 5. Temperature Instruments - Direct reading in degrees F, +.5% accuracy.
 - 6. Water Flow Instruments: Differential pressure type; direct reading in feet of water or PSI, accuracy, suitable for readout balancing valve provided.
 - 7. Sound Measuring Instrument: Octave Band Analyzer which essentially complies to AASA Standards SI.6 1960 with a range of 24DB to 150 DB sound pressure level ref. .0002 microbar. Calibrate sound test instrument before use to a closed coupler and a driving loudspeaker that produces a know-sound pressure level at the microphone of the analyzer.

PART 3 - EXECUTION

3.1 GENERAL PROCEDURES FOR ALL SYSTEMS

- A. Start with new, clean filters.

- B. In cooperation with the control manufacturer's representative, coordinate adjustments of automatically operated dampers and valves to operate as specified, indicated and/or noted.
- C. Use manufacturer's ratings on all equipment to make required calculations.
- D. Make final adjustments for each space per heating or cooling comfort requirement. State reason for variance from design CFM, i.e., "too noisy", "drafty", etc.
- E. Mark equipment and balancing device settings (including damper-control positions, valve position indicators, fan-speed-controls, and similar controls and devices) with paint or other suitable permanent identification material to show final settings.

3.2 REQUIREMENTS FOR ALL AIR HANDLING SYSTEMS

- A. Identify each diffuser, grille and register as to location and area.
- B. Identify and list size, type and manufacturer of diffusers, grilles, registers and all testing equipment.
- C. In readings and tests of diffusers, grilles and registers, include required FPM velocity and required CFM and test CFM after adjustments. If test apparatus is designed to read CFM directly, velocity reading may be omitted. Identify test apparatus used. Identify wide open (W.O.) runs.
- D. Check and record the following items:
 - 1. Air temperatures; mixed air, after coils, outside air, return air and supply air.
 - 2. Pressure drop at each coil, filter bank, etc.
 - 3. Operating suction and discharge pressure.
 - 4. Full nameplate data of all equipment.
 - 5. Rated and actual running amperage and voltage of all motors.
 - 6. Drive data including sheaves and belts and adjustments.
 - 7. Electrical overloads/heaters sizes and ranges of motors.

3.3 BALANCING LOW VELOCITY CONSTANT VOLUME DUCTWORK

- A. Analyze system and identify major branches. Tabulate design CFM for each branch.
- B. Select the branch which appears to be the longest run from the fan or to have the highest static pressure requirements.
- C. Adjust other branch dampers or the fan to establish 110% design air flow through the selected branch.

- D. Adjust the air flow through each air inlet (exhaust systems) or outlet (supply systems) on the selected branch to within +5% of the requirements so that at least one branch damper serving an inlet (or outlet) is wide open.
- E. Proceed to another branch and set up 110% design airflow. Balance each inlet or outlet to within +5% of requirements, again leaving at least one wide open run. Repeat this process until all branches are balanced 110% airflow.
- F. Once each branch has been balanced at 110% flow with one wide open run on each branch, balance with branches together, leaving at least one branch damper wide open. At this point, adjust the fan delivery so that each branch is at about 110% design airflow. Adjust the branch dampers so that each inlet (or outlet) in the system is within 10% of the required airflow.
- G. Adjust the fan for design airflow.
- H. Read and record the airflow at each inlet and outlet.
- I. Secure each branch damper and mark the balanced position of the damper quadrant.
- J. Test and record entering and leaving air temperatures of coils.
- K. Test and record entering and leaving water temperatures of coils.
- L. Test and record static pressure drop across each filter and coil bank.

3.4 BALANCING VAV AIR SYSTEMS

- A. The high velocity ductwork of the Variable Air Volume (VAV) systems are computer designed and in general should not require special balancing. The balancer must, however, check the CFM's and adjust as necessary and work with the Control Contractor to set up the fans and controls for proper operation through the range of system operation. The balancing essentially consists of the following:
 - 1. Set up and adjust each fan.
 - 2. Set up duct static pressure control.
 - 3. Balance ductwork and mixing boxes, air outlets, terminal units, etc.
 - 4. Set up building static pressure control.
- B. Step 1: Adjust all thermostats set points to call for full airflow. Adjust supply air temperature so that terminal units will stay in full airflow position. If system diversity exceeds 80%, some boxes may have to be temporarily closed.
- C. Step 2: Adjust variable speed drive controller to provide 100% fan CFM volume. Check current draw on motor. Do not exceed nameplate full load current rating. Adjust fan RPM accordingly.
- D. Step 3: Proceed with the adjustment of diffusers downstream of each terminal box. Proceed as though each box were a branch on a constant volume system. Adjust thermostats of nearby

boxes or adjust fan delivery to bring the total terminal box airflow to within + 10% of design box airflow. Record data. Establish a wide-open run and balance the diffusers to within +5% of percentage of total box airflow to design box airflow.

- E. Step 4: At each terminal box, adjust the high-volume limiter to the CFM scheduled to the total air flow scheduled through the box. Coordinate with the control subcontractor and adjust the low volume limit. Record correction factor for each box.
- F. Step 5: Upon completion of all the diffuser adjustments at each terminal box in all zones, place enough thermostats to the no flow position to compensate for diversity. These should be randomly selected based on judgment as to how diversity applies to the particular air distribution system, considering building use. The object is to create 100% airflow at the fan.
- G. Step 6: Adjust the static pressure sensor controlling the variable speed drive to the specified setting for its location in the duct system and adjust fan for 100% CFM at wide open RPM. Record fan suction and discharge static pressure, fan CFM, RPM, motor amperage and voltage, filter and coil pressure drops and static pressure at control sensor location. Refer to procedure for constant volume fan adjustment.
- H. Step 7: Work with control subcontractor to set up all fan system controls room and building static pressure control. Readjust space thermostats set points.

3.5 FLUID SYSTEM TESTING AND BALANCING

- A. Preparation of system - Phase I:
 - 1. Complete air balance before beginning fluid balance.
 - 2. Clean all strainers.
 - 3. Examine fluid in system to determine if treated and clean.
 - 4. Check pump rotation.
 - 5. Verify expansion tanks are not air bound and system full of fluid.
 - 6. Verify all air vents at high points of fluid systems are installed properly and are operating freely. Make certain all air is removed from circuiting system.
 - 7. Open all valves to full flow position including coil and heater stop valves, close bypass valves and open return line balancing cocks. Set temperature controls so that automatic valves are open to full flow through apparatus.
 - 8. Check and set operating temperature of boilers and heat exchangers to design requirements when balancing by temperature drop.
 - 9. Adjust all flows to 110% of design flows as shown.
- B. Test and Balance Procedure - Phase II:

1. Set pumps to proper GPM delivery and set proper GPM delivery in main piping runs from boiler room. Note flow variations for additive alternates.
 2. Adjust flow of fluid through primary equipment.
 3. Check leaving fluid temperatures and return fluid temperatures and pressure drop through major equipment. Reset to correct design temperatures.
 4. Check fluid temperature at inlet side of coils and other heat transfer equipment. Note rise or drop of temperatures from source.
 5. Balance each coil and all other heat transfer apparatus in system.
 6. Upon completion of flow readings and adjustments, mark all settings and record all data.
- C. Test and Balance Procedure - Phase III:
1. After making adjustments to coils and apparatus, recheck settings at pumps and major equipment. Readjust if required.
 2. Attach pressure gauges on each coil, then read pressure drop through coil at set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop. This prevents unbalanced flow conditions when coils are on full bypass.
 3. Check and record the following items with flows set at 100% of design.
 - a. Inlet and leaving fluid and air temperatures at coils and major equipment.
 - b. GPM flow of each coil and major equipment.
 - c. Pressure drop of each coil and major equipment.
 - d. Pressure drop across bypass valve.
 - e. Pump operating suction and discharge pressures and final total developed head.
 - f. Pump GPM.
 - g. Rated and actual running amperage and voltage of pump motor.
 - h. Full nameplate data of all pumps and equipment.
 - i. Electrical overloads/heaters sizes and ranges of motors.
 4. Permanently mark adjusted position of all balancing valves. Stamp indicator plate of circuit setters and other balancing valves without memory stop.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Equipment Insulation.
- C. Ductwork Insulation.
- D. Jackets and Accessories.

1.2 RELATED WORK

- A. Section 23 05 00 – Common Work Results for HVAC Systems.
- B. Section 23 05 19 – Meters and Gages for HVAC Piping.
- C. Section 23 21 13 – Hydronic Piping.
- D. Section 23 21 16 – Hydronic Specialties.
- E. Section 23 22 13 – Steam and Condensate Heating Piping.
- F. Section 23 22 16 – Steam and Condensate Heating Piping Specialties.
- G. Section 23 31 00 – HVAC Ducts and Casings.
- H. Section 23 33 00 – Air Duct Accessories.
- I. Section 23 57 00 – Heat Exchangers for HVAC.

1.3 REFERENCES

- A. ASTM B209 - Aluminum and Aluminum-alloy Sheet and Plate.
- B. ASTM C195 - Mineral Fiber Thermal Insulating Cement.
- C. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- E. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- F. ANSI/ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- G. ANSI/ASTM C547 - Mineral Fiber Pipe Insulation (Preformed).
- H. ANSI/ASTM C552 - Cellular Glass Thermal Insulation.

- I. ANSI/ASTM C553 - Mineral Fiber Blanket Insulation.
- J. ANSI/ASTM C578 - Preformed, Block Type Cellular Polystyrene Thermal Insulation.
- K. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- L. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- M. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
- N. ASTM C610 - Expanded Perlite Block and Pipe Thermal Insulation.
- O. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- P. ASTM C1427 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- Q. ASTM D774 – Standard Test Method for Bursting Strength of Paper.
- R. ASTM D1000 - Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
- S. ASTM E84 - Surface Burning Characteristics of Building Materials.
- T. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
- U. NFPA 255 - Surface Burning Characteristics of Building Materials.
- V. UL 723 - Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include product description, thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with three years minimum experience.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723, ASTM E84, or NFPA 255.
- D. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General Conditions of the Contract - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Shipment of materials from manufacturer to installation location shall be in weather tight transportation.
- D. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesive, mastics, and insulation cements.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. General Conditions of the Contract- Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armacell.
- B. Certain-Teed.
- C. IMCOA.
- D. Johns Manville.
- E. Knauf.
- F. Owens-Corning.
- G. Nomaco.
- H. Pittsburgh - Corning.
- I. K-Flex USA.
- J. Armstrong.
- K. Substitutions: Under provisions of General Conditions of the Contract.

2.2 INSULATION - PIPING

- A. Type A: Glass fiber, rigid, molded, non-combustible insulation; ANSI/ASTM C547; 'k' value of 0.23 at 75° F, rated from 0° F to 850° F, vapor retarder jacket of Kraft paper bonded to aluminum foil, self-sealing lap and butt strips; Johns Manville "Micro-Lok" or approved equal.
- B. Type E: Elastomeric foam; EPDM-based closed-cell flexible foam, ASTM C534; flexible cellular elastomeric in sheet or pre-formed tube, 'k' value of 0.26 at 75° F, max. service temp - 300° F, ASTM C534; max. flame spread = 50, max. smoke developed = 50, ASTM E84; UV-resistant coating/jacketing if exposed to sunlight; K-FLEX USA "Insul-Tube", "Insul-Sheet", or approved equal.

2.3 FIELD APPLIED PIPING JACKET

- A. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
- B. PVC Jackets and solvent welding adhesive: One piece, pre-molded type, Johns Manville "Zeston 2000", fitting covers and jacketing material. Johns Manville "Perma-Weld" solvent welding adhesive.
- C. Aluminum Jackets: ASTM B209; 0.016 inch thick; corrugated or textured finish, longitudinal slip joints.
- D. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; corrugated finish.
- E. Re-Wettable Canvas Jacketing: , Fiberglass cloth made from texturized yarns, impregnated throughout with an inorganic fire retardant asbestos free adhesive; 20x14 thread count, 14.5 oz./sq.yd, 0.04 inch thickness, 1,000° F upper temperature limit; GLT Products "Style 1989" or approved equal.

2.4 INSULATION - EQUIPMENT

- A. Type G: Rigid fiberglass board with FSK outer facing. Johns Manville 814 FSK, 3.0 lbs./cu. ft. density, ASTM C612, K= .23 @ 75° F, 450° F maximum service temperature, Johns Manville 1000 series "Spin-Glas" or approved equal.
- B. Type H: Reusable Valve Wrap Insulation Covers: Removable and reusable wraps packaged with a 1" thick fiberglass blanket insert to completely cover the insulated equipment. The outer cover of the shall be made of DuPont Tychem® QC that is secured with a Velcro closure. Tychem® QC consists of a durable Tyvek® substrate quality coated with polyethylene that is impermeable to water. K= .28 @ 100° F; Temperature Limits 0°F to 450°F; Water Vapor Transmission ASTM E 96 0.01 Perms at 37.8C/100F-RH/100%; Breaking Strength Grab (md/cd) ASTM D5034-90 43/49 lbs; Tearing Strength Trapezoid (md/cd) ASTM D1117-80 7/5 lbs; Weatherable Grade; UV resistant; White/gloss finish; UL25/50 rating and are non-combustible per ASTM E 136.

2.5 INSULATION - DUCTWORK

- A. Type J: Exterior FSK Duct Wrap: Flexible glass fiber; ASTM C553; commercial grade; 'k' value of 0.27 at 75° F, 0.6 lb./cu. ft. density. 0.00035 inch vinyl scrim facing with 2" stapling tab. Johns Manville "Microlite Standard Duct Wrap" or equal.
- B. Type K: Exterior FSK Rigid Fiber Board Duct Insulation; ASTM C612, 'k' value of 0.23 at 75° F, 3.0 lb./cu. ft. density. 0.00035 inch foil scrim facing. Johns Manville "814 Spin-Glas" or equal.

2.6 FIELD APPLIED EQUIPMENT AND DUCTWORK JACKETS

- A. Aluminum Jackets: ASTM B209; 0.016 inch thick; corrugated or textured finish, longitudinal slip joints.
- B. Stainless Steel Jackets: Type 304 stainless steel; 0.010 inch thick; corrugated finish.
- C. Re-Wettable Canvas Jacketing: , Fiberglass cloth made from texturized yarns, impregnated throughout with an inorganic fire retardant asbestos free adhesive; 20x14 thread count, 14.5 oz./sq.yd, 0.04 inch thickness, 1,000° F upper temperature limit; GLT Products "Style 1989" or approved equal.

2.7 INSULATION ACCESSORIES

- A. Adhesives: Waterproof and fire-retardant type.
- B. Lagging Adhesive: Fire resistive to NFPA 255.
- C. Impale Anchors: Galvanized steel, 12 gauge, self-adhesive pad.
- D. Joint Tape: Glass fiber cloth, open mesh.
- E. FSK Joint Tape; ASTM C1136 Foil-Scrim-Kraft (FSK) lamination coated with solvent acrylic pressure sensitive adhesive; capable of adhering to fibrous and sheet metal surfaces; tri-directionally reinforced 2x3 squares per inch fiberglass scrim; 9.5 mils thick, -40 to 240° F service temperatures; Venture Tape "1525CW" or approved equal.
- F. Tie Wire: Annealed steel, 16 gauge.
- G. Insulated pipe supports: Calcium silicate with galvanized steel jacket (min. 24 gauge); ANSI/ASTM C533; rigid white; 'k' value of 0.37 at 100° F, rated to 1,200° F; Thermal Pipe Shields "T-1000 Calsil" or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install materials after piping, equipment and ductwork has been tested and approved.
- B. Clean surfaces for adhesives.
- C. Prepare surfaces in accordance with manufacturer's recommendations.

3.2 INSTALLATION – PIPING INSULATION

- A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
- B. Continue insulation vapor barrier through penetrations except where prohibited by code.
- C. Locate insulation and cover seams in least visible locations.
- D. Neatly finish insulation at supports, protrusions, and interruptions.

- E. Provide insulated cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self-sealing laps. Insulate complete system, including under fitting jackets.
- F. For insulated pipes conveying fluids above ambient temperature, secure jackets with self-sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions. Insulate complete system, including under fitting jackets.
- G. Provide insulated piping supports on piping 1-½" inches diameter to 3" diameter for insulated piping supports. Insulated piping supports shall not be less than the following lengths:

1-½" to 2-½" pipe size	10" long
3" to 6" pipe size	12" long
- H. Fully insulate all piping including all spaces under jacketing.
- I. Jackets:
 - 1. Indoor, Concealed Applications: Insulated pipes shall have vapor barrier jackets, factory-applied. Vapor barrier PVC fittings may also be used provided joints are sealed with solvent welding adhesive approved by the jacket manufacturer.
 - 2. For pipe exposed in mechanical equipment rooms or in finished spaces below 10 feet above finished floor, finish with PVC jacket and fitting covers or metal jacket.
 - 3. For exterior applications, provide weather protection jacket or coating. Insulated pipe, fittings, joints, and valves shall be covered with metal jacket. Jacket seams shall be located on bottom side of horizontal piping.

3.3 SCHEDULE – PIPING

PIPING	TYPE	PIPE SIZE Inch	MINIMUM INSULATION THICKNESS Inch
Heating Glycol/Water Supply and Return	A	1-1/4" and Smaller	1"
Heating Glycol/Water Supply and Return	A	2" and Larger	1-1/2"
Cooling Glycol/Water Supply and Return	E	All Sizes	1"
Steam Piping	A	All Sizes	2"
Steam Condensate	A	All Sizes	1"
Cold Condensate Drains	E	All Sizes	1"

3.4 INSTALLATION - EQUIPMENT

- A. Install materials in accordance with manufacturer's instructions.
- B. Do not insulate factory insulated equipment.
- C. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands. Minimum 2" overlap on blanket material.

- D. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- E. Cover insulation with metal mesh and finish with heavy coat of insulating cement.
- F. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- G. When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.
- H. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.5 SCHEDULE - EQUIPMENT

EQUIPMENT	INSULATION TYPE	THICKNESS INCH
Chilled Glycol System Valves, All Sizes	H	1"
Heating Glycol/Water System Valves, 2" and larger	H	1"
Heat Exchangers	G	2"
Air Separators	G	2"

3.6 INSTALLATION – DUCTWORK INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Provide insulation with vapor barrier when air conveyed may be below ambient temperature. Continue insulation with vapor barrier through penetration.
- C. Exterior Insulation (Type J,K) Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use mechanical fasteners to prevent sagging. Secure insulation with mechanical fasteners on 15 inch centers maximum, on bottom and side of ductwork with dimension exceeding 20 inches. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
 - 4. Maximum 25% compression.
- D. Where canvas jacketing is indicated, apply mastic in sufficient thickness to completely cover the texture of the canvas material.

3.7 SCHEDULE - DUCTWORK

DUCTWORK	TYPE	INSULATION THICKNESS Inch	FINISH
Supply Air Ductwork-Exposed in Mechanical room	J,K	1"	Canvas
Supply Air Ductwork-Concealed	J,K	1"	FSK
Outside Air Ductwork	K	2"	Canvas
Exhaust & Relief Ductwork Within 5 ft. of Exterior Openings	J,K	1"	FSK

END OF SECTION

SECTION 23 09 23 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.
- B. Furnish Automated Logic Web CTRL Product Line supplied by Meridian Systems, Inc. to the existing Automatic Logic Web CTRL DDC system currently installed in the Hospital. All building controllers, application controllers, and all input/output devices shall communicate to the existing system installed at the Hospital.
- C. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- D. Implement the detailed design for all analog and binary objects, system databases, graphic displays, logs, and management reports based on control descriptions, logic drawings, configuration data, and bid documents.
- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in system startup, and commissioning.
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide new sensors, dampers, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

1.2 SYSTEM DESCRIPTION

- A. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface connected to the existing Automated Logic Web CTRL system installed in the Hospital.
- B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web

browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet.

- C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.
- D. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in 23 09 93 - "Sequence of Operations for HVAC Controls" shall be BACnet objects.
- E. Room sensors shall allow room setpoint adjustment within preset temperature and humidity limits. Initial settings 60-75 Degrees F, 30% - 50% RH.
- F. Provide all alarms, manual control, and status indication functions as indicated under the sequence of operation, Specification Section 23 09 93.

1.3 RELATED SECTIONS

- A. Section 23 05 00 – Common Work Results for Heating, Ventilation, and Air Conditioning (HVAC)
- B. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC.
- C. Section 23 21 13 – Hydronic Piping.
- D. Section 23 21 16 – Hydronic Specialties.
- E. Section 23 21 23 – Hydronic Pumps.
- F. Section 23 33 00 – Air Duct Accessories.
- G. Section 23 36 00 – Air Terminal Units.
- H. Section 23 64 33 – Modular Water Chillers.
- I. Section 23 73 00 – Indoor Central Air Handling Units.
- J. Division 26 – Electrical Specifications

1.4 REFERENCES

- A. ANSI/ASHRAE 135 Data Communication Protocol for Building Automation and Control Networks (BACnet).

1.5 DEFINITIONS

Term	Definition
BACnet Interoperability Building Blocks (BIBB)	A BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBS are combined to build the BACnet functional requirements for a device in a specification.

Term	Definition
BACnet/BACnet Standard	BACnet communication requirements as defined by the latest version of ASHRAE/ANSI 135 and approved addenda.
Control Systems Server	A computer(s) that maintain(s) the systems configuration and programming database.
Controller	Intelligent stand-alone control device. Controller is a generic reference to building controllers, custom application controllers, and application specific controllers.
Direct Digital Control	Microprocessor-based control including Analog/Digital conversion and program logic.
Gateway	Bi-directional protocol translator connecting control systems that use different communication protocols.
Local Area Network	Computer or control system communications network limited to local building or campus.
Master-Slave/Token Passing	Data link protocol as defined by the BACnet standard.
Point-to-Point	Serial communication as defined in the BACnet standard.
Primary Controlling LAN	High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
Protocol Implementation Conformance Statement	A written document that identifies the particular options specified by BACnet that are implemented in a device.
Router	A device that connects two or more networks at the network layer.
Wiring	Raceway, fittings, wire, boxes and related items.

1.6 QUALITY ASSURANCE

- A. The direct digital control system provided shall be designed, furnished, installed, tested, certified and placed into service by a Control Contractor who is regularly engaged in the installation of direct digital control systems in Alaska. The Control Contractor shall maintain an office in Alaska with parts and maintenance personnel to ensure prompt response (24 hour maximum) to an emergency call during the one year correction period.
- B. The Control Contractor shall be able to demonstrate that he has had experience designing and installing direct digital control systems of comparable type and size to that called for in these Specifications.
- C. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:
 - 1. Name of manufacturer and proof that the Control Contractor holds a manufacturer's franchise or license to design and install the proposed control system.
 - 2. Proof of Alaskan Office, with full time service representative.
 - 3. List of Alaskan buildings with names, addresses, and phone numbers of Owners which are representative of direct digital control systems that have been installed by the Control Contractor. Include a brief description and approximate control system construction cost of each system submitted.

1.7 SYSTEM PERFORMANCE

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
 6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
 9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table-1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15° (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)

Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: Accuracy applies to 10%–100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

1.8 EQUIPMENT AND SHOP DRAWING REVIEW SUBMITTALS

- A. Product Data and Shop Drawings: Provide product data and shop drawings in accordance with Section 23 05 00 and General Conditions of the contract.
- B. Product Data and Shop Drawings: The contractor shall provide shop drawings or other submittals on hardware, software, and equipment to be installed or provided. No work may begin on any segment of this project until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD compatible files on magnetic or optical disk (file format: .DWG, .DXF, .VSD, or comparable) and three 11" x 17" prints of each drawing. When manufacturer's cutsheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawing shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Submittals shall be provided within 4 weeks of contract award. Submittals shall include:
 1. DDC System Hardware
 - a. A complete bill of materials to be used indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct digital controllers (controller panels)
 - 2) Transducers and transmitters

- 3) Sensors (including accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Relays and switches
 - 7) Control panels
 - 8) Power supplies
 - 9) Batteries
 - 10) Operator interface equipment
 - 11) Wiring
- c. Wiring diagrams and layouts for each control panel. Show termination numbers.
 - d. Schematic diagrams for all field sensors and controllers. Provide floor plans of all sensor locations and control hardware. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Central System Hardware and Software
- a. A complete bill of material of equipment used indicating quantity, manufacturer, model number, and relevant technical.
 - b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions for items listed below and for relevant items furnished under this contract not listed below:
 - 1) Central Processing Unit (CPU) or web server
 - 2) Monitors
 - 3) Keyboards
 - 4) Power supplies
 - 5) Battery backups
 - 6) Interface equipment between CPU or server and control panels
 - 7) Operating System software
 - 8) Operator interface software
 - 9) Color graphic software
 - 10) Third-party software
 - c. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports

with computer manufacturers' model numbers and functions. Show interface wiring to control system.

- d. Network riser diagrams of wiring between central control unit and control panels.

3. Controlled Systems

- a. Riser diagrams showing control network layout, communication protocol, and wire types.
- b. A schematic diagram of each controlled system. The schematics shall have all control points labeled with point names shown or listed. The schematics shall graphically show the location of all control elements in the system.
- c. A schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
- d. An instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- e. A mounting, wiring, and routing plan-view drawing. The design shall take into account HVAC, electrical, and other systems' design and elevation requirements. The drawing shall show the specific location of all concrete pads and bases and any special wall bracing for panels to accommodate this work.
- f. A complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system.
- g. A point list for each control system. List I/O points and software points specified in Section 23 09 93. Indicate alarmed and trended points.

4. Quantities of items submitted shall be reviewed but are the responsibility of the Contractor.

5. A description of the proposed process along with all report formats and checklists to be used in Section 23 09 23 Paragraph 3.17 (Control System Demonstration and Acceptance).

6. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.

C. Schedules

1. Within one week of contract award, provide a schedule of the work to the general contractor indicating the following:
 - a. Intended sequence of work items
 - b. Start date of each work item
 - c. Duration of each work item

- d. Planned delivery dates for ordered material and equipment and expected lead times
 - e. Milestones indicating possible restraints on work by other trades or situations
2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Provide operations and maintenance manuals in accordance with Section 23 05 00 and General Conditions of the contract.
- B. Operation and Maintenance Manuals must be submitted for review, reviewed by the Project Manager, corrected in accordance with review comments, and accepted by the Project Manager before a request for final completion inspection will be considered by the Project Manager.
- C. Project Record Documents. Upon completion of installation, submit three copies of record (as-built) documents. The documents shall be submitted for approval prior to final completion and shall include:
 1. Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD compatible files on magnetic or optical media (file format: .DWG, .DXF, .VSD, or comparable) and as 11" x 17" prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 23 09 23 Paragraph 3.17 (Control System Demonstration and Acceptance).
 3. Operation and Maintenance (O&M) Manual.
 4. As-built versions of submittal product data.
 5. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 6. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 7. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 8. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 9. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 10. Graphic files, programs, and database on magnetic or optical media.

11. List of recommended spare parts with part numbers and suppliers.
 12. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 13. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 14. Licenses, guarantees, and warranty documents for equipment and systems.
 15. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- D. Training Materials: Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. Engineer will modify course outlines and materials if necessary to meet Owner's needs. Engineer will review and approve course outlines and materials at least three weeks before first class.
- E. After the final inspection and subsequent punch list inspections update each copy of the Operation and Maintenance Manual to reflect final as-built conditions.

1.10 SYSTEMS DEMONSTRATION

- A. The Contractor will completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and sequences of operation.
- B. Provide complete demonstration of system operation to the owners representative at the project substantial completion inspection. The Contractor will demonstrate to the Owner's satisfaction that all equipment and systems operate in accordance with the sequence of operation as outlined under Section 23 09 93. Demonstration will include all equipment controlled by the Direct Digital Control System.

1.11 WARRANTY

- A. Under provisions of General Conditions of the Contract.
- B. All components, system software, parts and assemblies will be guaranteed against defects in materials and workmanship for one year from acceptance date.
- C. Labor to troubleshoot, repair, reprogram, or replace system components will be furnished by the Contractor at no charge to the owner during the warranty period.
- D. All corrective software modifications made during warranty service periods will be updated on user documentation and on user and manufacturer archived software.

PART 2 - PRODUCTS

2.1 APPROVED BUILDING AUTOMATION SYSTEMS

- A. Automated Logic Web CTRL Product Line supplied by Meridian Systems, Inc. The system shall integrate to the existing Automatic Logic Web CTRL DDC system currently installed in the Hospital.

2.2 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135, BACnet.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Use existing Ethernet backbone for network segments marked "existing" on project drawings.
- D. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- E. Internetwork operator interface and value passing shall be transparent to internetwork architecture.
 - 1. An operator interface connected to a controller shall allow the operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, and control algorithms shall be viewable and editable from each internetwork controller.
 - 2. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers shall be readable by each controller on the internetwork. Program and test all cross-controller links required to execute control strategies specified in Section 23 09 93. An authorized operator shall be able to edit cross-controller links by typing a standard object address or by using a point-and-click interface.
- F. Workstations, Building Control Panels, and Controllers with real-time clocks shall use the BACnet Time Synchronization service. System shall automatically synchronize system clocks daily from an operator-designated device via the internetwork. The system shall automatically adjust for daylight saving and standard time as applicable.
- G. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.

2.3 OPERATOR INTERFACE

- A. Connect all new system and components installed under this project to the existing Automated Logic Operator Interface installed at the Hospital.
- B. System Graphics. The operator interface software shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

1. **Functionality.** Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.
 2. **Animation.** Graphics shall be able to animate by displaying different image files for changed object status.
 3. **Alarm Indication.** Indicate areas or equipment in an alarm condition using color or other visual indicator.
 4. **Format.** Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins (such as Adobe Flash).
- C. **Custom Graphics.** Custom graphic files shall be created with the use of a graphics generation package furnished with the system. The graphics generation package shall be a graphically based system that uses the mouse to create and modify graphics that are saved in the same formats as are used for system graphics.
- D. **Graphics Library.** Furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

2.4 CONTROLLER SOFTWARE

- A. **Furnish the following applications for building and energy management.** All software application shall reside and operate in the system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. **Scheduling.** Provide the capability to execute control functions according to a user created or edited schedule. Each schedule shall provide the following schedule options as a minimum:
1. **Weekly Schedule.** Provide separate schedules for each day of the week. Each schedule shall be able to include up to 5 occupied periods (5 start-stop pairs or 10 events).
 2. **Exception Schedules.** Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule has executed, the system shall discard and replace the exception schedule with the standard schedule for that day of the week.
 3. **Holiday Schedules.** Provide the capability for the operator to define up to 24 special or holiday schedules. These schedules will be repeated each year. The operator shall be able to define the length of each holiday period.
- C. **System Coordination.** Operator shall be able to group related equipment based on function and location and to use these groups for scheduling and other applications.
- D. **Binary Alarms.** Each binary object shall have the capability to be configured to alarm based on the operator-specified state. Provide the capability to automatically and manually disable alarming.

- E. Analog Alarms. Each analog object shall have both high and low alarm limits. The operator shall be able to enable or disable these alarms.
- F. Alarm Reporting. The operator shall be able to determine the action to be taken in the event of an alarm. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display on graphics.
- G. Remote Communication. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.
- H. Maintenance Management. The system shall be capable of generating maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits. Configure and enable maintenance alarms as specified in 23 09 93 (Sequences of Operation).
- I. Sequencing. Application software shall sequence chillers, boilers, and pumps as specified in Section 23 09 93 (Sequences of Operation).
- J. PID Control. System shall provide direct- and reverse-acting PID (proportional-integral-derivative) algorithms. Each algorithm shall have anti-windup and selectable controlled variable, setpoint, and PID gains. Each algorithm shall calculate a time-varying analog value that can be used to position an output or to stage a series of outputs. The calculation interval, PID gains, and other tuning parameters shall be adjustable by a user with the correct security level.
- K. Staggered Start. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- L. Anti-Short Cycling. All binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- M. On and Off Control with Differential. Provide an algorithm that allows a binary output to be cycled based on a controlled variable and a setpoint. The algorithm shall be direct-acting or reverse-acting.
- N. Runtime Totalization. Provide software to totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit. Configure and enable runtime totalization and alarms as specified in Section 23 09 93 (Sequence of Operations).

2.5 CONTROLLERS

- A. General. Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Section 23 09 23 Article 1.9 (System Performance). Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. Unless otherwise specified, hardwired actuators and sensors may be used in lieu of BACnet Smart Actuators and Smart Sensors.
- B. BACnet.
 - 1. Building Controllers (BCs). Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

2. Advanced Application Controllers (AACs). Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.
3. Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.
4. Smart Sensors (SSs). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.
5. BACnet Communication.
 - a. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing.
 - b. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs and ASCs.
 - c. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - d. Each ASC shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.
 - f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Communication

1. Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Signal Management. BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.
3. Data Sharing. Each BC and AAC shall share data as required with each networked BC and AAC.
4. Stand-Alone Operation. Each piece of equipment specified in Section 23 09 93 shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

- D. Environment. Controller hardware shall be suitable for anticipated ambient conditions.
 - 1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20°F to 140°F.
 - 2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32°F to 120°F.
- E. Keypad. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.
- F. Real-Time Clock. Controllers that perform scheduling shall have a real-time clock.
- G. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.
- H. Memory.
 - 1. Controller memory shall support operating system, database, and programming requirements.
 - 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 - 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.
- J. Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.6 INPUT AND OUTPUT INTERFACE

- A. General. Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Protection. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground shall cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no controller damage.
- C. Binary Inputs. Binary inputs shall allow the monitoring of ON/OFF signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against contact bounce and noise.

Binary inputs shall sense dry contact closure without application of power external to the controller.

- D. Pulse Accumulation Inputs. Pulse accumulation inputs shall conform to binary input requirements and shall also accumulate up to 10 pulses per second.
- E. Analog Inputs. Analog inputs shall allow the monitoring of low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- F. Binary Outputs. Binary outputs shall provide for ON/OFF operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building Controllers shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- G. Analog Outputs. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0-10 Vdc or a 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- H. Tri-State Outputs. Control three-point floating electronic actuators without feedback with tri-state outputs (two coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- I. Universal Inputs and Outputs. Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.
- J. System Object Capacity. The system size shall be expandable to at least twice the number of input/ output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system

2.7 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - b. Line voltage units shall be UL recognized and CSA listed.

- B. Power Line Filtering.
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.8 AUXILIARY CONTROL DEVICES

- A. Electric Damper and Valve Actuators.
 - 1. Stall Protection. Mechanical or electronic stall protection shall prevent actuator damage throughout the actuator's rotation.
 - 2. Spring-return Mechanism. Actuators used for power-failure and safety applications shall have an internal mechanical spring-return mechanism or an uninterruptible power supply (UPS).
 - 3. Signal and Range. Proportional actuators shall accept a 0-10 Vdc or a 0-20 mA control signal and shall have a 2-10 Vdc or 4-20 mA operating range. (Floating motor actuators may be substituted for proportional actuators in terminal unit applications as described in paragraph 2.6H.)
 - 4. Wiring. 24 Vac and 24 Vdc actuators shall operate on Class 2 wiring.
 - 5. Manual Positioning. Operators shall be able to manually position each actuator when the actuator is not powered. Non-spring-return actuators shall have an external manual gear release. Spring-return actuators with more than 7 N·m (60 in.-lb) torque capacity shall have a manual crank.
- B. Control Valves.
 - 1. Control valves shall be two-way or three-way type for two-position or modulating service as shown.
 - 2. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 - a. Water Valves:
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - b. Steam Valves: 150% of operating (inlet) pressure.
 - 3. Water Valves.

- a. Body and trim style and materials shall be in accordance with manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service.
 - b. Sizing Criteria:
 - 1) Two-position service: Line size.
 - 2) Two-way modulating service: Pressure drop shall be equal to twice the pressure drop through heat exchanger (load), 50% of the pressure difference between supply and return mains, or 5 psi, whichever is greater.
 - 3) Three-way modulating service: Pressure drop equal to twice the pressure drop through the coil exchanger (load), 35 kPa (5 psi) maximum.
 - 4) Valves ½ in. through 2 in. shall be bronze body or cast brass ANSI Class 250, spring-loaded, PTFE packing, quick opening for two-position service. Two-way valves to have replaceable composition disc or stainless steel ball.
 - 5) Valves 2½ in. and larger shall be cast iron ANSI Class 125 with guided plug and PTFE packing.
 - c. Water valves shall fail normally open or closed, as scheduled on plans, or as follows:
 - 1) Water zone valves-normally open preferred.
 - 2) Heating coils in air handlers-normally open.
 - 3) Chilled water control valves-normally closed.
 - 4) Other applications-as scheduled or as required by sequences of operation.
4. Steam Valves.
- a. Body and trim materials shall be in accordance with manufacturer's recommendations for design conditions and service with linear ports for modulating service.
 - b. Sizing Criteria:
 - 1) Two-position service: pressure drop 10% to 20% of inlet psig.
 - 2) Modulating service: 100 kPa (15 psig) or less; pressure drop 80% of inlet psig.
- C. Binary Temperature Devices.
1. Low-Voltage Space Thermostats. Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats. Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or

equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed setpoint adjustment, 13°C-30°C (55°F-85°F) setpoint range, 1°C (2°F) maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats. Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 m (20 ft) long. Element shall sense temperature in each 30 cm (1 ft) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

D. Temperature Sensors.

1. Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft² of duct cross-section.
3. Immersion Sensors. Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors. Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors. Provide matched sensors for differential temperature measurement.

E. Humidity Sensors.

1. Duct and room sensors shall have a sensing range of 20%-80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 20%-95% RH and shall be suitable for ambient conditions of -40°F-170°F.
4. Humidity sensors shall not drift more than 1% of full scale annually.

F. Flow Switches. Flow-proving switches shall be paddle (water service only) or differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Paddle switches shall have adjustable sensitivity and NEMA 1 enclosure unless otherwise specified.
2. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

G. Relays.

1. Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown.

Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

H. Override Timers.

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

I. Current Transmitters.

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

J. Current Transformers.

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

K. Voltage Transmitters.

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

L. Voltage Transformers.

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide $\pm 0.5\%$ accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

- M. Current Switches.
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.
- N. Pressure Transducers.
1. Transducers shall have linear output signal and field-adjustable zero and span.
 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
 4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 1000 kPa (150 psi). Over-range limit (differential pressure) and maximum static pressure shall be 2000 kPa (300psi.) Transducer shall have 4-20 mA output, suitable mounting provisions, and 5-valve manifold.
- O. Differential Pressure Switches. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.
- P. Occupancy Sensors. Occupancy sensors shall utilize Passive Infrared (PIR) and/or Microphonic Passive technology to detect the presence of people within a room. Sensors shall be mounted as indicated on the approved drawings. The sensor output shall be accessible by any lighting and/or HVAC controller in the system. Occupancy sensors shall be capable of being powered from the lighting or HVAC control panel, as shown on the drawings. Occupancy sensor delay shall be software adjustable through the user interface and shall not require manual adjustment at the sensor.
- Q. Local Control Panels.
1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable subpanels. A single key shall be common to all field panels and subpanels.
 2. Interconnections between internal and face-mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.
- R. Airflow Sensor Measurement Devices
1. Acceptable Manufacturers:
 - a. EBTRON, Inc.
 - b. No Substitutions.

2. Provide airflow sensor measurement devices as indicated in the sequence of operations. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.
3. Each measurement device shall consist of one or more sensor probe assemblies and a single microprocessor-based transmitter. Each sensor probe assembly will contain one or more independent sensor housings. Multiple sensor housings shall be equally weighted and averaged by the transmitter prior to output. Vortex shedding flow meters are not acceptable.
4. All Sensor Probe Assemblies:
 - a. Each electronic sensor housing shall utilize two hermetically sealed thermistor probes to determine airflow rate and ambient temperature. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
 - b. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor assembly shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
 - c. Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
 - d. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to a remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
 - e. Each sensor assembly shall not require matching to the transmitter in the field.
 - f. A single manufacturer shall provide both the airflow measuring probe(s) and transmitter at a given measurement location.
5. SAV and RAV Sensor Probes:
 - a. Provide sensors for field installation on SAV and RAV units. Remove factory mounted airflow sensor and install thermal dispersion measuring sensor.
 - b. Sensor probes shall be constructed of 316 stainless steel tubes.
 - c. Sensor probe mounting brackets shall be constructed of 304 stainless steel.
 - d. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.
 - e. PVC jacketed internal wiring is not acceptable.
 - f. Probe internal wiring connections shall consist of solder joints and spot welds.
 - g. Connectors of any type within the probe are not acceptable.
 - h. Printed circuit boards within the probe are not acceptable.

- i. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy.
- j. Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
- k. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
- l. Each sensor node shall be calibrated to volumetric standards at a minimum of 7 calibration points.
- m. The number of independent sensor nodes provided shall be as follows:

Diameter - in	# Sensor Nodes
4	1
≥ 5 & ≤ 16	2

6. Duct and Plenum Sensor Probe Assemblies:

- a. Sensor housings shall be mounted in an extruded, 6063 aluminum tube probe assembly.
- b. The number of sensor housings provided for each location shall be as follows:

1) Area (sq. ft.)	Sensors
<=1	2
>1 to <4	4
4 to <8	6
8 to <12	8
12 to <16	12
>=12	16

- c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
 - 1) Insertion mounted through the side or top of the duct.
 - 2) Internally mounted inside the duct or plenum.
 - 3) Standoff mounted inside the plenum.
- d. The operating airflow range shall be 0 to 5,000 CFM unless otherwise indicated on the plans.

7. Fan Inlet Sensor Probe Assemblies (Allowed only at roof mounted relief fans upon written permission from the engineer).

- a. Sensor housings shall be mounted on 304 stainless steel blocks.
- b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
- c. Mounting feet shall be constructed of 304 stainless steel.

- d. The operating airflow range shall be 0 to 10,000 CFM unless otherwise indicated on the plans.
8. Transmitters:
 - a. The transmitter shall have an LCD display capable of displaying airflow and temperature. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
 - b. The transmitter shall be capable of displaying the individual airflow and temperature readings of each sensor on the LCD display.
 - c. The transmitter shall operate on 24 VAC. The transmitter shall be protected from weather and water.
 - d. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
 - 1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
 - 2) BACnet-MS/TP.
 - 3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, The measuring device shall be UL listed as an entire assembly.
 9. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.
 10. Install in accordance with manufacturer's instructions at the locations indicated on the contract drawings. Duct and plenum devices shall not be adjusted without approval from the mechanical engineer.

2.9 VARIABLE FREQUENCY DRIVES (VFDs)

A. Description:

1. This specification covers a complete Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor or better.
2. The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of fifteen years.

B. Referenced Standards:

1. Institute of Electrical and Electronic Engineers (IEEE) Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. Underwriters laboratories UL508C.

3. National Electrical Manufacturer's Association (NEMA) ICS 7.0, AC Adjustable Speed Drives.
- C. Testing: All printed circuit boards shall be completely tested and burned-in before being assembled into the completed VFD. The VFD shall then be subjected to a computerized systems test (cold), burn-in, and computerized systems test (hot). The burn-in shall be at 104°F (40°C), at full rated load. All testing and manufacturing procedures shall be ISO 9001 certified.
- D. Qualifications: VFDs and options shall be UL listed as a complete assembly. VFDs and options shall be cUL listed as a complete assembly. VFDs and options shall be CE labeled as a component. VFDs shall be listed for use at remote locations from devices.
- E. Warranty: Warranty shall be 24 months from the date of shipment (with certified start-up).
- F. Products: The Variable Frequency Drives (VFDs) shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD package as specified herein shall be enclosed in a NEMA 1 enclosure, completely assembled and tested by the manufacturer. The VFD shall employ a full wave rectifier (to prevent input line notching), Capacitors, and Insulated Gate Bipolar Transistors (IGBT's) as the output-switching device. The drive efficiency shall be 97% or better at full speed and full load. Fundamental power factor shall be no less than 0.98 at all speeds and loads. Provide VFDs that are compatible with motors provided under this project.
- G. Harmonic Distortion Control:
1. The VFD shall limit harmonic distortion reflected onto the utility system to a voltage and current level as defined by IEEE 519 for general systems applications. This shall be accomplished by using drive components specifically designed to reduce harmonic distortion. AC line reactors are required where their use will assist in reducing harmonic distortion.
 2. Any harmonic calculations shall be done based on kVA capacity X/R ratio and the impedance of the utility transformer feeding the installation and the total system load. The calculations shall be made with the point of the common coupling being the utility feeder.
 3. The system containing the VFD shall comply with the 5% level of total harmonic distortion on line voltage and the line current limits as defined in IEEE 519-1992.
- H. Specifications:
1. Input voltage 208-240, 380-480, 575-600 VAC +/- 10%, 3 phase, 48-63 Hz.
 2. Undervoltage trip @ rated input -35%, Overvoltage trip @ rated input +30%.
 3. Interrupt rating 65 kAIC, suitable for use on a circuit capable of delivering not more than 10,000 RMS symmetrical amps, 480 V maximum.
 4. Output Frequency 0 to 150 Hz. Operation above 60 Hz shall require programming changes to prevent inadvertent high-speed operation.
 5. Environmental operating conditions: 0 to 40°C, 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
 6. Provide line side filter.

7. Enclosure shall be rated NEMA 1 or as specifically mentioned elsewhere.
 8. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable, capable of remote mounting, and shall have it's own non-volatile memory. An optional keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 9. VFD shall be rated for use in remote located setups.
- I. Input/Output Features:
1. Four (4) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
 2. A custom PID preset for HVAC & fluid systems, allow a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The auxiliary power supply shall have overload and over current protection. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, digital inputs, or over the communications bus.
 3. Two (2) programmable analog inputs shall accept a current, voltage, or Ni 1000 sensor level input signal for speed reference, or for reference and actual (feedback) signals for PID controller.
 4. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. One digital input is to be utilized as a customer safety connection point for fire, freeze, and smoke interlocks (Enable). Upon customer reset (reclosure of interlock) drive is to resume normal operation. These inputs can also be used to activate the setpoints of individual control loops.
 5. Two (2) programmable analog output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.
 6. Two (2) programmable digital relay outputs. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC.
 7. The VFD shall Ramp or Coast to a stop, as selected by the user.
- J. Operator Display: The following operating information displays shall be standard using an optional VFD digital display. All applicable operating values shall be capable of being displayed in engineering (user) units. All parameters viewed from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable).
1. Output frequency.
 2. Motor speed (RPM, %, or engineering units).
 3. Motor current.
 4. Calculated motor torque.

5. Calculated motor power (kW).
 6. DC bus voltage.
 7. Output voltage.
 8. Heatsink temperature (0 F).
 9. Analog input values.
 10. Analog output value.
 11. Keypad reference values.
 12. Elapsed time meter (resetable).
 13. kWh meter (resetable).
 14. mWh meter.
 15. Digital input status.
 16. Digital output status.
- K. Safeties: The VFD shall have the following protection circuits. In the case of a protective trip, the drive shall stop and announce the fault condition in complete words (alphanumeric codes are not acceptable):
1. Overcurrent trip 350% instantaneous (170% RMS) of the VFD's variable torque current rating.
 2. Overvoltage trip 130% of the VFD's rated voltage.
 3. Undervoltage trip 65% of the VFD's rated voltage.
 4. Overtemperature +90° C, Heatsink Temperature.
 5. Ground Fault either running or at start.
 6. Adaptable Electronic Motor Overload (1 2 t). The Electronic Motor Overload protection shall protect the motor based on speed, load curve, and external fan parameter. Circuits, which are not speed dependant, are unacceptable. The electronic motor overload protection shall be UL Listed for this function.
- L. Communications:
1. The VFD shall have an RS-485 port as standard. The standard protocol shall be selectable between Siemens Building Technologies, Inc. P1 (FLN) protocol, and Johnson Controls Inc. N2 Metasys protocol. There shall be an optional LON (LONMARK) interface and Modbus interface.
 2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control (Set Point) adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback,

output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, digital inputs and diagnostic warning and fault information. Additionally, remote (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored.

3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control without being tied to a VFD function. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

M. Installation:

1. Installation shall be the responsibility of the Division 16 electrical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
2. Power wiring shall be the responsibility of the Division 16 electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

N. Start-up: Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

O. Product Support: Factory trained application engineering and service personnel that are thoroughly familiar with the drive products offered shall be locally available at both the specifying and installation locations.

P. Required Optional Features: Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly.

1. Bypass Controller - Manual or automatic (selectable) transfer to line power via contactors. When in the "Drive" mode, the bypass contactor is open and the drive output contactor is closed. In the "Bypass" position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be Dry type 115V compatible and shall function in both the "Drive" and "Bypass" modes. The design shall include single-phase protection in both the VFD and bypass modes.
2. Customer Interlock Terminal Strip - provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, Drive or Bypass modes.
3. Automatic / manual bypass operation shall be selectable in the standard bypass design.
4. Door / cover interlocked disconnect switch will disconnect all input power from the drive, bypass and all internally mounted options. The disconnect handle shall be through the door, and be lockable in the "Off" position.

2.10 WIRING AND RACEWAYS

A. Provide wiring and raceway complying with the National Electrical Code, Division 26, and State and Local Codes and Ordinances.

- B. Provide wiring and raceway complying with the National Electrical Code, and State and Local Codes and Ordinances.
- C. Raceways:
 - 1. EMT, metal duct, IMC, surface metal raceways, or totally enclosed metal trough with flexible metal tubing unless otherwise noted.
 - 2. Provide rigid steel conduit raceways when raceway is buried or embedded in concrete.
 - 3. Provide 18 inches minimum to 36 inches maximum flexible metal conduit of galvanized steel construction for final connection to control devices. For connections to pipe mounted devices, and to devices in damp, wet, or exterior locations, or in mechanical rooms containing boilers or steam converters, provide oil-resistant liquid-tight flexible metal conduit.
 - 4. Provide EMT connectors with rain tight compression fittings and insulated throats.
 - 5. Wire mould is generally not allowed except as approved on a case-by-case basis with the owner's representative.
- D. Wiring:
 - 1. Provide wire with copper stranded conductors. Provide color or number coded jackets.
 - 2. Low voltage wiring from control components to input/output modules: 20 gauge minimum foil-shielded cable rated 100 VDC at 80 deg C.
 - 3. Provide plenum rated cable whenever wire is run without conduit.
 - 4. Provide communications network wiring meeting the gauge, impedance, capacitance, resistance and shielding requirements specified by the manufacturer of the connected devices.
 - 5. Identify wires and cables with permanent self-laminating machine print labeling system. Provide labels capable of receiving 8 characters of type written text, with minimum print on area of 1 inch by 1/2 inch, and protected by a clear sheath. Thomas & Betts E-Z Code or equal.
 - 6. Support or bundle wire with self locking, UL listed cable ties. Provide 40 lb rated cable ties incorporating a stainless steel locking insert. Provide UL 94V-0 flammability rated, halar cable ties when installed without panel enclosure. Thomas & Betts Ty-Rap or equal.
 - 7. Provide cable tie anchors designed for mechanical anchoring, allowing removal of cable tie without removal of anchor, capable of accepting at a minimum a number 8 screw. Adhesive cable tie anchors are allowed only on the interior surface of panel doors. Panduit TM series or equal.

2.11 FIRESTOPPING

- A. Capable of maintaining an effective barrier against flame, heat, and smoke. Metalines, Dow, 3M, or equal.

- B. Provide installations classified in Underwriter's Laboratories (UL) Building Materials Directory or listed in the Warnock Hersey International Directory.
- C. Paintable where exposed to view.
- D. Waterproof in plumbing chases.
- E. Provide the product of more than one manufacturer if required to provide listed installations throughout.

PART 3 - EXECUTION

3.1 GENERAL

- A. Modify existing control system devices as required. Extend and modify the existing wiring and control system power source to accommodate indicated direct digital control system devices.
- B. Before beginning installation of new system components, test the existing system devices that are being reused in modified control systems for proper operation and report any devices in need of replacement or repair to the Project Manager. At the option of the Project Manager, he will issue a contract amendment to replace or repair the defective devices or he will have Owner maintenance personnel replace or repair the defective devices. The Contractor shall be responsible for providing new devices to replace existing devices that are not brought to the Project Manager's attention before beginning installation of new system components.
- C. Work must comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards. Perform work by persons qualified to produce workmanship of specified quality. If required by the State of Alaska workers shall be licensed. If requested provide copy of license.
- D. Do not install control devices in locations where they are subject to damage or malfunction due to normally encountered ambient temperatures.
- E. Mount damper operators and other control devices secured to insulated ductwork on brackets such that the device is external of the insulation.
- F. Schematics and diagrams, when indicated on the Drawings, show approximate functional relationships and sequences only. All required devices are not shown. Contractor is responsible for providing all components required for a complete functioning system selected to meet the specific functional requirements of each application.
- G. Unless indicated otherwise, connect the primary sensing input and the associated output for each control loop to the same controller. A secondary or resetting input may be attached to any controller and communicated over the network.
- H. Tune control loops to respond quickly to control fluctuations without hunting.
- I. Label control devices mounted in the field and within control cabinets with 1/4 inch high white embossed letters and black tape background. Dymo or equal. Tags to match tags used on Control Drawings.

3.2 COORDINATION

- A. Coordination with controls specified in other sections or divisions. Other sections and/or divisions of this specification include controls and control devices that are to be part of or

interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:

1. Each supplier of a controls product is responsible for the configuration, programming, start up, and testing of that product to meet the sequences of operation described in Section 23 09 93.
2. The contractor shall coordinate and resolve any incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
3. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
4. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.3 DEMOLITION

- A. Remove existing valves, dampers, operators, sensors, and controllers that are replaced by new devices or that are not reused. Present all removed equipment to owner for first right of refusal before disposing of equipment. Review copy of existing system "As-Built" control schematics for existing device location and extent of required demolition.
- B. Patch holes in existing ductwork at removed sensors that are not reused with sheet metal patches of equal gauge or heavier material sheet metal that are seal airtight with adhesive and then screwed or pop riveted to the ductwork.
- C. Existing conduit and wiring may be reused when available and when wiring is rated for application. Remove existing unused conductors.
- D. Demolish unused pneumatic tubing back to main air connection. Plug tubing with brass fittings.
- E. Repairs: Any portion of the facility damaged, cut back or made inoperable shall be repaired with similar materials as the existing structure and/or damaged item as instructed by the Project Manager.

3.4 SHUT DOWN OF EXISTING SYSTEMS

- A. Refrigeration, Heating and Ventilation are critical to the function of the facility. Schedule any required shutdowns with Project Manager. Provide a minimum of 5 days written notification to the Project Manager before shutdown of any systems. Coordinate equipment shutdowns with phasing plan.
- B. This building depends on operation of the ventilation systems for space heating and cooling. During system shutdowns the contractor is responsible for maintaining all spaces within the building at a minimum temperature of 65 deg F. and maximum of 75 deg F.

3.5 TEST AND BALANCE

- A. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.

- B. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours.
- C. In addition, the contractor shall provide a qualified technician to assist in the test and balance process, until the first 20 terminal units are balanced.
- D. The tools used during the test and balance process will be returned at the completion of the testing and balancing.

3.6 CLEANING

- A. The contractor shall clean up all debris resulting from his/her activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.
- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.7 WIRING AND RACEWAYS

- A. Permanently label electrical or electronic wiring at each end indicating location and the device at opposite end. At the direct digital controller end use either the I/O address, if it describes the connected device, or the unique control device tag used on the control schematics. At the device end indicate both the terminal number and the controller connected at the other end. For color coded multi-conductor cable, label cable sheath not individual conductors.
- B. At field devices where conductors are not wired to terminal strips wire using a unique color for each conductor connected to that device.
- C. Install wiring in a neat and orderly manner generally running along building lines.
- D. Support low voltage wiring run without conduit at a maximum of 4 feet between anchors.
- E. Seal conduit penetrations at floor and wall penetrations with firestopping installed as indicated. Note that this applies to all floor and wall penetrations, not just fire barrier penetrations. At all mechanical rooms or other rooms containing floor drains, except those with slab on grade floors, make penetration watertight and extend sleeve 3 inches above the floor.
- F. Wire all electrical controls and switches furnished under this Section of the Specifications.
- G. Make wire connections using factory fabricated jack assemblies, terminal strips, or solder connections. Use crimp connectors on stranded wire unless connecting to terminal strips approved for direct stranded wire connection. Insulate solder connections with heat shrink tubing. Field connections in control power wiring circuits may be made using wire nuts.
- H. Avoid splices in signal wire, where unavoidable connect with solder connections and label on each side of splice. Use identical wire type and color on each side of splice.
- I. Conceal wiring in finished areas. Unless otherwise noted, install wiring inside conduit or fully enclosed metallic raceway.

- J. Low voltage wiring installed in concealed accessible locations may be run without conduit. Sleeve wiring at wall penetrations.
- K. Metal raceways crossing expansion joints make provision for 3 way movement. For conduits 1 & 1/2 inch and larger use O-Z type DX fittings, or equal.
- L. At raceway penetrations of the vapor barrier provide a double splice patch (one on each side of vapor barrier) by cutting a square piece of vapor barrier 12 inches larger on all sides than the pipe. Cut a round hole in the center of the square splice patch, smaller than the pipe, to form a stretched fit. Force the pipe through the splice patch and tape all sides to the vapor barrier and seal the vapor barrier to the pipe at the penetration with an adhesive compatible with the vapor barrier material.
- M. Securely seal at both ends, raceways running from a warm area to a cold area. Ductseal or equal.
- N. Install all wiring in accordance with National Electrical Code, and State and Local Codes and Ordinances.

3.8 PANELS

- A. Provide UL listed panel assemblies when required by local authorities.
- B. Mount control devices other than sensors and operators in panels on the panel face and the subpanel surface. Removal of devices shall not require removal of subpanel. Do not mount devices on panel sides.
- C. Wire control devices mounted in control panels through permanently and sequentially labeled terminal strips.
- D. Arrange panels and junction boxes in a clear, logical manner, installed to allow easy servicing and labeling.
- E. Arrange control devices such that inadvertent operation of push-buttons, switches, etc. will not result in a jammed or inoperable system caused by component or device failure.
- F. Label panels, control switches, and panel mounted gauges with minimum 1/2 inch high by 1/16 inch thick, black, laminated plastic with white core. "Setonply" by Seton Nameplate Corp. or equal. Engrave with 1/4 inch high characters.

3.9 SENSORS AND SWITCHES

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for environment within which the sensor operates.
- C. Room temperature sensors shall be installed on concealed junction boxes properly supported by wall framing.
- D. All wires attached to sensors shall be sealed in their raceways or in the wall to stop air transmitted from other areas from affecting sensor readings.
- E. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

- F. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 3 m (1 ft) of sensing element for each 1 m²(1 ft²) of coil area.
- G. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 3 m (10 ft) downstream.
- H. All pipe-mounted temperature sensors shall be installed in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- J. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
 - 3. Building Static Pressure. Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
 - 4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 - 5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - 6. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shut-off valves installed before the tee.
- K. Install humidity sensors for duct mounted humidifiers at least 6 ft downstream of the humidifier. Do not install filters between the humidifier and the sensor.

3.10 ACTUATORS

- A. General. Mount and link control damper actuators according to manufacturer's instructions.
 - 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 - 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 3. Provide all mounting hardware and linkages for actuator installation.
- B. Electric/Electronic

1. Dampers: Actuators shall be direct mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° travel available for tightening the damper seal. Actuators shall be mounted following manufacturer's recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.

3.11 CONTROL VALVES

- A. Valve submittals shall be coordinated for type, quantity, size, and piping configuration to ensure compatibility with pipe design.
- B. Slip-stem control valves shall be installed so that the stem position is not more than 60 degrees from the vertical up position. Ball type control valves shall be installed with the stem in the horizontal position.
- C. Valves shall be installed in accordance with the manufacturer's recommendations.
- D. Control valves shall be installed so that they are accessible and serviceable and so that actuators may be serviced and removed without interference from structure or other pipes and/or equipment.
- E. Isolation valves shall be installed so that the control valve body may be serviced without draining the supply/return side piping system. Unions shall be installed at all connections to screw-type control valves.
- F. Provide tags for all control valves indicating service and number. Tags shall be brass, 1.5 inch in diameter, with ¼ inch high letters. Securely fasten with chain and hook. Match identification numbers as shown on approved controls shop drawings.

3.12 CONTROL DAMERS

- A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.
- B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure ¼ in. larger than damper dimensions and shall be square, straight, and level.
- C. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within 0.3 cm (1/8 in.) of each other.
- D. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to ensure proper operation. On multiple section assemblies, all sections must open and close simultaneously.
- E. Provide a visible and accessible indication of damper position on the drive shaft end.

3.13 CONTROLLERS

- A. Provide a separate controller for each AHU or other HVAC system. A DDC controller may control more than one system provided that all points associated with the system are assigned to the same DDC controller. Points used for control loop reset, such as outside air or space temperature, are exempt from this requirement.
- B. Provide uninterruptible power supply (UPS) on power supply to all control panels and control transformers.
- C. Provide electric power to control devices from control system power circuit or from device or equipment being controlled.
- D. Carry a dedicated ground wire to controllers from the associated breaker panel. Do not use the conduit system for grounding purposes.
- E. Building Controllers and Custom Application Controllers shall be selected to provide the required I/O point capacity required to monitor all of the hardware points listed in Section 23 09 93 (Sequences of Operation).

3.14 PACKAGED EQUIPMENT CONTROLS

- A. General. The electronic controls packaged with any equipment furnished under this contract shall communicate with the building direct digital control (DDC) system. The DDC system shall communicate with these controls to read the information and change the control setpoints as shown in the points list, sequences of operation, and control schematics. The information to be communicated between the DDC system and these controls shall be in the standard object format as defined in ANSI/ASHRAE Standard 135 (BACnet). Controllers shall communicate with other BACnet objects on the internetwork using the Read (Execute) Property service as defined in Clause 15.5 of Standard 135.
- B. Distributed Processing. The controller shall be capable of stand-alone operation and shall continue to provide control functions if the network connection is lost.
- C. I/O Capacity. The controller shall contain sufficient I/ O capacity to control the target system.
- D. The Controller shall have a physical connection for a laptop computer or a portable operator's tool.
- E. Environment. The hardware shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 40°F to 140°F.
 - 2. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 32°F to 120°F.
- F. Serviceability. Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field removable, modular terminal strips or to a termination card connected by a ribbon cable.
- G. Memory. The Controller shall maintain all BIOS and programming information in the event of a power loss for at least 30 days.
- H. Power. Controller shall be able to operate at 90% to 110% of nominal voltage rating.

- I. Transformer. Power supply for the Controller must be rated at minimum of 125% of ASC power consumption and shall be fused or current limiting type.

3.15 IDENTIFICATION OF HARDWARE AND WIRING

- A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with control system address or termination number.
- B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show the instrument or item served.
- D. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that label removal of the component does not remove the label.
- F. Identify room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Identifiers shall match record documents.

3.16 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Upon completion of the installation, the contractor shall initiate operation of the control system and perform all necessary testing and diagnostics to ensure proper operation. A formal commissioning procedure shall be utilized to insure complete system integrity and conformance to these specifications. This procedure shall consist of two separate steps incorporating point verification and program verification. Commissioning forms shall address all field devices, field controllers, software statements, and software points.
- B. Startup Testing. All testing listed in this article shall be performed by the contractor and shall make up part of the necessary verification of an operating control system. This testing shall be completed before the owner's representative is notified of the system demonstration.
- C. The contractor shall furnish all labor and test apparatus required to calibrate and prepare for service of all instruments, controls, and accessory equipment furnished under this specification.
- D. Start up, check out, and test all hardware and software and verify communication between all components.
- E. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- F. Verify that all analog and binary input/output points read properly.
- G. Verify alarms and interlocks.
- H. Verify operation of the integrated system.

- I. Verify that all control wiring is properly connected and free of all shorts and ground faults. Verify that terminations are tight.
- J. Enable the control systems and verify calibration of all input devices individually. Perform calibration procedures according to manufacturers' recommendations.
- K. Verify that all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly and that the normal positions are correct.
- L. Verify that all analog output devices (I/Ps, actuators, etc.) are functional, that start and span are correct, and that direction and normal positions are correct. The contractor shall check all control valves and automatic dampers to ensure proper action and closure. The contractor shall make any necessary adjustments to valve stem and damper blade travel.
- M. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules. Tune all DDC loops.
- N. Alarms and Interlocks:
- O. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
- P. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
- Q. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action

3.17 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Prior to the substantial inspection, review and test entire installation for conformance with contract documents. Test shall include thorough field check of sequence of operations for each system and piece of equipment including simulation of all possible modes of operation. With the call for inspection, verify in writing that this system review and test has been performed and anything not conforming to contract documents shall be so noted.
- B. During the Substantial inspection Contractor personnel shall provide on-site assistance to inspection personnel required for a complete and thorough inspection. During the Substantial inspection Contractor personnel shall demonstrate that the control system performs in accordance with the contract documents. Provide material and personnel required to perform the demonstration.
- C. Demonstration:
 - 1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 - 2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.

3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
 4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
 5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 6. Demonstrate compliance with sequences of operation through all modes of operation.
 7. Demonstrate complete operation of operator interface.
 8. Additionally, the following items shall be demonstrated:
 9. DDC loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
 10. Demand limiting. The contractor shall supply a trend data output showing the action of the demand limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 11. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.
 12. Interface to the building fire alarm system.
 13. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.
 14. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.
- D. Acceptance.
1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if

stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.

2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 ORIENTATION AND TRAINING

- A. Provide 16 hours of on-site orientation and training to Owner personnel designated by the Project Manager. Orientation and training sessions shall be conducted by a factory trained manufacturers representative familiar with the systems software, hardware, and accessories. Limit training time per day to 6 hours. Complete training and orientation according to the following schedule:
 1. 8 hours (1 days) of instruction after acceptable performance of the system hardware and software has been established and prior to final inspection.
 2. 8 hours (1 days) of instruction six months after final inspection.
- B. Submit proposed training dates and instruction session course outlines for acceptance by Project Manager.
- C. Provide instructions on all the operations listed in the initial course outline during the first training session. On subsequent sessions communicate in advance with facility supervisor to determine which operations require additional instruction.
- D. Initial course outline:
 1. Determine the control strategies that have been defined for a specific piece of equipment.
 2. Utilize X-Y graphing and histories as an aid for control loop tuning.
 3. Enable or disable control strategies.
 4. Assign sensors and/or actuators to a control strategy.
 5. Simulate control strategies with substituted inputs or outputs.
 6. Define appropriate control loop algorithms and choose optimum loop parameters for loop control.
 7. Add/delete control loops to the system.
 8. Add/delete points to the system.
 9. Label parameters and variables with names or acronyms of a minimum of eight letters.
 10. Select points to be alarmable and define the alarm state(s).
 11. Download programming to the system after all direct digital controllers and building management station program memory has been lost.
 12. Process stored historical data and display and printout data in tabular and graphical formats.

13. Diagnose system malfunctions.
14. Change system operating sequences.

END OF SECTION

SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Air Handling Unit.
- B. Chiller System.
- C. Glycol Tank.
- D. Heat Exchanger.
- E. Heating Pumps.
- F. Relief Fans.
- G. VAV Units.
- H. Humidifiers.
- I. Existing Equipment.

1.2 RELATED SECTIONS

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 09 23 - Direct Digital Control System for HVAC.
- C. Section 23 21 23 - Hydronic Pumps.
- D. Section 23 64 00 - Packaged Water Chillers.
- E. Section 23 73 00 - Indoor Central Air-Handling Units.

1.3 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

1.4 SUBMITTALS

- A. Submit under provisions of General Conditions of the Contract.
- B. Submit diagrams indicating mechanical system controlled and control system components. Label with settings, adjustable range of control and limits. Include written description of control sequence.
- C. Include flow diagrams for each control system, graphically depicting control logic.
- D. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of General Conditions of the Contract.
- B. Accurately record actual setpoints and settings of controls, including changes to sequences made after submission of shop drawings.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 AIR HANDLING UNIT (AC-2, RF-2A,2B)

- A. Alarms:
 - 1. Low S/A air temperature (40° F adjustable).
 - 2. Humidity (space reading High or Low 5% beyond set point).
 - 3. High S/A Humidity (above 85%, initial setting, adjustable).
 - 4. Pre filter high differential pressure.
 - 5. Final Filter high differential pressure.
 - 6. High Supply Duct Static Pressure.
 - 7. High Return Duct Static Pressure.
 - 8. Building Fire Alarm.
- B. Digital Control and Indication:
 - 1. AC-2, Fan 1 and 2 On-off control.
 - 2. AC-2, Fan 1 and 2 On-off indication.
 - 3. AC-2, Fan 1 and 2 Speed control.
 - 4. AC-2, Fan 1 and 2 VFD Fault.
 - 5. RF-2A, 2B On-off control.
 - 6. RF-2A, 2B On-off indication.
 - 7. RF-2A, 2B Speed control.
 - 8. RF-2A, 2B VFD Fault.
 - 9. Supply duct static pressure setpoint.
 - 10. Supply duct static pressure indication.
 - 11. Supply fan operating volume indication (Ebtron sensor – Sum of SAV Units)

12. S/A temperature setpoint.
13. S/A temperature indication.
14. Humidity indication (Return Air, 1 per RAV Zone).
15. Humidity indication (Outside Air).
16. Humidity Setpoint (Supply Air, 1 per ea Humidifier Zone).
17. Humidity indication (Supply Air, 1 per ea Humidifier Zone).
18. Heating coil control valve position.
19. Cooling coil control valve position.
20. M/A temperature setpoint.
21. M/A temperature indication.
22. M/A humidity indication.
23. R/A temperature indication (prior to mixing box).
24. R/A humidity indication (prior to mixing box).
25. O/A minimum position damper position adjustment.
26. O/A economizer damper position adjustment.
27. R/A damper position adjustment.
28. O/A incoming air volume indication (Ebtron sensor)
29. R/A air volume indication (Ebtron sensor – Sum of RAV Units)
30. Relief air volume indication (Ebtron sensor)
31. O/A temperature indication.
32. M/A static pressure setpoint.
33. M/A static pressure indication (Ebtron bleed air sensor).
34. R/A static pressure setpoint.
35. R/A static pressure indication (Ebtron bleed air sensor).
36. Alarm setpoints.

C. Automated Control:

1. Operation Mode: Unit will operate continuously to heat, ventilate, cool and humidify the building.

- a. During operation, an airflow sensor shall be used to accurately control and record the volume of outside air delivered to the building. The minimum outside airflow rate during occupied hours shall be 1,300 CFM (adjustable). The minimum outside airflow rate during unoccupied hours shall be 950 CFM (adjustable).
- b. The unit will operate to provide minimum outside air during normal use to allow for humidity control in the operating rooms. Economizer cooling will not be active. Minimum outside air damper will modulate to maintain minimum outside setpoint based on occupied or unoccupied mode. The economizer outside air damper will be closed and return damper full open. Relief fans, RF-2A and 2B will be off. Monitor mixing box pressure, provide an alarm if mixing box pressure exceeds 2" WC.
- c. Economizer cooling mode: In the event of failure of the Chiller, CH-1, enabled economizer cooling mode. During economizer cooling mode, the economizer cooling outside air damper and return air damper shall modulate to provide cooling when outside air temperature is below 65 Degrees F. The incoming outside airflow rate shall be recorded and used to control the volume of air discharged to the exterior by the respective relief air fan(s) in the relief air ductwork. Outside air and relief air volumes shall be monitored using airflow stations to ensure tight control of space static pressure. An 1,250 CFM offset for the relief air volume shall maintain positive pressure in the project area when taking into account the air exhausted from the building. Under normal operation the relief air volume will be 0 CFM and relief air fans will be off. Monitor return air duct pressure, provide an alarm if return air duct pressure exceeds 2" WC.
- d. Humidity Control: The DDC system shall monitor the humidity of both the incoming outside air and return air humidity sensors to determine if humidification or dehumidification is required. The outside air humidity sensor shall be disabled when outside air temperatures drop below 32 degrees F and sensor accuracy is limited and dehumidification will not be required. The S/A desired humidity shall be reset between 20% relative humidity and 50% relative humidity based on sensing all the room humidity sensors and humidity control valve positions and adjusting the calculated S/A setpoint up or down as required to provide dehumidification to the most humid room with the humidity control valve closed. When O/A or S/A humidity exceeds setpoint, enable dehumidification mode. During dehumidification mode, the cooling coil shall modulate to provide dehumidification by cooling the mixed air stream to 45 degrees F. When S/A humidity is below setpoint, disable dehumidification mode. When dehumidification is required the cooling coil shall be enabled and the mixed air stream shall be cooled to 45 Degrees F to sufficiently remove humidity from the air. Duct mounted humidifiers will add humidity to each zone as required.
- e. The S/A desired temperature shall be reset between 45 degrees F and 65 Degrees F based on sensing all the room sensors and VAV box positions and adjusting the calculated S/A setpoint up or down as required to maintain the setpoint in the hottest room with the VAV box wide open.
- f. The cooling coil and heating coil shall modulate in sequence to maintain the desired S/A temperature setpoint. When dehumidification mode is enable cooling coil will prioritize dehumidification over temperature, heating valve will operate to increase S/A temperature as required.
- g. Supply Fan(s) Variable Speed Drives: Duct static pressure sensor shall modulate the supply fan(s) VFD to maintain setpoint of 1.20" initial setpoint (adjustable).

- h. Relief Fan(s) Variable Frequency Drives: Modulate the relief fan(s) VFD to maintain a relief air setpoint when economizer cooling mode is enabled. Relief air setpoint shall be equal to the total of the measured outside air intake minus 1,250 CFM.
2. On freeze alarm set initially at 35° F (adjustable), the fan shall stop, O/A dampers will fully close, R/A dampers will fully open, heating valve control valve will go to full open. Provide automatic reset.
3. On high duct static, set at 4.0 in WC (adjustable), the fan shall stop, O/A dampers will fully close, R/A dampers will fully open, heating valve control valve will go to full open. Provide manual reset.
4. Air handling unit smoke detector shall be wired directly to the addressable fire alarm system. Air handling unit fan motor starter shall be connected to the fire alarm system to stop fan motor on alarm. DDC system shall verify fan shut down and shall close the outside air damper and relief damper. Detection of smoke at the air handling unit smoke detector shall shut down the AHU, Coordinate with Division 28.

3.2 GLYCOL WATER PUMP (CP-1A, CP-1B)

- A. Alarms:
 1. No flow.
- B. Manual Control and Indication:
 1. CP-1A and CP-1B H-O-A Control.
 2. CP-1A and CP-1B On-Off Indication.
 3. Outside temperature setpoint adjustment.
 4. Lead pump selector.
 5. Alternator setting (hours of use).
- C. Automated Control:
 1. The lead pump shall operate when the outside temperature is below 65° F (adjustable). The pump shall be off when the outside temperature is above 70° F (adjustable).
 2. Upon failure of the lead pump, the lag pump shall operate.
 3. Alternator: Lead/lag pump operation shall alternate every week of use (adjustable).

3.3 GLYCOL HEAT EXCHANGER (HX-1)

- A. Alarms:
 1. Low discharge temperature.
 2. Low system pressure.
 3. Glycol Tank Low level alarm.

- B. Manual Control and Indication:
 - 1. HWS supply temperature.
 - 2. HWR return temperature.
 - 3. HGS supply temperature.
 - 4. HGR return temperature.
 - 5. Outdoor temperature reset adjustment.
 - 6. Glycol System pressure.
 - 7. Alarm setpoints.
- C. Automated Control:
 - 1. Monitor supply and return temperatures. Provide alarm is glycol supply drops below 120 Degrees F when pumps are enabled.
 - 2. Glycol tank pump will operate to maintain system pressure, initially set at 12 PSIG, adjustable. Provide low level alarm for glycol tank.

3.4 CHILLED GLYCOL SYSTEM (CH-1)

- A. Manufacturer's Control Panel: Direct control of chilled water system will be by micro-processor based panel and/or combination of panels provided by the chiller equipment manufacturer.
- B. DDC Interface: Alarms, manual control points and indication points as outlined below will be integrated into the Direct Digital Controls system (as specified under 23 09 23) for system monitoring and control. Coordinate with Section 23 64 16 for control panel requirements.
- C. Alarms:
 - 1. General Alarm.
 - 2. Low evaporator refrigerant pressure
 - 3. Loss of water flow through the evaporator
 - 4. High condenser refrigerant pressure
 - 5. High compressor motor temperature
 - 6. Chiller circulation pump alarms (CP-2A,2B).
 - 7. Low suction gas temperature
 - 8. Low leaving evaporator water temperature
 - 9. Low chilled glycol system pressure.
 - 10. High Chilled Glycol Temperature.

11. Low Chilled Glycol Temperature
- D. Digital Control and Indication:
1. CH-1 Enable/Disable.
 2. CH-1 Chilled Glycol Setpoint.
 3. CH-1 Condenser pressure.
 4. CH-1 Evaporator pressure.
 5. CH-1 Glycol supply temperature.
 6. CH-1 Glycol return temperature.
 7. Chilled Glycol Setpoint.
 8. Compressors On-off Status.
 9. Evaporator Fans On-off status.
 10. Free cooling Module status.
 11. Pumps Status.
 12. System pressure.
 13. Alarm setpoints.
 14. Alarm setpoints.
- E. Automated Control:
1. When chiller is enabled, the factory supplied Master Controller modulates the chiller capacity from minimum to maximum as required by building load. The unit will operate in free cooling mode when ambient temperature is low enough. The chiller control system shall operate the chilled glycol pumps when the chiller is enabled on a lead/lag alternating schedule. The pump VFD's will be set during balancing and operate at constant flow. The DDC system shall provide setpoint to the Chiller System, initial setpoint shall be 37 Degrees F (Adjustable).

3.5 AIR HANDLING UNIT (AC-1)

- A. Existing controls and sequence to remain for AC-1. Reprogram supply air duct zone serving Nurse Station to control from existing sensor to remain.

3.6 SAV TERMINAL UNITS, RAV TERMINAL UNITS AND DISPERSION TUBES

- A. Alarms:
1. High space temperature.
 2. Low space temperature.

3. High supply temperature.
 4. Low supply temperature.
 5. High space humidity.
 6. Low space humidity.
 7. High supply humidity.
 8. Low supply humidity.
- B. Digital Control and Indication:
1. Space temperature setpoint.
 2. Space temperature indication.
 3. Supply temperature setpoint.
 4. Supply temperature indication.
 5. Space humidity setpoint.
 6. Space humidity indication.
 7. Supply humidity setpoint.
 8. Supply humidity indication.
 9. Return humidity setpoint.
 10. Return humidity indication.
 11. Return temperature indication
 12. Operation mode schedule adjustment.
 13. Operation mode indication.
 14. Actual S/A cfm indication.
 15. Minimum S/A airflow setpoint.
 16. Maximum S/A airflow setpoint.
 17. S/A Damper position.
 18. Actual R/A cfm indication.
 19. Minimum R/A airflow setpoint.
 20. Maximum R/A airflow setpoint.
 21. R/A Damper position.

22. Operating room pressure indication.
 23. Alarm setpoints.
- C. Automated Control:
1. Operation Mode: Occupied and Unoccupied mode of operation will be controlled by a schedule at the operator workstation. Provide manual override at local room sensor.
 2. Unoccupied Mode: Operate SAV and RAV at minimum CFM setpoint. Heating coil operates to maintain room air temperature.
 3. Occupied Mode: Operate SAV and RAV at maximum CFM setpoint. Heating coil operates to maintain room air temperature.
 4. When humidification is required, the steam dispersion tube humidifiers (H-1 through H-6) will be enabled and operated to provide humidification in the supply air duct. Supply air humidity setpoint shall be reset based on return air humidity. Install hi-limit humidistat in supply ducts to shut down humidifiers if supply duct humidity exceeds 90%.
 5. Operating room pressure control: Monitor operating room pressure. SAV setpoint to be 300 CFM (initial setting, adjustable) higher than RAV setpoint to provide positive pressurization of at least 0.01 in. WC but not to exceed 0.07 in. WC. Adjust CFM differential setpoint to maintain positive pressure in room.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Heating Water Piping System.
- D. Glycol Water Piping System.
- E. Chilled Water Piping System.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 19 - Meters and Gages for HVAC Piping.
- C. Section 23 07 00 - HVAC Insulation.
- D. Section 23 09 23 - Direct Digital Control System for HVAC.
- E. Section 23 21 16 - Hydronic Pumps.
- F. Section 23 57 00 - Heat Exchangers for HVAC.
- G. Section 23 73 00 - Indoor Central Air-Handling Units.
- H. Section 23 64 33 – Modular Water Chillers.

1.3 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9.

1.4 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.5 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include data on pipe materials, pipe fittings, valves, and accessories.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.

- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 HEATING WATER AND GLYCOL PIPING, ABOVE GROUND

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ANSI/ASME B16.18 cast bronze or ANSI/ASME B16.29 solder wrought copper.
 - 2. Joints: ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.
 - 3. Press Fittings: Viega ProPress Fittings are allowed. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have Smart Connect feature design leakage path. Smart Connect™ (SC Feature) In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.
- B. Grooved piping systems are not allowed.

2.2 CHILLED WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L hard drawn.
 - 1. Fittings: ANSI/ASME B16.18 cast bronze or ANSI/ASME B16.29 solder wrought copper.
 - 2. Joints: ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.
 - 3. Press Fittings: Viega ProPress Fittings are allowed. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Press end shall have Smart Connect feature design leakage path. Smart Connect™ (SC Feature) In ProPress ½" to 4" dimensions the Smart Connect Feature assures leakage of liquids and/or gases from inside the system past the sealing element of an un-pressed connection. The function of this feature is to provide the installer quick and easy identification of connections which have not been pressed prior to putting the system into operation.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- A. Steel Pipe: ASTM A53, Schedule 40 galvanized.
 - 1. Fittings: Galvanized cast iron, or ANSI/ASTM B16.3 malleable iron.
 - 2. Joints: Screwed, or grooved mechanical couplings.
- B. Copper Tubing: ASTM B88, Type L, hard drawn.
 - 1. Fittings: ANSI/ASME B16.18 cast bronze, or ANSI/ASME B16.29 solder wrought copper.
 - 2. Joints: ASTM B32, solder, Grade 95TA or ANSI/AWS A5.8, BCuP silver braze; Flux: ASTM B813.

- C. PVC Pipe: ASTM D1785, Schedule 40, and Schedule 80 for sizes 8 inch and larger, or ASTM D2241, SDR 21 or 26.
 - 1. Fittings: ASTM D2466 or D2467, PVC.
 - 2. Joints: ASTM D2855, solvent weld.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. Pipe Size 2 Inches and Under: 150 psig malleable iron unions for threaded ferrous piping; bronze unions for copper pipe, soldered joints.
- B. Pipe Size Over 2 Inches: 150 psig forged steel slip-on flanges for ferrous piping; bronze flanges for copper piping.
- C. Grooved and Shouldered Pipe End Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; C-shape elastomer composition sealing gasket for operating temperature range from -30° F to 230° F; steel bolts, nuts, and washers; galvanized couplings for galvanized pipe.

2.5 GATE VALVES

- A. Gate valves will not be permitted. Use ball or butterfly valves for isolation.

2.6 GLOBE VALVES

- A. Globe valves will not be permitted. Use ball or butterfly valves for throttling.

2.7 ACCEPTABLE MANUFACTURERS - ALL VALVE TYPES

- A. Milwaukee.
- B. Nibco.
- C. Crane.
- D. Hammond.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.8 BALL VALVES

- A. Up to 2 Inches: Bronze two piece body, full port, forged brass, chrome plated ball, Teflon seats and stuffing box ring, lever handle and balancing stops, solder or threaded ends with union. Seat material to be compatible with fluid handled.
- B. Over 2 Inches: Cast steel, two piece body, full port chrome plated steel ball, Teflon seat and stuffing box seals, lever handle, flanged. Seat material to be compatible with liquid handled.

2.9 BUTTERFLY VALVES

- A. Iron body, bronze disc, resilient replaceable seat for service to 250° F, lug ends, extended neck, 10 position lever handle.

2.10 SWING CHECK VALVES

- A. Up to 2 Inches: Bronze 45° swing disc, solder ends.
- B. Over 2 Inches: Iron body, bronze trim, 45° swing disc, renewable disc and seat, flanged ends.

2.11 SPRING LOADED CHECK VALVES

- A. Iron body, bronze trim, stainless steel spring, renewable composition disc, screwed, wafer or flanged ends.

2.12 RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space and other work.
- C. Group piping whenever practical at common elevations.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Fusion Welding of Joints for Polypropylene Piping:

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

3.3 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install ball or butterfly valves for throttling, bypass, or manual flow control services.
- F. Provide spring loaded check valves on discharge of condenser water pumps.
- G. Provide $\frac{3}{4}$ inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.

3.4 CLEANING OF THE HYDRONIC SYSTEM

- A. Prior to starting work, verify system is complete. Thoroughly flush, drain and refill system.
- B. Fill the hydronic piping systems system with the system cleaner, Hercules, utilize one (1) quart hydronic system cleaner for every twenty (20) gallons of water in the hydronic system.
- C. Circulate system for a period of four (4) hours. Operate at maximum operating temperature during cleaning. Upon completion of boil out, completely flush system and drain all low points. Remove, clean and reinstall strainer baskets.
- D. Verify expansion tank pre-charge is set to 12 psig. Adjust expansion tank pre-charge to 12 psig prior to filling system.
- E. Fill system with water or glycol as indicated on the plans. Feed water to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psig. Pressure heating system cold at 5 psig, adjust when hot to 12 psig. Pressure cooling system at 12 psig. See Specification Section 23 21 16 for glycol fill procedures.
- F. Submit a written and signed statement to the Owner that the above referenced cleaning procedures have been completed.

3.5 TESTING

- A. Test all heating water and glycol piping hydrostatically at 100 psig or 150 percent of working pressure, whichever is greater, for a period of 4 hours. Observe piping during this period and repair all leaks.

END OF SECTION

SECTION 23 21 16 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Expansion Tanks.
- B. Air Vents.
- C. Air Separators.
- D. Strainers.
- E. Balance Valves.
- F. Relief Valves.
- G. Glycol Specialties.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 09 23 - Direct Digital Control System for HVAC.
- C. Section 23 21 23 - Hydronic Pumps.
- D. Section 23 57 00 - Heat Exchangers for HVAC.

1.3 REFERENCES

- A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME Boilers and Pressure Vessels Code Section 8D for manufacture of tanks.

1.5 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract and Section 23 05 00.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.

- B. Include installation instruction, assembly views, lubrication instructions, and replacement parts list.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.

1.9 EXTRA STOCK

- A. Provide one extra 55 gallon drum of propylene glycol.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Amtrol.
- B. Taco.
- C. Bell & Gossett.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Construction: Welded steel, rated for working pressure of 100 psig, with flexible EPDM diaphragm sealed into tank, and steel support base.
- B. Accessories: Pressure gauge and air-charging fitting, tank drain; pre-charge to 12 psig.

2.3 ACCEPTABLE MANUFACTURERS - AIR VENTS

- A. Taco.
- B. Amtrol.
- C. Bell & Gossett.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.4 AIR VENTS

- A. Coin Vent: Disk type vent with built-in check valve for manual or automatic operation, discs replaceable without draining system, 1/8 inch shank, rated at 50 psi; Hoffman No. 500 or equal.
- B. Float Type: Maintenance free solid brass construction, continuous air venting, 150 psig standard working pressure, 270° F maximum temperature, 1 1/2 inch male thread at vent point for pressure testing or remote venting, 1/2 inch female threaded connections provide mini ball valve. Spirotherm Spirotop VTP.

2.5 ACCEPTABLE MANUFACTURERS - AIR SEPARATORS

- A. Spirotherm.

- B. Substitutions: Under provisions of General Conditions of the Contract.

2.6 AIR SEPARATORS

- A. Coalescing type combination air eliminator and dirt separator fabricated of steel, rated for 150 psig working pressure, stamped and registered in accordance with ASME Section VIII, General Conditions for the Contract for unfired pressure vessels, and include two equal chambers above and below the inlet / outlet nozzles. The elements shall consist of a copper core tube with continuous wound copper medium permanently affixed to the core. Internal coalescing elements consisting of plastic, perforated steel plate/tubes or loosely filled steel rings will not be accepted. A separate copper medium is to be wound completely around and permanently affixed to the internal element. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
- B. Units shall incorporate bottom blow-down with a valved and capped hose thread connection. Line connections shall be flanged.

2.7 ACCEPTABLE MANUFACTURERS - STRAINERS

- A. Bell & Gossett.
- B. Taco.
- C. Armstrong.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.8 STRAINERS

- A. Size 2 inch and Under: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. Size 2-½ inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.9 ACCEPTABLE MANUFACTURERS - BALANCE VALVES

- A. Armstrong.
- B. Taco.
- C. Bell & Gossett.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.10 BALANCE VALVES

- A. Angle or straight pattern, inside screw globe valve for 125 psig working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

2.11 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

- A. Watts.
- B. Taco.
- C. Bell & Gossett.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.12 RELIEF VALVES

- A. Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

2.13 GLYCOL SYSTEM

- A. 55 U.S. gallon HDPE storage/mixing tank with cover; pump suction hose with inlet strainer; two pressure pumps with thermal cut-out; pump isolation valves; integral pressure switches; integral check valve; cord and plug; pre-charged accumulator tank with EPDM diaphragm; manual diverter valve for purging air and agitating contents of storage tank; pressure regulating valve adjustable (5 – 55 psig) complete with pressure gauge; integral replaceable strainer; built-in check valve; union connection; ½" x 36" long flexible connection hose with check valve; low level pump cut-out; Second Pressure Reducing Valve, Pressure Gauge, System Connector Hose and Check Valve to allow for independent pressure supply to a second system; Low Level Alarm Panel c/w Remote Monitoring Dry Contacts and Selectable Audible Alarm. Pressure pumps shall be capable of running dry without damage. Power supply 115/60/1 0.7 Amp. Unit shall include Unit shall be completely pre-assembled and UL certified.
- B. Glycol Solution Heating System: Inhibited propylene glycol and water solution factory pre-mixed 40-60, suitable for operating temperatures of -6° F. The glycol shall be delivered to site in sealed containers, color shall be bright red. DOWFROST HD as manufactured by DOW Chemical Company or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Support tanks inside building from building structure, in accordance with manufacturer's instructions.
- C. Where large air quantities can accumulate, provide enlarged air collection standpipes.
- D. Provide manual air vents at system high points and as indicated.
- E. For automatic air vents, provide vent tubing to nearest drain or back to glycol tank if in mechanical room. Provide air separator on suction side of system circulation pump.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide shutoff valves on water inlet to terminal heating units such as radiation, unit heaters, and fan coil unit.

- H. Provide balancing valves on water outlet from terminal heating units.
- I. Provide relief valves on pressure tanks, low pressure side of reducing valves, and heat exchangers.
- J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- K. Pipe relief valve outlet to glycol tank.
- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- M. Clean and flush glycol system in accordance with Section 23 21 13 before adding glycol solution.
- N. Verify expansion tank pre-charge is set to 12 psig. Adjust expansion tank pre-charge to 12 psig prior to filling system.
- O. Fill system with water or glycol as indicated on the plans. Feed water to system through make-up line with pressure regulator, venting system high points. Set to fill at 12 psig. Pressure heating system cold at 5 psig, adjust when hot to 12 psig. Pressure cooling system at 12 psig. See Specification Section 23 21 16 for glycol fill procedures.
- P. Perform tests determining strength of glycol and water solution and submit written test results.

3.2 AIR VENT APPLICATION SCHEDULE

Location	Type
Terminal heating units, mains below	Manual
Terminal heating units, mains above	None
Heating mains, at high points in system	Automatic

Note: For terminal heating units, mains above unit, install branch piping connections at bottom of mains or 45° from bottom to allow air migration to mains.

END OF SECTION

SECTION 23 21 23 – HYDRONIC PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. In-line Circulators.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 19 - Meters and Gages for HVAC Piping.
- C. Section 23 09 23 - Direct Digital Control System for HVAC.
- D. Section 23 21 13 - Hydronic Piping.
- E. Section 23 21 16 - Hydronic Piping Specialties.

1.3 REFERENCES

- A. ANSI/UL 778 - Motor Operated Water Pumps.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years' experience.

1.5 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.

1.8 EXTRA PARTS

- A. Provide one extra set of mechanical seals for pumps.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Grundfos.
- B. Substitutions: Under provisions of General Conditions of the Contract.

2.2 GENERAL CONSTRUCTION REQUIREMENTS

- A. Balance: Rotating parts, statically and dynamically.
- B. Construction: To permit servicing without breaking piping or motor connections.
- C. Pump Motors: Operate at 1750 rpm unless specified otherwise.
- D. Pump Connections: Flanged.

2.3 IN-LINE CIRCULATORS

- A. Type: Maintenance free, self-lubricated, 3 speed industrial/commercial single stage, direct drive circulator.
- B. Casing: Cast iron.
- C. Impeller: Type 304 stainless steel.
- D. Bearings: Upper and lower radial bearings to be aluminum oxide ceramic, tungsten carbide shaft bearing surfaces.
- E. Shaft: Stainless steel with type 430F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pumps in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.
- C. Ensure pumps 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.
- D. Decrease from line size with long radius reducing elbows or reducers.
- E. Support piping adjacent to pump such that no weight is carried on pump casings. In-line pumps are supported by adjacent piping.
- F. Provide line sized shut-off valve and strainer on pump suction, and line sized combination pump discharge valve on pump discharge.

END OF SECTION

SECTION 23 22 13 - STEAM AND STEAM CONDENSATE PIPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Pipe and fittings.
- B. Valves.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 19 - Meters and Gages for HVAC Piping.
- C. Section 23 07 00 - HVAC Insulation.
- D. Section 23 09 23 - Direct Digital Control System for HVAC.
- E. Section 23 22 16 - Steam and Condensate Heating Piping Specialties.

1.3 REFERENCES

- A. ANSI/ASME SEC 9 - Welding and Brazing Qualifications.
- B. ANSI/ASME B16.11 – Forged Fittings, Socket-Welding and Threaded.
- C. ANSI/ASME B31.9 - Building Services Piping.
- D. ASTM A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
- E. ANSI/AWS D1.1 - Structural Welding Code.
- F. ASTM A312 – Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/ASME B31.9 and ANSI/ASME B31.1.

1.5 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9.
- C. Welders Certification: In accordance with ANSI/ASME SEC 9.

1.6 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Include data on pipe materials, pipe fittings, valves and accessories. Indicate valve data and ratings.

- C. Include welders certification of compliance with ANSI/ASME SEC 9.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.1 LOW PRESSURE STEAM PIPING (15 PSI MAX)

- A. Steel Pipe: ASTM A312, Schedule 40, 316 Stainless Steel.
 - 1. Fittings: ANSI/ASTM A403, wrought austenitic Class 125; or ANSI B16.11 or ANSI B16.9 welded 316 Stainless Steel Class 150.
 - 2. Joints: Screwed, or ANSI/AWS D1.1, welded.

2.2 LOW PRESSURE STEAM CONDENSATE PIPING

- A. Steel Pipe: ASTM A312, Schedule 40, 316 Stainless Steel.
 - 1. Fittings: ASTM A403, wrought austenitic Class 125; or ANSI B16.11 or ANSI B16.9 welded 316 Stainless Steel Class 150.
 - 2. Joints: Screwed, or ANSI/AWS D1.1, welded.

2.3 FLANGES, UNIONS, AND COUPLINGS

- A. Stainless Steel pressure rated according to application with ASTM A193/A bolts and nuts and 1/16 inch thick compressed inorganic fiber with nitrile binder gasket suitable for 125 psi steam service.

2.4 ACCEPTABLE MANUFACTURERS - ALL VALVES

- A. Crane.
- B. Nibco.
- C. Milwaukee.
- D. Hammond.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.5 BALL VALVES

- A. Full port, ASTM-A351, three piece body stainless body, blowout-proof stem, 316 stainless steel ball and stem, lever handle, welded or threaded ends.

2.6 SWING CHECK VALVES

- A. ASTM-A351, stainless steel body and trim, threaded ends.

2.7 STRAINERS

- A. Y-Pattern Strainers: stainless steel body with threaded or socket weld connections, stainless steel screen, stainless steel retainer cap with PTFE gasket, and blow-down plug.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient.
- B. Install piping to conserve building space and not interfere with use of space, other work, or equipment.
- C. Provide clearance for installation of insulation and access to valves and fittings.
- D. Provide access where valves and fittings are not exposed.
- E. Slope steam piping one inch in 40 feet (0.25 percent) in direction of flow.
- F. Slope steam condensate piping one inch in 40 feet (0.25 percent). Provide drip trap assembly at low points and before control valves. Run condensate lines from trap to nearest condensate receiver. Provide loop vents over trapped sections.
- G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- H. Prepare pipe, fittings, supports, and accessories for finish painting. Refer to Division 09.
- I. Install valves with stems upright or horizontal, not inverted.

3.3 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections. Install dielectric unions where joining dissimilar materials.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install globe valves for throttling, or manual flow control services.

END OF SECTION

SECTION 23 22 16 - STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Steam Traps.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 19 - Meters and Gages for HVAC Piping.
- C. Section 23 09 23 - Direct Digital Control System for HVAC.
- D. Section 23 22 13 - Steam and Condensate Heating Piping.

1.3 REFERENCES

- A. ANSI/ASTM - Boilers and Pressure Vessels Code.
- B. ASTM A105 - Forgings, Carbon Steel, for Piping Components.
- C. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- D. ASTM A216 - Steel Casings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
- E. ASTM A395 - Ferric Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
- F. ASME B31.9 - Building Services Piping.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 - Building Services Piping.

1.5 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

1.6 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Submit data indicating manufacturer, model number, size, location, rated capacity, and features for each specialty.
- C. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.

1.8 EXTRA STOCK

- A. Provide two service kits for each size and type of steam trap under provisions of General Conditions of the Contract.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - STEAM TRAPS

- A. Armstrong.
- B. Sarco.
- C. Bell & Gossett.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.2 INVERTED BUCKET TRAPS

- A. Stainless steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with top test plug and bottom drain plugs, stainless steel bucket, stainless steel seats and plungers, and stainless steel lever mechanism with knife edge operating surfaces.

2.3 FLOAT AND THERMOSTATIC TRAPS

- A. Stainless steel body and bolted cover for 250 psig WSP; provide access to internal parts without disturbing piping; with bottom drain plug, stainless steel air vent, stainless steel lever and valve assembly.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Install float and thermostatic traps to drain condensate from humidifiers.
- C. Install inverted bucket steam traps to drain condensate from steam main headers and branch lines.
- D. Size steam traps to handle minimum of two times maximum condensate load of apparatus served.
- E. Traps used on steam mains and branches shall be minimum ¾ inch size.
- F. Install steam traps with union or flanged connections at both ends.
- G. Provide valve and strainer at inlet, and gate valve at discharge of steam traps.

- H. Provide minimum 10 inch long dirt pocket of same pipe sizes as apparatus return connection between apparatus and steam trap.
- I. Remove thermostatic elements from steam traps during temporary and trial usage, and until system has been operated and dirt pockets cleaned of sediment and scale.

END OF SECTION

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Duct Materials.
 - 2. Flexible Ducts.
 - 3. Low Pressure Ductwork.
 - 4. Medium Pressure Ductwork.
 - 5. Ductwork Fabrication.

1.2 RELATED SECTIONS

- A. Division 09 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
- B. Section 23 05 00 - Common Work Results for HVAC.
- D. Section 23 07 00 – HVAC Insulation.
- E. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - 4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - 5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 9. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 10. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- C. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - HVAC Air Duct Leakage Test Manual.
 2. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- D. Underwriters Laboratories Inc.:
1. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 QUALITY ASSURANCE

- A. Sheetmetal Contractor Qualifications:
1. The Sheetmetal Contractor shall have a minimum of five (5) years of documented experience working in Health Care Facilities in the State of Alaska. Contractor shall provide list with a minimum of 5 successful Health Care projects completed in the last 5 years prior to any on-site work.
- B. Within two weeks after award of contract submit to the Project Manager the following items for Contractor qualification:
1. List of 5 successful Health Care Facilities projects in the State of Alaska with names, addresses, and phone numbers of Owners. Include a brief description and scope of Sheetmetal work complete in each project.

1.5 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Low Pressure: Three pressure classifications: ½ inch WG positive or negative static pressure and velocities less than 2,000 fpm; 1 inch WG positive or negative static pressure and velocities less than 2,500 fpm and 2 inch WG positive or negative static pressure and velocities less than 2,500 fpm.

- C. Medium Pressure: Three pressure classifications: 3 inch WG positive or negative static pressure and velocities less than 4,000 fpm, 4 inch WG positive static pressure and velocities greater than 2,000 fpm, 6 inch WG positive static pressure and velocities greater than 2,000 fpm.

1.6 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.7 SUBMITTALS

- A. See General Conditions and the General Requirements in General Conditions of the Contract regarding submittals.
- B. Provide sheetmetal contractor qualifications submittal to include list of health care projects.
- C. Product Data: Submit data for duct materials, duct connectors, fire caulking, and high pressure sealant.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.
- E. Manufacturer's Certificate: Certify installation of duct products meet or exceed specified requirements.

1.8 CLOSEOUT SUBMITTALS

- A. General Conditions of the Contract - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.9 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B standards.
- C. Maintain one copy of each document on site.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. General Conditions of the Contract - Product Requirements.

- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.12 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.13 WARRANTY

- A. General Conditions of the Contract - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.
- B. Stainless Steel Ducts: ASTM A167, Type 304.
- C. Flexible Ductwork: Medical Grade Acoustical Triple Lock Ductwork, all aluminum perforated flexible core, with a free open area of 20-25%. The fiberglass blanket shall be totally isolated from the air stream by UL 181 approved acoustically transparent seamless UL approved polyethylene liner. Internal working pressure: 6" w.g. positive, 2" w.g. negative. Rated Velocity 5500 F.P.M. Min Burst Pressure 15" w.g. positive. Operating Temperature Range -400 to +2500F, Flame/Smoke 25/50, Minimum R6 insulation thermal conductance.
- D. Fasteners: Rivets, bolts, or sheet metal screws.
- E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 LOW PRESSURE DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30° divergence upstream of equipment and 45° convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

- E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- F. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- G. Connect flexible ducts to metal ducts with draw bands.
- H. Use crimp joints with or without bead for joining round duct sizes 12" and smaller with crimp in direction of airflow.
- I. Use double nuts and lock washers on threaded rod supports.

2.3 MEDIUM PRESSURE DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes.
- C. Transform duct sizes gradually, not exceeding 15° divergence and 30° convergence.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- F. Plenum connections: Ensure round duct connections are welded joint bellmouth type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General Conditions of the Contract - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 12" and smaller.
- D. Install duct hangers and supports in accordance with Section 23 05 00.

- E. Use double nuts and lock washers on threaded rod supports.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect air outlets and inlets to supply ducts directly or with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.4 SCHEDULES

- A. Ductwork Material Schedule:

Air System	Material
Supply Upstream of VAV Boxes	Medium Pressure Steel
Medium Pressure Supply	Steel
Supply, 5'-0" Downstream of Humidifier Steam Dispersion Tubes.	Medium Pressure Stainless Steel, Welded
Supply, Downstream of VAV, Dispersion Tubes and 5' section of Stainless Ductwork	Low Pressure Steel
Return and Relief	Medium Pressure Steel
Outside Air	Medium Pressure Steel

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Duct Access Doors.
 - 2. Fire Dampers.
 - 3. Volume Control Dampers.
 - 4. Duct Test Holes.
 - 5. Turning Vanes.
 - 6. Backdraft Dampers.
 - 7. Control Dampers.

1.2 RELATED SECTIONS

- A. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 31 00 - HVAC Ducts and Casings.
- E. Division 26 - Equipment Wiring Connections.

1.3 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
 - 1. ASTM E1 - Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- D. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- E. Underwriters Laboratories Inc.:
 - 1. UL 555 - Standard for Safety for Fire Dampers.

1.4 SUBMITTALS

- A. General Conditions of the Contract - Submittal Procedures: Submittal procedures.
- B. Product Data, Submit for the following:
 - 1. Duct Access Doors.
 - 2. Fire Dampers.
 - 3. Volume Control Dampers.
 - 4. Duct Test Holes.
 - 5. Turning Vanes.
 - 6. Backdraft Dampers.
 - 7. Control Dampers
- C. Product Data: For fire dampers, submit the following:
 - 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 - 2. Indicate materials, construction, dimensions, and installation details.
 - 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- D. Manufacturer's Installation Instructions: Submit for Fire Dampers.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. General Conditions of the Contract - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors and test holes

1.6 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. General Conditions of the Contract - Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. General Conditions of the Contract - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

- A. General Conditions of the Contract - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. General Conditions of the Contract - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each size and type of fusible link.

1.13 COMPLETION REQUIREMENTS

- A. In accordance with the General Conditions and the General Requirements in General Conditions of the Contract, Project Closeout; before acceptance and final payment, the Contractor shall furnish:
 - 1. Accurate project record drawings, shown in red ink on prints, showing all changes from the original plans made during installation of the work.
 - 2. Contractors One Year Warranty.
 - 3. All Manufacturers' Guarantees.
 - 4. Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Duro-Dyne.
 - 2. Ruskin.
 - 3. Nailor.
 - 4. Substitutions: General Conditions of the Contract - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Review locations prior to fabrication.
- D. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- E. Access doors smaller than 12 inches square may be secured with sash locks.
- F. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- G. Access doors with sheet metal screw fasteners are not acceptable.

2.2 ACCEPTABLE MANUFACTURERS - FIRE DAMPERS

- A. Ruskin.
- B. Greenheck.
- C. Substitutions: Under provisions of General Conditions of the Contract.

2.3 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and shall be dynamic type.
- B. Fabricate multiple blade fire dampers with 16 gauge galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- C. Fusible links, UL 33, shall separate at 212 degrees F. Provide adjustable link straps for combination fire/balancing dampers.

2.4 BALANCE DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

- B. Fabricate splitter dampers of material same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.
- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends. Where volume dampers are located above gypsum or other non-accessible ceilings, extend damper rods to ceiling and install recessed concealed regulator with adjustable cover for flush installation, with cover. Exposed portions shall be chrome plated. Regulator shall include spring washer, lock nut, coupling, ninety degree screw or gear drive and rod as required, Young Regulator or equal. Coordinate location of access covers with Architect.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.5 REMOTE OPERATED BALANCE DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- B. Damper controller and cable shall be concealed above the ceiling. Cable to consist of 0.054" stainless steel control wire with a tensile strength of 260,000 lbs. that is encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of "C" bracket to fastened above the ceiling, 7/8" diameter cold rolled steel zinc plated threaded cap suitable for painting, and 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push / pull torque that converts rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4" diameter with 265-degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit is designed to be imbedded in the ceiling flush with the finished surface. Control kit shall be manually operated with a wrench. Young Regulator or approved equal.

2.6 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.7 TURNING VANES

- A. Double Width: Air foil design double width galvanized turning vanes with 2 inch inside radius.

- B. Single Width: Single galvanized turning vane with 2 inch radius and minimum 1" trailing straight leg.
- C. Acoustical Vanes: Double width vanes with inner vane of perforated galvanized steel with 3/32 inch holes on 5/32 inch spacing. Fill space between vanes with minimum 1.5 lb/cu ft glass fiber duct liner.

2.8 CONTROL DAMPERS – ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Greenheck.
 - 3. Substitutions: General Conditions of the Contract – Product Requirements.

2.9 CONTROL DAMPERS

- A. Multi-blade, opposed blade action, control dampers of extruded aluminum, with airfoil type blades of maximum six inch width, blades positioned across short air opening dimension, field replaceable extruded vinyl sealed edges, linked together in rattle-free manner, non-corrosive molded synthetic bearings, square or hexagonal axles for positive locking connection to blades and linkage, with documented leakage rate not to exceed 6 CFM/sq. ft. at 4" W.G.

2.10 BACK-DRAFT DAMPERS

- A. Manufacturers:
 - 1. Ruskin.
 - 2. Greenheck.
 - 3. Substitutions: General Conditions of the Contract - Product Requirements.
- B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
- C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of 16 gauge galvanized steel, or extruded aluminum, with center pivoted blades of maximum 6" width, with felt of flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General Conditions of the Contract - Administrative Requirements: Coordination and project conditions.
- B. Verify rated walls are ready for fire damper installation.
- C. Verify ducts and equipment installations are ready for accessories.

- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Access Doors: Install access doors at the following locations and as indicated:
 - 1. Upstream of each reheat coil.
 - 2. Before and after each duct mounted coil.
 - 3. Before and after each duct mounted fan.
 - 4. Before and after each automatic control damper.
 - 5. Before and after each fire damper.
 - 6. Downstream of each VAV box.
- C. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Install temporary duct test holes as required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- E. Install fire dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
 - 1. Install dampers square and free from racking with blades running horizontally.
 - 2. Do not compress or stretch damper frame into duct or opening.
 - 3. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
 - 4. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.

3.3 DEMONSTRATION

- A. General Conditions of the Contract - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Centrifugal fans.
- B. Related Sections:
 - 1. Section 23 05 00 – Common Work Results for HVAC.
 - 2. Section 23 09 23 - Direct Digital Control System for HVAC
 - 3. Section 23 31 00 - HVAC Ducts and Casings.
 - 4. Section 23 33 00 - Air Duct Accessories.
 - 5. Section Division 26 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 - Standards Handbook.
 - 2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 - 5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. American Refrigeration Institute:
 - 1. ARI 1060 - Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

- E. Underwriters Laboratories Inc.:
 - 1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210.
- B. Sound Ratings: AMCA 301, tested to AMCA 300.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.
- C. Protect motors, shafts, and bearings from weather and construction dust.

1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.9 WARRANTY

- A. Provide one year warranty under provisions of General Conditions of the Contract.

PART 2 - PRODUCTS

2.1 HVAC FANS

- A. Manufacturers:
1. Greenheck.
 2. Cook.
 3. Substitutions: General Conditions of the Contract - Product Requirements

2.2 INLINE CABINET FANS

- A. General Description:
1. Base fan performance at standard conditions (density 0.075 Lb/ft³)
 2. Performance capabilities up to 5,000 cubic feet per minute (cfm) and static pressure to 1.75 inches of water gauge
 3. Fans are available in thirteen sizes with nominal wheel diameters ranging from 8 inches through 16 inches (60 - 160 unit sizes)
 4. Normal operating temperature up to 130 Fahrenheit (54.4 Celsius)
 5. Applications include: intake, exhaust, return, or make-up air systems
 6. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
- B. Wheel:
1. Non-overloading, backward inclined centrifugal wheel
 2. Constructed of aluminum
 3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
 4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
 5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.
- C. Motor:
1. NEMA Premium Efficiency Motor.
 2. Motors shall be permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase.

3. Motor shall be speed be VFD rated, provide with shaft grounding protection.
- D. Housing Supports and Drive Frame:
1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
 2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
 3. Housing supports are constructed of structural steel with formed flanges. Drive frame is welded steel which supports the motor.
- E. Accessories:
1. Gravity backdraft damper.
 2. Housing supports are constructed of structural steel with formed flanges
 3. Provide vibration isolators.
- F. Seismic Rating:
1. The unit shall be certified compliant with the seismic requirements of the International Building Code and conform to the requirements of California CAN2-1708A.5, including an OSHPD Special Seismic Certification Preapproval (OSP), for the building classification and site conditions indicated in the bid documents. The manufacturer shall confirm compliance at time of bid by providing a Certificate of Compliance from a certified Seismic Qualification Agency.
 2. Compliance shall be clearly noted on the unit via a compliance label, as required for field inspection. Labels shall include the manufacturer's identification, model number, serial number and definitive information describing the product's performance characteristics and the approved agency's identification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install HVAC Fans in accordance with manufacturer's instructions.
- B. Suspended Cabinet Fans: Install flexible connections between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- C. Vacuum clean inside of fan cabinet.
- D. Demonstrate fan operation and maintenance procedures.
- E. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable volume terminal units.
- B. Integral heating coils.
- C. Integral damper motor operators.

1.2 RELATED SECTIONS

- A. Section 23 05 00 – Basic Mechanical Materials and Methods.
- B. Section 23 05 48 –Seismic Restraint.
- C. Section 23 09 23 – Direct Digital Control System for HVAC.
- D. Section 23 21 13 – Hydronic Piping.
- E. Section 23 21 16 - Hydronic Specialties.
- F. Section 23 31 00 – HVAC Ducts and Casings.
- G. Section 23 33 00 – Air Duct Accessories.

1.3 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- B. UL 181 - Factory-Made Air Ducts and Connectors.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00 and General Conditions of the Contract.
- B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and NC designation.
- C. Submit manufacturer's installation instructions under provisions of Section 23 05 00 and General Conditions of the Contract Standard General Provisions.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 23 05 00 and General Conditions of the Contract.
- B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.

1.6 QUALIFICATIONS

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

1.7 WARRANTY

- A. Provide warranty under provisions of General Conditions of the Contract.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Titus.
- B. Price.
- C. Substitutions: Under provisions of General Conditions of the Contract Standard General Provisions.

2.2 SUPPLY VARIABLE AIR VOLUME (SAV) TERMINAL UNITS

- A. Variable air volume supply air terminals for connection to single medium pressure duct, central air system. Provide hot water heating coil at units noted on the drawings.
- B. Identify each VAV unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory set air flow, minimum factory set air flow, and coil type.
- C. The control system serving the VAV air terminal units shall be electronic DDC controls. The contractor shall coordinate fully with Specification Section 23 09 23. Controls will be furnished by Section 23 09 23 for field installation. Verify controls are compatible with VAV boxes and control enclosures are sized to accommodate control components.
- D. Boxes to be able to provide accurate flow measurements with 1-1/2 diameters or less of straight ductwork prior to unit inlet.
- E. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal.
- F. The terminal casing shall be minimum 22-gauge galvanized steel. The units shall be lined with 1-inch thick matte faced insulation, meeting UL 181 and NFPA 90A, enclosed between the unit casing and a non-perforated internal 22-gauge sheet metal cover extending over the fiberglass insulation, as well as covering the liner cut edges. The discharge connection shall be slip and drive construction for attachment to metal ductwork. The casing shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.
- G. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
- H. Casing with access panel shall be constructed to hold leakage to the maximum values shown in the Casing Leakage table.

- I. The airflow sensor shall be removable.
- J. At an inlet velocity of 2000 fpm, the minimum static pressure required to operate any terminal size shall not exceed 0.13-inch wg for the basic terminal.
- K. Sound ratings for the terminal shall not exceed scheduled values. Sound performance shall be ARI certified.
- L. Hot water heating coils shall be enclosed in a minimum 20-gauge galvanized steel casing with slip and drive construction for attachment to metal ductwork. Coils shall be factory installed on the terminal discharge. Fins shall be rippled and corrugated heavy gauge aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016-inch with male solder header connections. Coils shall be leak tested to 300 psi with minimum burst pressure of 1800 psi at ambient temperature. Number of coil rows and circuits shall be selected to provide performance as required per the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.
- M. Access Doors: Locate an access door in each box, to allow adequate space for cleaning.

2.3 RETURN VARIABLE AIR VOLUME (RAV) TERMINAL UNITS

- A. The terminal casing shall be minimum 22-gauge galvanized steel, with a minimum of three concentric rolled beads to ensure units are round.
- B. The damper shall be heavy gauge steel with shaft rotating in Delrin® self-lubricating bearings. Nylon bearings are not acceptable. Shaft shall be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. The damper shall incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close-off leakage to the maximum values shown in the Damper Leakage table.
- C. The airflow sensor shall be removable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure. Do not support from adjacent ductwork.
- D. Label ceiling grid adjacent to ceiling tile for access to unit in accordance with Section 23 05 00.
- E. Connect to ductwork in accordance with Section 23 31 00.
- F. Field verify connection requirements to existing ductwork. Provide ductwork transition as required for connection to existing ductwork.
- G. Provide gasketed access door in ductwork downstream of heating coil for access.
- H. Remove manufacturer provided airflow sensor. Field install thermal dispersion airflow sensor in accordance with Section 23 09 23.

END OF SECTION

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Diffusers.
- B. Grilles.

1.2 REFERENCES

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. ARI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA - HVAC Duct Construction Standard.

1.3 QUALITY ASSURANCE

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Earthquake tabs, in seismic zones, in accordance with IBC Standards.

1.5 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Provide product data for items required for this project.
- C. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DIFFUSERS AND GRILLES

- A. Titus.
- B. Price.

- C. Substitutions: Under provisions of General Conditions of the Contract.

2.2 LAMINAR FLOW CEILING DIFFUSERS

- A. Laminar flow diffuser shall be constructed using a maximum 6 inches tall backpan designed for optimum performance with the diffuser. The backpan shall have integral hanger tabs for securing the unit to the overhead structure to prevent falling in case of earthquakes or other ceiling damage. Each unit shall have a fully welded airtight plenum, integral internal baffle for evenly distributing air over the entire face of the diffuser, snap-in removable equalization baffles and retainer cables to prevent accidental dropping of perforated face after removal. Each unit shall have an integral Cable Operated Radial volume damper accessible through the face of the diffuser. The face of the diffuser shall be constructed of 22-gauge 304 stainless steel perforated with 3/32-inch diameter holes on ¼-inch centers. The face shall be secured in place by quarter-turn fasteners for quick removal and sanitizing. Provide with frame for mounting in gypsum wallboard ceiling.
- B. Performance tests shall have been conducted in ASHRAE Standards 70-2006 and 113-2005.

2.3 SQUARE PANEL CEILING DIFFUSERS

- A. The square panel ceiling diffuser shall have a heavy gauge aluminum face panel that captures a secondary heavy gauge aluminum panel. The face panel shall be removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.
- B. The face panel shall project ¼ inch below the outside border of the diffuser backpan. Panels projecting more than ¼ inch below the outside border are not acceptable. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. A single metal thickness on the edges of the face panel will not be accepted. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size. Ceiling diffusers with a 12 x 12-inch full face shall have no less than a 9 x 9-inch face panel size.
- C. The backpan shall be one piece precision die-stamped and shall include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). The diffuser backpan shall be constructed of aluminum. The diffuser neck shall have a minimum of 1¼-inch depth available for duct connection.
- D. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. Provide frame type as required for ceiling. Provide earthquake tabs for installation in lay-in ceilings.

2.4 PERFORATED DIFFUSER

- A. Perforated ceiling diffusers shall have a perforated face with 3/16-inch diameter holes on ¼-inch staggered centers and no less than 51 percent free area. Perforated face shall be aluminum. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 1/8-inch depth for easy duct connection.
- B. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

2.5 LINEAR RETURN GRILLES

- A. Aluminum return grilles with fixed deflection blades parallel to the long or short dimension of the grille. Construction shall be of extruded aluminum with a 1¼-inch wide border on all sides. Minimum border thickness shall be 0.040-0.050 inch. Sizes 24 x 24 inches and smaller shall be constructed using a roll-formed frame. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 x 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be counter-sunk for a neat appearance.
- B. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 35°.
- C. The grille finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315° F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

END OF SECTION

SECTION 23 57 00 - HEAT EXCHANGERS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Brazed Plate Heat Exchangers.
- B. Accessories and Trim.

1.2 RELATED SECTIONS

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 21 13 - Hydronic Piping.
- C. Section 23 21 16 - Hydronic Specialties.

1.3 REFERENCES

- A. ANSI/ASME - Boilers and Pressure Vessels Code.

1.4 REGULATORY REQUIREMENTS

- A. Conform to Section 8D of the ANSI/ASME Boilers and Pressure Vessels Code for manufacture of tubular heat exchangers and heat exchanger shells.

1.5 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract.
- B. Indicate dimensions, locations, and size of tappings and performance data.
- C. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.
- D. Submit design data in sufficient detail to verify that heat exchangers meet or exceed specified requirements.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Include start up and shut down instructions, assembly drawings, and spare parts lists.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Store and protect products under provisions of General Conditions of the Contract.
- C. Protect internals from entry of foreign material by temporary caps on flanged openings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS – BRAZED PLATE TYPE HEAT EXCHANGERS

- A. Alfa-Laval.
- B. Danfoss.
- C. GEA Flat Plate.
- D. ONDA Advanced Heat Exchangers.
- E. Taco.
- F. Tranter.
- G. Bell & Gossett.
- H. Substitutions: Under provisions of General Conditions of the Contract.

2.2 BRAZED PLATE TYPE HEAT EXCHANGER

- A. Plates: Stainless steel Type 316L, vacuumed brazed together with high temperature copper braze Nickel Alloy, ASME Certified.
- B. Maximum working pressure 150 psig, maximum working temperature 350 Degrees F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Support heat exchangers on welded steel pipe and angle floor stand.
- C. Pipe relief valves to glycol tank.
- D. Pipe drain valves to nearest floor drain.

3.2 WATER TO WATER HEAT EXCHANGER TRIM

- A. Water Inlets and Outlets: Thermometer wells, pressure gauge tappings.
- B. Heated Glycol Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure relief valve, valved drain.

END OF SECTION

SECTION 23 64 33 - MODULAR WATER CHILLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Work Included: The air-cooled modular chiller system shall consist of a single chiller module and a free cooling module with integral dual lead/lag pumps and expansion tank that are assembled on site. The chiller module shall be completely factory wired, and tested prior to shipment. The chiller module shall include a compressor, evaporator, air-cooled condenser, and controls.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 05 48 - Vibration and Seismic controls for HVAC.
- C. Section 23 09 23 - Direct Digital Control System for HVAC.
- D. Section 23 09 23 - Sequence of Operation for HVAC Controls.
- E. Section 23 21 13 - Hydronic Piping.
- F. Section 23 21 16 - Hydronic Piping Specialties.
- G. Section 23 73 00 - Indoor Central Air-Handling Units.
- H. Section 26 05 03 - Equipment Wiring Connections.

1.3 QUALITY ASSURANCE

- A. Chiller module shall be constructed in accordance with the UL 1995 and NEC standards and be UL or ETL listed.
- B. Chiller module shall be rated and tested in accordance with ARI 550/590 - Standard for Fluid Chilling Packages.
- C. Chiller module shall meet the safety standards of ANSI/ASHRAE 15 - Safety Standard for Refrigerated Systems.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of General Conditions of the Contract.
- B. Provide submittal for packaged water cooled chiller unit within 5 days of contract award.
- C. Submit complete drawings including cabinet dimensional details and anchor point locations, required clearances, location and sizes of field connections, performance data, electrical wiring diagrams, dry and operation weights, and all required electrical data.
- D. Submit manufacturer's installation instructions, including any remote panel installation instructions.

- E. Submit Operating and Maintenance manuals including completed manufacturer start-up forms.

1.5 DELIVERY STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting modules.
- B. Protect all modules on site from physical damage after unloading.

1.6 WARRANTY

- A. Provide one year warranty on the chiller module and all associated components. Provide a five year warranty on the compressors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Artichill.
- B. Multistack.
- C. Substitutions: Under provisions of General Conditions of the Contract.

2.2 CHILLER MODULE

- A. General: The chiller module shall be assembled on an integral epoxy coated welded channel steel frame, shall be enclosed with epoxy painted aluminum panels and shall be shipped as an individual module and assembled on site. The module shall be fully charged with refrigerant and factory tested for capacity and controller functions prior to shipment. A single point power supply shall be provided to a central distribution block inside a power distribution panel. The power distribution panel contains a circuit breaker for the chiller module and free cooling module for branch circuit overload protection. Electrical supply to each module shall consist of factory provided flexible conduit in the chiller module that must be field routed back to the circuit breaker in the power distribution panel on the free cooling module. No electrical connection to a module shall carry the load of more than that module.
- B. Frames: Frames shall be constructed of welded structural channel steel and be epoxy powder coated with an oven baked finish.
- C. Cabinets: Epoxy coated aluminum cabinet panels on welded steel frame. The cabinet enclosures shall include easily removable access panels for service. Access panels shall be removable via stainless steel fasteners and retaining clips. Modules shall not require access via sheet metal screws or protruding threaded fasteners.
- D. Compressors: Hermetically sealed scroll compressor on each refrigeration circuit each with rotalock connections, crankcase heater, oil level sight glass, suction gas-cooled motor with solid-state sensors in the windings for overload protection, and in-line circuit breaker. There shall be two, independent compressors and refrigerant circuits per module with the lead compressor of the lead module being a digital scroll compressor for close temperature control and unloading to 15% of the chiller capacity. Compressors shall be mounted to the heavy gauge steel frame with rubber-in-shear isolators.
- E. Evaporator: Dual circuit, brazed plate evaporator constructed of 316 stainless steel plates and copper brazing. The supply and return fluid piping connections shall include manual isolation

valves to allow service isolation. The fluid connections to the evaporator shall use roll grooved couplings for service convenience and ease of installation. The evaporator shall be insulated with ¾" closed cell insulation. The minimum working pressure shall be 650 psi. Evaporator piping fluid velocity shall not exceed 10 fps at any point in the system.

- F. Isolation valves: The evaporator branch line shall include butterfly type service valves for the independent isolation of the evaporator. Valves shall have roll grooved pipe connections
- G. Filters: A 40-mesh industrial grade filter strainer shall be factory installed between the header system and the evaporator inlet. The strainer shall be serviceable by closing the manual isolation valves on the evaporator branch lines.
- H. Condenser fan motors: The condenser fan motors shall be maintenance free and highly efficient Electronically Commutated Motors (ECM) with energy reduction capabilities of up to 35%. These variable speed fan assemblies shall vary fan motor RPM to maintain the refrigeration pressure of the chiller modules and allow operation of the chiller down to 0 F ambient.
- I. Condenser Coil: Aluminum fins mechanically bonded to copper tubes with integral subcooling circuits. Fin spacing shall not exceed 12 fins per inch. The coils shall be sized to provide full heat of rejection at jobsite elevation above sea level, at a maximum 25 degree F temperature difference between the condensing temperature and ambient air temperature. The coils shall be factory tested to a minimum of 600 psig.
- J. Refrigerant piping: Piping shall be Type L seamless copper, and shall have an insulated suction line using closed cell pipe insulation, compressor rotalock service valves, solenoid valves for compressor pumpdown, and Schrader service valves in the suction, discharge, and liquid lines.
- K. Fluid Piping: The fluid piping shall be Schedule 40 steel, and be insulated using closed cell pipe insulation to prevent condensation and maintain fluid temperature. The chiller module shall connect to the adjacent free cooling module using roll grooved steel couplings and neoprene gaskets. Any type of module-to-module connection external to the modules is unacceptable.
- L. Controls: The master microprocessor shall include a phase monitor to protect against low voltage, phase unbalance, phase loss, and phase reversal conditions. The master controller shall read all analog and fault port values and shall pass these values to the Building Automation System via BACnet, Modbus or Lonworks protocols.
- M. The chiller control system shall include operational switches for each compressor; high and low pressure transmitter to provide indication of refrigeration pressures in each circuit; high and low refrigeration pressure alarms including shutting shut down the responsible compressor(s); anti-short cycling compressor timers; minimum compressor run timers; connection to Building Automation System.
- N. Microprocessor: The microprocessor shall provide the following minimum functions and alarms:
 - 1. Adjustable fluid temperature set point
 - 2. Multiple stage compressor control, including compressor rotation to provide even compressor usage and wear.
 - 3. High and low fluid temperature alarm set points
 - 4. Fluid inlet and outlet temperature

5. Suction and discharge refrigeration pressures
 6. Compressor run status
 7. Current alarm status
 8. Demand load
 9. Compressor run hours
 10. Alarm logging with minimum of previously 100 logged alarms with time and date of each occurrence
 11. Remote start stop input
 12. Dry contact for general alarm
- O. Interface Panel: A remote operator interface panel shall be provided to allow operator adjustment of user set points, and alarm monitoring. The remote interface panel shall be installed in the operator's control room. The wiring between the chiller and the remote panel shall be provided and installed by the electrical contractor. The wiring shall be 6-conductor wiring with straight-through connections

2.3 FREE COOLING MODULE

- A. Frame and Cabinet: The module shall be constructed on an epoxy coated welded steel frame and enclosed with white painted aluminum panels. The module shall be shipped individually and assembled on site. The module shall be fully factory tested prior to shipment. Electrical supply shall be via factory provided assembled wiring in flexible, liquid tight conduit and field connected to the load distribution panel on the end of the tank and pump module.
- B. Condenser fan motors: The condenser fan motors shall be maintenance free and highly efficient Electronically Commutated Motors (ECM) with energy reduction capabilities of up to 35%. These variable speed fan assemblies shall vary fan motor RPM to maintain the refrigeration pressure of the chiller modules and allow operation of the chiller down to 0 F ambient.
- C. Coils: Aluminum fins mechanically bonded to coppers tubes. Fin spacing shall not exceed 14 fpi. The coils shall be sized to provide partial free cooling in ambient temperatures typically 3-4 degrees F below the chilled fluid set point temperature. The tubes and headers shall be sized for a maximum velocity of no more than 10 ft/sec.
- D. Three-way Valve: The module shall include a 3-way, 2-position valve to allow the system fluid to be cooled by free cooling coils when the ambient temperature falls below the ambient temperature set point. The valve actuator is housed in a NEMA 3R weather resistant enclosure. The module piping shall include isolation valves on all three ports to allow the 3-way valve to be removed from the piping without shutting down the system for service and replacement. The valve shall be supported from the cabinet framing and not from the system piping.
- E. Controls: The module shall include controls to allow the system fluid to be cooled by the free cooling coils upon a drop in ambient temperature when the differential between the ambient temperature and the EWT is 5 F and larger. The fluid temperature set point shall be clearly displayed via a digital LCD display. This set point is field adjustable. Systems with analog indication are not acceptable.

- F. Pumps: The free cooling module shall contain dual, independent cast iron bronze fitted centrifugal pumps. Each pump shall have a cast bronze dynamically balanced impeller, stainless steel shaft, carbon ceramic seal with stainless steel nuts and bolts. The pump motors shall be rated for a maximum speed of 3500 rpm. The pumps shall include inlet and discharge ports for venting and draining. The pumps shall not require disassembly from the chilled fluid piping for service access or repair.
- G. Pump Motors: The pump motors shall be rated for a maximum speed of 3500 rpm.
- H. Fluid Piping: The fluid piping shall be Schedule 40 steel, and be insulated with closed cell pipe insulation to prevent condensation and maintain fluid temperature. The free cooling module shall connect to the adjacent chiller module using roll grooved steel couplings and neoprene gaskets. Any type of module-to-module connection external to the package is unacceptable.
- I. Pump Controls: Each pump shall be sized for 100% capacity, and shall include magnetic motor starters and disconnect switches on each pump to allow for service repair while operating the back-up pump. The pump module shall incorporate microprocessor controller to control all the operations of the pumps. The microprocessor shall communicate with the remaining microprocessors in each module via a local network communications protocol. The microprocessor shall include operational switches for each pump; leaving fluid pressure transmitters to display the leaving fluid pressure; and integral pressure differential switch to switch to the backup pump upon loss of pressure of the primary pump
- J. Microprocessor: The microprocessor shall provide the following minimum functions and alarms:
 - 1. Pump run status
 - 2. Current alarm status
 - 3. Pump run hours
 - 4. Alarm logging with minimum of previously 100 logged alarms with time and date of each occurrence
 - 5. Automatic lead/lag switchover of the pumps once per week
 - 6. Pump discharge pressure

2.4 SEISMIC COMPLIANCE

- A. The complete unit shall be certified compliant with the seismic requirements of the International Building Code and conform to the requirements of California CAN2-1708A.5, including an OSHPD Special Seismic Certification Preapproval (OSP), for the building classification and site conditions indicated in the bid documents. The manufacturer shall confirm compliance at time of bid by providing a Certificate of Compliance from a certified Seismic Qualification Agency.
- B. Compliance shall be clearly noted on the unit via a compliance label, as required for field inspection. Labels shall include the manufacturer's identification, model number, serial number and definitive information describing the product's performance characteristics and the approved agency's identification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Chiller modules shall be installed in accordance with the Manufacturer's recommendations.
- B. Each chiller module is shipped individually for field assembly. Field assembly of chiller system shall consist of the following minimum steps:
 - 1. Manifold chilled fluid piping with factory supplied roll grooved connections. Insulate roll grooved connections after assembly.
 - 2. Connect factory supplied power supply wiring harnesses to the load distribution panel. Install wires to the proper terminals for proper phasing. Chiller module is wired for A, B, C phase right to left in the load distribution panel. Each wire on the wire harness is identified as to its respective phase.
 - 3. Connect all microprocessors together to form the local communication network. Wiring must be 20-gauge minimum, single twisted pair, shielded wiring.

3.2 PIPING SYSTEM FLUSHING PROCEDURE

- A. Prior to connecting the chiller to the building chilled water loop, the piping shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organic residue. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.
- B. During the flushing a 30 mesh (max.) Y-strainers (or acceptable equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The use of on board chiller strainers shall not be acceptable. The flushing process shall take no less than 6 hours or until the strainers, when examined after each flushing, are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

3.3 START-UP AND TESTING

- A. Factory-supervised start-up and checkout with start-up report shall be provided for each module. Provide copies of the start-up report in Operations and Maintenance Manuals.
- B. Owner training by factory representative shall be provided. After start-up a Manufacturer's Representative shall provide a minimum of 4-hours of operator training to the owner's designated representative(s).

END OF SECTION

SECTION 23 73 00 - INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Indoor Central-Station Air-Handling Units.

1.2 RELATED WORK

- A. Section 23 05 00 - Common Work Results for HVAC.
- B. Section 23 09 23 - Direct Digital Control System for HVAC.
- C. Section 23 21 16 - Hydronic Piping Specialties.
- D. Section 23 31 00 - HVAC Ducts and Casings.
- E. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- E. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
- F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- H. ANSI/UL 900 - Test Performance of Air Filter Units.
- I. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- J. ARI 430 - Standard for Central-Station Air-Handling Units.
- K. ARI 435 - Standard for Application of Central-Station Air- Handling Units.
- L. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- M. SMACNA - Low Pressure Duct Construction Standards.

1.4 QUALITY ASSURANCE

- A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

- C. Fabrication: Conform to AMCA 99 and ARI 430.
- D. Filter Media: ANSI/UL 900 listed, Class I or Class II, approved by local authorities.
- E. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- F. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product.
- G. Conform to all information documented in approved submittal package and construction notes.
- H. Fan vibration test results shall be available for review prior to any air handling unit shipment to the jobsite.
- I. Manufacturer shall have a documented quality assurance plan for providing consistent product quality. The quality assurance plan shall include component quality check lists, random product inspections, fan balance reports, coil and piping leak test reports, electrical system test reports, etc. Copies of these reports shall be made available to the engineer upon request.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the design and manufacture of the products specified in this section with a minimum of ten (10) years documented experience, and which issues complete catalog data on the total product.
- B. Each unit shall bear an ETL label, conforming to UL Standard 1995.

1.6 SUBMITTALS

- A. Submit shop drawings and product data under provisions of General Conditions of the Contract.
- B. Provide submittal for indoor central air handling unit within 5 days of contract award.
- C. Shop drawings shall indicate assembly drawings, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- D. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials, electrical characteristics and connection requirements.
- E. Provide fan curves with specified operating point clearly plotted.
- F. Submit sound power levels for both fan outlet and casing radiation at rated capacity.
- G. Submit product data of filter media, filter performance data, filter assembly, and filter frames.
- H. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- I. Submit two samples of replacement filter media with frame, under provisions of General Conditions of the Contract.

- J. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Maintenance Data: Include instructions for inspection, maintenance, lubrication, filter replacement, motor and drive replacement, adjustments, spare parts lists and wiring diagrams.
- C. Manufacturer's Installation Instructions

1.8 UNIT TESTING AND QUALITY CONTROL

- A. Prior to unit shipment, the following qualifications shall be performed and documented:
 - 1. All fans shall be balanced and factory run tested to ensure design integrity.
 - 2. All bearings shall be provided with a full complement of grease.
 - 3. All factory piping shall be leak tested to ensure integrity.
 - 4. All electrical circuits shall be tested to ensure correct operation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.
- B. Store and protect products under provisions of General Conditions of the Contract.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.11 EXTRA STOCK

- A. Provide one set of filters under provisions of General Conditions of the Contract.

1.12 WARRANTY

- A. Provide one year warranty under provisions of General Conditions of the Contract.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Energy Labs.
- B. Haakon.

- C. Huntair.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.2 GENERAL CONSTRUCTION

- A. Provide factory-fabricated cabinet units with capacity as indicated on the equipment schedule. Units shall have overall dimensions as indicated and fit into the space available with adequate clearance for service. Field verify dimensions prior to ordering unit. Units shall be factory assembled and taken apart for shipment. Multiple section units shall be re-assembled on site.
- B. Cabinets shall be constructed in a water and airtight manner and shall have a leakage performance equal or better than SMACNA Class 5.
- C. Units shall comply with UL1995 and NFPA90.
- D. Units shipping in multiple sections shall be designed for ease of field joining. Field joining shall be accomplished using instructions and materials supplied by the unit manufacturer, and shall be capable of providing a factory quality seal.

2.3 BASE

- A. Each unit shall be constructed on a base fabricated from ASTM A36 welded structural steel channel. Tubular or formed bases are not acceptable.
- B. Bases shall be sized to provide adequate strength and L/200 rigidity for uniform lifting over the entire length of the unit.
- C. Heavy duty lifting lugs shall be added to the perimeter channel along the longest length of the unit to facilitate hoisting and field attachment to the building structure. After fabrication, the base frame shall be thoroughly cleaned, primed and painted with an industrial grade, high solids polyurethane paint. The paint system shall meet ASTM B117 salt spray test criteria for a minimum of 2,000 hours.
- D. The unit floor shall be fabricated of 14-gauge G90 galvanized steel sheets. The entire floor shall be insulated with water impervious foam, minimum R14 total insulating value protected by a G90 galvanized steel under liner. Glass fiber insulation is not acceptable.
- E. Floor sheets shall maintain a water and airtight seal and be capable of supporting a 300lb. load with maximum L/200 deflection at any floor seam. Floor sheets shall be continuously welded along all seams and shall include a minimum 2" upturned lip around the section perimeter and all floor openings. Floor drains shall be provided in sections as indicated on the Plan drawings. All floor openings shall include a 12 gauge galvanized steel flange around the entire perimeter duct connection. Floor openings larger than 8"x8" shall be covered with galvanized steel grating designed to support a minimum of 100lbs/sq. ft. No fastener penetrations thru the floor sheets shall be acceptable.
- F. All fans, coils and major components shall be directly supported by structural steel frame members.

2.4 HOUSING

- A. Exterior wall and roof panels shall be constructed of 16-gauge G90 bright galvanized steel with a mill painted industrial grade, high solids polyurethane paint that shall provide a durable, "wet look" finish with excellent color and gloss retention, and shall meet ASTM B117 salt spray

performance criteria for a minimum rating of 1,000 hours and shall utilize a modular panel type construction. Panels shall be double wall construction with 20-gauge G90 bright galvanized steel liners and insulated with 2" of R4.2/inch glass fiber insulation. All panels shall be securely attached to each other, to the roof, and to the base and all seams shall be sealed to create a water and airtight assembly.

- B. Units with fasteners that penetrate thru the wall or roof panels and into the air tunnel will not be acceptable.

2.5 DOORS

- A. Hinged, double wall, man size access doors shall be provided in all sections requiring access for maintenance or service as indicated in the Plan documents. Doors shall include 2" thick, R13 polyisocyanurate foam insulation and shall have exterior and interior surfaces of the same materials as the associated cabinet section. The door frame shall be extruded aluminum. Access doors shall be fully sealed with a dual set of closed cell, replaceable neoprene gasket. Door gasket shall be installed to allow for easy removal and replacement in case of damage.
- B. Door hinges and latches shall be adjustable, without the use of shims or special tools. Hinges shall be stainless steel or cast aluminum. Provide door detail drawings with submittal package.
- C. Door handles shall be composite, fiber reinforced nylon equal to those by Allegis Corporation. The latch mechanism shall be a thermal break assembly which can be operated from outside or inside of the cabinet. Doors shall open against pressure or shall include a built-in safety catch to release cabinet operating pressure prior to opening the door.
- D. Fan section door(s) shall be equipped with a switch interlocked with the fan starter to stop the fan before the access door is opened.
- E. Include an 8" x 12" wire reinforced double pane glass view window in each access door.
- F. All outdoor mounted units shall use a rain diversion gutter over each door frame.

2.6 FAN ASSEMBLY

- A. Fans shall be of the size and type shown in the project Schedule and shall perform as indicated. The fan wheel diameter shall not be less than that shown on the equipment schedule. Fans shall be constructed to AMCA Standards for the Class Rating as indicated on the Equipment Schedule.
- B. Fan performance shall be based on tests run in an AMCA certified laboratory and administered in accordance with AMCA Standards 210 and 300. Fans shall be licensed to bear the AMCA seal for air and sound performance.
- C. Fan performance shall be adjusted to reflect fans running inside the cabinet so as to include any affects from the unit cabinet and other internal components.
- D. Fan and motor shall be mounted on an internal, fully welded, rigid steel assembly. Each individual fan assembly shall be free-floating at all four corners on minimum 2" deflection spring type isolators with earthquake restraints. The spring isolators shall be mounted to structural steel members and shall be rated for a minimum of 1G. The fan discharge shall be isolated from the cabinet by means of a neoprene-coated flexible connection.
- E. Manufacturers who submit on units without individually spring isolated fans must provide comparable isolation for the entire air handling unit. In addition, the purchasing contractor will be

responsible for all additional costs associated with providing external isolation including, but not limited to, the cost of external pipe, conduit and duct flexible connections. Units utilizing non-spring isolated fans shall be furnished with one spare, factory balanced fan/motor assembly to allow the unit to operate at 100% design conditions should a fan need to be returned to the factory for motor replacement, repair or rebalancing.

- F. Each fan shall be mounted into its final intended assembly and balanced to ISO Standard BV3. A copy of the balance test data, including a balance nomograph, shall be made available to the engineer and owner at time of unit shipment. Balance reports where the fan & motor assemblies are balanced on a test fixture, and not in point of use, will not be accepted.
- G. Multiple, Arrangement #4 plenum fan assemblies shall be provided. Fans shall be arranged to provide even air distribution within the unit cabinet. Minimum/maximum fan quantity shall be as indicated in the project Schedule. Total fan BHP and motor HP shall not be exceeded. Scheduled motor efficiencies are considered to be the minimum allowed.
- H. Individual fan performance shall be based on tests run in an AMCA certified laboratory and administered in accordance with AMCA Standards 210 and 300. Fans shall be licensed to bear the AMCA seal for air and sound performance. Submitted fan performance shall be adjusted to reflect multiple fans running inside the cabinet and to reflect any affects from the unit cabinet and other internal components.
- I. The fan wheel shall be aluminum with extruded aluminum airfoil blades continuously welded to the fan side plates. The fan back plane shall be bolted to a cast aluminum fan hub with keyway. Fans not using airfoil blades, or using steel construction, will not be considered. Fan inlets shall be isolated from the cabinet by means of a neoprene-coated flexible connection.
- J. Motors shall be premium-efficiency TEFC, NEMA frame, ball bearing type complete with grease lubricated bearings and alemite fittings for field lubrication. Motors shall have a NEMA Class F insulation rating.
- K. BHP values as shown on the Schedule are maximum allowable.
- L. Fans shall be provided with thrust restraints.
- M. Each motor shall be provided with a shaft grounding device that will bleed potential induced motor shaft voltage to ground.
- N. For the safety of service personnel, provide inlet and outlet screens.
- O. Fans shall be provided with a back draft damper that shall close in the event of a motor failure to prevent air bypass through the off fan. Damper pressure losses shall be reflected in fan performance.

2.7 COILS

- A. Coils shall be rated in accordance with AHRI Standard 410 and licensed to bear the AHRI certification seal.
- B. All cooling coil sections shall include drain pans constructed from 16-gauge, type 304 stainless steel. Galvanized steel drain pans will not be considered. Drain pans shall be insulated with a minimum R14 of spray foam insulation to prevent condensation under the pan. Insulation shall be protected with a type 304 stainless steel outer liner. Drain pans must be sized such that the entire coil, including headers and return bends, are contained within the drain pan. Downstream drain pan extension shall be no less than as indicated on the plan drawings. Drain

pans must slope in two directions so that there is no standing water in the pan. A stainless steel condensate connection shall be provided on one side of the unit, located as shown on the plan drawings. Coils shall be supported on 10 gauge stainless steel members to prevent immersion of the coil in condensate and to allow for periodic inspection and cleaning of the drain pan.

- C. Intermediate condensate drain pans shall be furnished on all stacked coil arrangements and single coils greater than 48" finned height. There shall never be more than a 48" vertical separation between drain pans. Pans shall be sloped, 16-gauge, type 304 stainless steel and shall drain to the main pan through copper downspouts.
- D. All water coils shall be of the high efficiency, plate fin, extended surface type. Tubes shall be 5/8" OD seamless copper with a 0.020" minimum wall thickness. 1/2" diameter tube coils will not be considered.
- E. Coils shall have individually replaceable return bends with a minimum wall thickness that matches the performance of the specified coil tube thickness. Coils incorporating a "hairpin" type design with "thinned" tube thickness at the bend are not acceptable. Tubes shall be expanded into the fin collars to provide a permanent mechanical bond.
- F. The coil secondary surface shall be formed of 0.008 aluminum fins spaced not closer than 12 fins per inch with integral spacing collars that cover the tube surface. Headers shall be seamless copper tube, outside of the airstream. Coil connections shall be copper ODS. Supply and return connections shall be extended to the exterior of the air handling unit. Connection exit locations shall be sealed airtight at the factory.
- G. All coils shall utilize counter flow circuiting with connections left or right hand as shown on the drawings. The use of internal restrictive devices to obtain turbulent flow will not be accepted.
- H. Cooling coil casings shall be minimum 16-gauge, type 304 stainless steel with double-formed 1-1/4" stacking flanges and 3/4" flanges on the side plates. Heating coil casings shall be 16-gauge galvanized steel. Coil tube sheets shall have extruded holes to prevent raw edges of tube sheets cutting into the copper tubes during thermal expansion of the tubes. Straight punched tube holes with raw sheet metal edges are not acceptable. Reinforcing shall be furnished so that the unsupported fin length is not over 60".
- I. All coil assemblies shall be tested under water at AHRI 410 prescribed conditions, and rated for 150-psi working pressure. Headers are to be located inside the cabinet casing with only the pipe connections extending through the casing. All sides of coils shall be carefully blanked off to ensure all air passes through the coil.
- J. Chilled water and hot water coil connections shall be factory piped to the unit exterior. Connection penetrations shall be factory sealed at the inside and exterior surfaces of the panel. All pipe insulation shall be supplied and installed in the field by the piping contractor and shall match that used on external piping

2.8 FILTERS

- A. Complete filter sections shall be integral to the air-handling unit. Filter frames shall be arranged for upstream loading as shown on the drawings. Filter frames shall be 16 Ga. galvanized steel and shall include factory applied gasket. Frames shall be installed with vertical stiffeners to provide a rigid assembly.
- B. Filter clips shall be provided by the air handling unit manufacturer. Clips shall be capable of use without a tool. All filter frames shall be 12"x24" or 24"x24" in size.

- C. Each filter rack shall come complete with a factory installed pressure gauge, complete with static pressure taps, hardware and fittings.
- D. Medium efficiency pre filters shall be 2" thick rigid, disposable pleated media type, rated MERV 8 per ASHRAE Standard 52.2. Filters shall be UL900 Class 2.
- E. High efficiency final filters shall be 12" thick rigid, disposable cartridge type, rated MERV 14 per ASHRAE Standard 52.2. Filters shall be UL900 Class 2.

2.9 ELECTRICAL

- A. The manufacturer shall factory wire, test, and have all air handling units approved by UL.
- B. Fan motors shall be factory wired to a j-box with flexible conduit of adequate length so that it will not affect vibration isolation.
- C. Provide factory installed marine type light fixtures in each air handling unit section serviced by a door. Cabinets >14' in width shall have two fixtures per section. Fixtures to be factory wired to a single toggle switch located on the unit exterior at the supply fan section door. A 15 amp GFCI convenience outlet shall be mounted with the light switch. The electrical contractor shall bring a separate 120/60/1 power service to operate the GFCI & lighting circuit. Lamps to be LED.

2.10 TEST PORTS

- A. The manufacturer shall provide Duro Dyne IP-4 test ports for unit air stream testing in each plenum section between each component within the AHU.

2.11 DRAINS

- A. The manufacturer shall provide 1" valved and capped hose thread drain connections on the side of the unit for complete drainability of the base pan for the following sections:
 - 1. Fresh air plenums.
 - 2. Sections upstream and downstream of coils.

2.12 SEISMIC COMPLIANCE

- A. The complete unit shall be certified compliant with the seismic requirements of the International Building Code and conform to the requirements of California CAN2-1708A.5, including an OSHPD Special Seismic Certification Preapproval (OSP), for the building classification and site conditions indicated in the bid documents. The manufacturer shall confirm compliance at time of bid by providing a Certificate of Compliance from a certified Seismic Qualification Agency.
- B. Compliance shall be clearly noted on the unit via a compliance label, as required for field inspection. Labels shall include the manufacturer's identification, model number, serial number and definitive information describing the product's performance characteristics and the approved agency's identification.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble and install in strict accordance with manufacturer's Operation & Maintenance Instructions, shop drawings and contract documents.

- B. Verify all components, accessories and appurtenances are on site.
- C. Manufacturer shall provide a factory trained service engineer to supervise equipment assembly.
- D. Align, level and seismically restrain unit in place and grout. Seismic restraint to be provided in accordance with Section 23 05 48.
- E. Install in conformance with ARI 435.

END OF SECTION

SECTION 23 84 00 – HUMIDITY CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dry Steam Humidifier with Distribution Manifold.
- B. Humidistat and Controls Connections.

1.2 RELATED WORK

- A. Section 23 22 13 – Steam and Condensate Piping.
- B. Section 23 22 16 – Steam and Condensate Piping Specialties.
- C. Section 23 09 23 – Direct Digital Controls.
- D. Section 26 05 03 – Equipment Wiring Connections.

1.3 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 630 - Selection, Installation, Servicing of Humidifiers.
- B. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.4 QUALITY ASSURANCE

- A. Units shall be product of manufacturer, regularly engaged in production of such units issuing complete catalog data on such products, and providing local service personnel.

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00.
- B. Submit load calculation inputs and calculated humidity values.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 01 78 23.
- B. Include installation instructions, assembly views, maintenance instructions, and replacement parts list.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products to site under provisions of Section 01 60 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Armstrong.
- B. Dri Steem.
- C. Carel USA.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.2 TYPE

- A. Prefabricated steam humidifier system that is ready for insertion in the duct. The system shall consist of a separator/header, multiple-tube dispersion assembly and steam-jacketed "active" tubes. The humidifier system shall include a steam-supply control valve, strainer, steam trap and header drain traps.
- B. The header/separator and dispersion assembly shall be constructed of rugged stainless steel, tube-to-header joints shall be welded stainless steel. Control valves, strainer, steam trap and header drain traps shall all be stainless steel construction.
- C. Receive steam at supply pressure and discharge at atmospheric pressure.

2.3 STEAM SEPARATOR

- A. Separating Chamber: Disengage and remove water droplets and particle matter larger than three micrometers when operated at maximum capacity.
- B. Integral Control Valve: Steam jacketed parabolic plug, capable of modulating flow of steam over entire stroke of operator.
- C. Internal Drying and Silencing Chamber: Designed to receive steam at atmospheric pressure and be jacketed by steam at supply pressure. Utilize stainless steel silencing medium in silencing chamber.

2.4 DISTRIBUTION MANIFOLD

- A. Manifold: Designed to provide uniform distribution over entire length, and be jacketed by steam at supply pressure.
- B. Distribution manifold includes a fabricated separator/header and multiple steam jacketed dispersion tube design of stainless steel wetted parts. No O-rings or slip couplings shall be used. Discharge orifices are sized and spaced to accept steam from the separator/header and provide dry and uniform discharge of steam.
- C. Distribution manifold includes a steam supply control valve utilizing a parabolic plug design offering immediate response and precise modulation of flow throughout the complete valve stroke.
- D. The control valve is protected by a steam supply strainer and float and thermostatic trap. A float and thermostatic trap will be used to drain the separator/header and a second float and thermostatic trap will drain the dispersion tube jackets.

2.5 CONTROLS

- A. Provide electric modulating control valve.
- B. Equip with interlocked temperature switch to prevent humidifier from operating before start-up condensate is drained.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide galvanized steel rods to support distribution manifolds and mount in air system plenums.
- B. Connect unit steam supply. Provide ball valve, inlet strainer, and float and thermostatic steam trap.
- C. Connect unit condensate piping.

END OF SECTION

SECTION 26 01 26 – MAINTENANCE TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Feeder Megohm Testing.
- B. Receptacle Branch Circuit Testing.
- C. Ground Fault Circuit Interrupter Testing.
- D. Ground Fault Protection Testing.
- E. Phase Rotation.
- F. Additional Testing and Maintenance Requirements in Individual Equipment and System Sections.

1.2 REFERENCES

- A. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. ANSI/TIA/EIA – 568-B.1 and Addendums, General Cabling System Requirements.

1.3 SUBMITTALS

- A. Submit data under provisions of General Conditions of the Contract and Section 26 05 00.
- B. Product Data: Submit technical information for each test instrument to include manufacturer, model number, serial number, ratings, accuracy, and National Institute of Standards and Technology (NIST) Traceable calibration certification.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit Test Reports per Section 26 05 00.

1.5 COORDINATION

- A. Provide written 72 hours advance notice of all tests to be performed to allow Owner's Representative to witness testing.

1.6 REQUIRED TEST INSTRUMENTS

- A. MEGOHMMETER.
 - 1. Product Description: 1000 Volt DC, portable, insulation and resistance test Megohmmeter.
 - 2. Equipment Accuracy:
 - a. 2000 Megohm Range - 3% of full Scale.

B. BRANCH CIRCUIT ANALYZER

1. Product Description: Branch circuit analyzer capable of receptacle testing of voltage drop under load, hot-neutral-ground conductor resistances, common mode (N-G) Voltage, and G.F.C.I. trip point.
2. Manufacturer: Ideal SureTest. Model: 61-156 ST-1THD Wiring/Harmonic Distortion Analyzer or approved equal.
3. Equipment Accuracy:
 - a. Accuracy 1% full scale \pm 1 digit True RMS.

C. GROUND RESISTANCE CLAMP-ON METER

1. Product Description: Digital, direct reading clamp-on resistance ground tester.
2. Manufacturer: AEMC. Model: 3711 or approved equal.
3. Equipment Accuracy:
 - a. 1.0 to 50.0 Ohms \pm (1.5% + 0.1 Ohm).
 - b. 50.0 to 100.0 Ohms \pm (2.0% + 0.1 Ohm).
 - c. 100 to 200 \pm (1.5% + 0.1 Ohm).
 - d. 200 to 400 Ohms \pm (1.5% + 0.1 Ohm).
 - e. 400 to 600 Ohms \pm (1.5% + 0.1 Ohm).

D. MULTIMETER

1. Product Description: Digital True RMS Multimeter.
2. Equipment Accuracy:
 - a. AC Voltage Range: 0.75% \pm 3 last single digits at 60 Hz.
 - b. AC Current Range: 0.90% \pm 3 last single digits at 60 Hz.
 - c. DC Voltage Range: 0.25% \pm 1 last single digit.
 - d. DC Current Range: 0.75% \pm 1 last single digit.
 - e. Resistance Ranges: 0.50% \pm 1 last single digit.
 - f. Frequency Range: 0.10% \pm 1 last single digit @ 60 Hz.

E. SOUND LEVEL METER

1. Product Description: Sound Level Meter meeting ANSI S.14a Type 2, Specifications for Sound Level Meters. Capable of A-Weighted measurement.

1.7 TEST INSTRUMENT CALIBRATION

- A. All test equipment shall be in good mechanical and electrical condition.
- B. Provide calibration for each test instrument directly traceable to the National Institute of Standards and Technology (NIST) of higher accuracy than that of the instrument tested.
- C. Provide calibration labels visible on all test equipment. Records, which show date and results of instruments calibrated or tested, shall be kept up-to-date.
- D. Calibrate instruments in accordance with the following frequency schedule:
 - 1. Field instruments: 12 months maximum.
 - 2. Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument with the equipment.

1.8 MINIMUM REPORT INFORMATION

- A. Report Criteria: After each test, promptly submit one copy of report to the Owner's Representative. [Include information on the ASD report form where included within this specification otherwise] provide form with the minimum following information:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name and Model of Tester and witnesses.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.
 - 6. Type of inspection or test.
 - 7. Date of test.
 - 8. Results of tests.
 - 9. Indicate compliance or non-compliance with Contract Documents.
 - 10. Final adjustment setting values where applicable.
- B. Submit copy of all tests performed in the O&M manual.

1.9 GENERAL REQUIREMENTS

- A. Submit test results within 3 working days of each test and included in the O&M manual.
- B. Provide qualified personnel at site to perform all testing.
- C. Perform specified testing of products in accordance with specified standards or as denoted in this specification whichever is more stringent.

- D. Promptly notify Owner's Representative of irregularities or non-conformance of Work or products.
- E. Perform additional tests when test is performed incorrectly, deemed inaccurate, or incorrectly documented.
- F. The Contractor shall provide all forms, instrumentation and test equipment, loads, and other consumables required to demonstrate the systems to Owner's Representative satisfaction.
- G. Perform and submit all testing prior to substantial completion and system acceptance.
- H. Retest all material, cables etc that are disturbed after testing.
- I. Replace and retest all material installed which does not meet or exceed the minimum acceptable limits set forth in this specification in accordance with the contract original requirements at no additional charge to Contract Sum/Price.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 FEEDER CONDUCTOR TEST

- A. Tests Criteria:
 - 1. Use Megohm meter to test all conductors sized #6AWG and larger.
 - 2. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential 1000 volts DC for 600 volt rated cable.
 - 3. Perform test immediately after installation.
 - 4. Clean exposed cable ends with clean cloth and alcohol.
 - 5. Test duration shall be one minute.
 - 6. Disconnect conductors from all equipment.
 - 7. Record the resistance of the insulated conductor under test with all other conductors connected together and to ground (metallic raceway, grounding conductor, etc).
 - 8. Perform continuity test to insure correct cable connection.
 - a. Submit test results to Owner's Representative.
- B. Test Values:
 - 1. Minimum insulation-resistance value: 50 megohms.
 - 2. Investigate deviations between adjacent phases.

3.2 RECEPTACLE GROUND FAULT CIRCUIT INTERRUPTER TEST

- A. Test Criteria:
 - 1. Use Branch Circuit Analyzer to perform test of each GFCI protected receptacle.
 - 2. Record trip level in ma for each outlet.
 - 3. Submit test results to Owner's Representative.
- B. Test Values:
 - 1. Trip Range: Between 6-9 mA.

3.3 HOSPITAL GRADE RECEPTACLES

- A. Test straight-blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. prepare reports that comply with recommendations in NFPA 99

3.4 GROUND FAULT PROTECTION SYSTEMS

- A. Visual and Mechanical Inspection:
 - 1. Compare equipment nameplate data with drawings and specifications.
 - 2. Visually inspect the components for damage and errors in polarity or conductor routing.
 - 3. Verify that ground connection is made ahead of neutral disconnect link and on the line side of any ground fault sensor.
 - 4. Verify that neutral sensors are connected with correct polarity on both primary and secondary.
 - 5. Verify that all phase conductors and the neutral pass through the sensor in the same direction for zero sequence systems.
 - 6. Verify that grounding conductors do not pass through zero sequence sensors.
 - 7. Verify that the grounded conductor is solidly grounded.
 - 8. Verify correct operation of all functions of the self-test panel.
 - 9. Set pickup and time-delay settings in accordance with the settings provided in a manufacturer's coordination study. Record appropriate operation and test sequences as required by NEC Article 230-95. Submit test results to Owner's Representative.
- B. Electrical Tests:
 - 1. Measure the system neutral-to-ground insulation resistance with the neutral disconnect link temporarily removed. Replace neutral disconnect link after testing.
 - 2. Perform the following pickup tests using primary injection:
 - a. Verify that the relay does not operate at 90 percent of the pickup setting.

- b. Verify pickup is less than 125 percent of setting or 1200 amperes, whichever is smaller.
 3. For summation type systems utilizing phase and neutral current transformers, verify correct polarities by applying current to each phase-neutral current transformer pair. This test also applies to molded-case breakers utilizing an external neutral current transformer.
 - a. The relay shall operate when current direction is the same relative to polarity marks in the two current transformers.
 - b. The relay shall not operate when current direction is opposite relative to polarity marks in the two current transformers.
 4. Measure time delay of the relay at 150 percent or greater of pickup.
 5. Verify reduced control voltage tripping capability: 55 percent for ac systems and 80 percent for dc systems.
 6. Submit test results to Owner's Representative.
- C. Test Values:
 1. Relay timing shall be in accordance with manufacturer's specifications but shall not exceed one second at 3000 amperes.

3.5 PHASE ROTATION TEST

- A. Test each three phase circuit and feeder for consistent phase rotation for the entire power system with a phase rotation meter.
- B. Bump test each motor for proper rotation prior to use.
- C. Correct conductor phase relationship to provide proper phase rotation.
- D. Record the rotation sequence on each panelboard, MDP and Service circuit schedule.
- E. Submit test results of each panelboard, MDP and Service to the Owner's Representative.

3.6 PHASE LOAD BALANCE TEST

- A. After energizing building loads conduct a phase load balance test for each new or remodeled panelboard with a clamp on ammeter.
- B. Shift loads to provide current balance within 20% of the other phases. Revise circuit directory and all conductor labels to reflect any changes.
- C. Notify Owner's Representative at least 72 hours in advance before test.

END OF SECTION

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General Requirements specifically applicable to Division 26, in addition to General Conditions of the Contract provisions.
- B. The electrical system equipment and installation shall comply with all provisions and requirements of this specification, as well as any and all applicable national, state and local codes and standards.

1.2 WORK SEQUENCE

- A. Construct Work in sequence under provisions of General Conditions of the Contract.

1.3 COORDINATION

- A. Coordinate the Work specified in this Division under provisions of General Conditions of the Contract.
- B. Prepare drawings showing proposed rearrangement of Work to meet job conditions, including changes to Work specified under other Sections. Obtain permission of Architect prior to proceeding.

1.4 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, latest adopted edition including all state and local amendments.
- B. NECA - Standard of Installation.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. Electrical Reference Symbols: The Electrical "Legend" on drawings is standardized version for this project. All symbols shown may not be used on drawings. Use legend as reference for symbols used on plans.
- E. Electrical Drawings: Drawings are diagrammatic; complimentary to the Architectural drawings; not intended to show all features of work. Install material not dimensioned on drawings in a manner to provide a symmetrical appearance. Do not scale drawings for exact equipment locations. Review Architectural, Civil, Structural, and Mechanical Drawings and adjust work to conform to conditions shown thereon. Field verification of dimensions, locations and levels is directed.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to the latest adopted edition of the International Building Code and the International Fire Code including all state and local amendments thereto.

- C. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.6 SUBMITTALS

- A. Submit inspection and permit certificates under provisions of General Conditions of the Contract.
- B. Include certificate of final inspection and acceptance from authority having jurisdiction.
- C. Submittal review is for general design and arrangement only and does not relieve the Contractor from any requirements of Contract Documents. Submittal not checked for quantity, dimension, fit or proper operation. Where deviations of substitute product or system performance have not been specifically noted in the submittal by the Contractor, provisions of a complete and satisfactory working installation is the sole responsibility of the Contractor.
- D. In addition to requirements referenced in General Conditions of the Contract, the following is required for work provided under this division of the specification.
 - 1. Provide material and equipment submittals containing complete listings of material and equipment shown on Electrical Drawings and specified herein. Separate from work furnished under other divisions. Index and clearly identify all material and equipment by item, name or designation used on drawings and in specifications.
 - 2. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring diagrams and controls; component parts; finishes; dimensions; and required clearances.
 - 3. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information not applicable.
 - 4. Review submittals prior to transmittal; determine and verify field measurements, field construction criteria, manufacturer's catalog numbers, and conformance of submittal with requirements of Contract Documents.
 - 5. Coordinate submittals with requirements of work and of Contract Documents.
 - 6. Certify in writing that the submitted shop drawings and product data are in compliance with requirements of Contract Documents. Notify Architect/Engineer in writing at time of submittal, of any deviations from requirements of Contract Documents.
 - 7. Do not fabricate products or begin work which requires submittals until return of submittal with Architect/Engineer acceptance.
 - 8. Equipment scheduled by manufacturer's name and catalog designations, manufacturer's published data and/or specification for that item, in effect on bid date, are considered part of this specification. Approval of other manufacturer's item proposed is contingent upon compliance therewith.
 - 9. Submittals for Division 26 shall be complete and submitted at one time. Unless given prior approval, partial submittals will be returned unreviewed.

1.7 SUBSTITUTIONS

- A. In accordance with the General Conditions and the General Requirements, Substitution and Product Options, all substitute items must fit in the available space, and be of equal or better quality including efficiency performance, size, and weight, and must be compatible with existing equipment.

1.8 PROJECT RECORD DRAWINGS

- A. Maintain project record drawings in accordance with General Conditions of the Contract.
- B. In addition to the other requirements, mark up a clean set of drawings as the work progresses to show the dimensioned location and routing of all electrical work which will become permanently concealed. Show routing of work in permanently concealed blind spaces within the building. Show complete routing and sizing of any significant revisions to the systems shown.
- C. Record drawing field mark-ups shall be maintained on-site and shall be available for examination of the Owner's Representative at all times.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals for training of Owner's Representative in operation and maintenance of systems and related equipment. In addition to requirements referenced in General Conditions of the Contract, the following is required for work provided under this section of the specifications.
- B. Manuals shall be separate from work furnished under other divisions. Prepare a separate chapter for instruction of each class of equipment or system. Index and clearly identify each chapter and provide a table of contents.
- C. Unless otherwise noted in General Conditions of the Contract, provide one copy of all material for approval.
- D. The following is the suggested outline for operation and maintenance manuals and is presented to indicate the extent of items required in manuals.
 - 1. List chapters of information comprising the text. The following is a typical Table of Contents:
 - a. Electrical power distribution.
 - b. Lighting.
 - c. Fire alarm.
 - d. Other chapters as necessary.
 - 2. Provide the following items in sequence for each chapter shown in Table of Contents:
 - a. Describe the procedures necessary for personnel to operate the system including start-up, operation, emergency operation and shutdown.
 - 1) Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable.

- 2) Give step-by-step instructions for shutdown procedure if a particular sequence is required.
- 3) Include test results of all tests required by this and other sections of the specifications.

b. Maintenance Instructions:

- 1) Provide instructions and a schedule of preventive maintenance, in tabular form, for all routine cleaning and inspection with recommended lubricants if required for the following:
 - a) Lighting fixtures.
 - b) Distribution equipment.
 - c) Fire alarm and detection equipment.
- 2) Provide instructions for minor repair or adjustments required for preventive maintenance routines, limited to repairs and adjustments which may be performed without special tools or test equipment and which requires no special training or skills.
- 3) Provide manufacturers' descriptive literature including approved shop drawings covering devices used in system, together with illustrations, exploded views, etc. Also include special devices provided by the Contractor.
- 4) Provide any information of a maintenance nature covering warranty items, etc., which have not been discussed elsewhere.
- 5) Include list of all equipment furnished for project, where purchased, technical representative if applicable and a local parts source with a tabulation of descriptive data of all electrical-electronic spare parts and all mechanical spare parts proposed for each type of equipment or system. Properly identify each part by part number and manufacturer.

1.10 DEMONSTRATION OF ELECTRICAL SYSTEMS

A. During substantial completion inspection:

1. Conduct operating test for approval under provisions of General Conditions of the Contract.
2. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents.
3. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
4. Have instruments available for measuring light intensities, voltage and current values, and for demonstration of continuity, grounds, or open circuit conditions.
5. Provide personnel to assist in taking measurements and making tests.

1.11 WARRANTY

- A. In addition to the requirements of General Conditions of the Contract, or as specified in other sections. Warrant all materials, installation and workmanship for one (1) year from date of acceptance.
- B. Copies of manufacturer product warranties for all equipment shall be included in the operation and installation manuals.

1.12 INSTRUCTION OF OPERATING PERSONNEL

- A. In accordance with the requirements of General Conditions of the Contract and this section provide services of qualified representative of supplier of each item or system listed below to instruct designated personnel of Owner in operation and maintenance of item or system.
- B. Make instruction when system is complete, of number of hours indicated, and performed at time mutually agreeable.

System or Equipment	Hours of Instruction
OR Isolated Power System	2

- C. Certify that an Anchorage, Fairbanks or Kenai based authorized service organization regularly carries complete stock of repair parts for listed equipment or systems, that organization is available and will furnish service within 48 hours after request. Include name, address and telephone number of service organization.
- D. Have approved operation and maintenance manuals and parts lists for all equipment on hand at time of instruction.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. All Materials and Equipment shall be new.
- B. All Materials and Equipment shall be listed by Underwriter's Laboratories or equivalent third party listing agency for the use intended.
- C. Materials and Equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended when installed per listing and labeling instructions.
- D. No materials or equipment containing asbestos in any form shall be used. Where materials or equipment provided by this Contractor are found to contain asbestos such items shall be removed and replaced with non-asbestos containing materials and equipment at no cost to the Owner.
- E. In describing the various items of equipment, in general, each item will be described singularly, even though there may be numerous similar items.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- A. Install Work using procedures defined in NECA Standard of Installation and/or the manufacturer's installation instructions.

3.2 TESTS

- A. Perform tests in accordance with Section 26 01 26 – Testing and Maintenance of Electrical Systems.
- B. Notify the Owner's representative at least 72 hours prior to conducting any tests.
- C. Following completion of installation, test system ground in accordance with the requirements of NETA ATS 7.13. and all feeders in accordance with NETA ATS 7.3. Submit logs of values obtained, and nameplate data of instruments used prior to final inspection. Include a copy of all data in the power distribution section of the Operation and Maintenance Manuals.
- D. Perform additional tests required under other sections of these specifications.
- E. Perform all tests in the presence of the Owner's representative.
- F. The Contractor shall provide written notification to the Owner's representative and the State Electrical Inspector thirty days in advance of requests for rough-in and substantial completion inspections.

3.3 PENETRATIONS OF FIRE BARRIERS

- A. Related information to this section appears in Division 07, Fire Stopping.
- B. All holes or voids created to extend electrical systems through fire rated floors, walls or ceiling shall be sealed with an asbestos-free intumescent fire stopping material capable of expanding 8 to 10 times when exposed to temperatures 250°F or higher.
- C. Materials shall be suitable for the fire stopping of penetrations made by steel, glass, plastic and shall be capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814 and UL 1479.
- D. The rating of the fire stops shall be the same as the time-rated floor, wall or ceiling assembly.
- E. Install fire stopping materials in accordance with the manufacturer's instructions.
- F. Unless protected from possible loading or traffic, install fire stopping materials in floors having void openings of four (4) inches or more to support the same floor load requirements as the surrounding floor.

END OF SECTION

SECTION 26 05 03 - EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical connections to equipment specified under other Sections or existing equipment furnished by Owner.

1.2 RELATED WORK

- A. General Conditions of the Contract - Administrative Requirements; Summary: Owner-furnished equipment.
- B. Division 08 - Automatic Entrances, Door Hardware.
- C. Division 22 – Plumbing Equipment.
- D. Division 23 – HVAC Equipment.
- E. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.
- F. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- G. Section 26 28 16 - Enclosed Switches and Circuit Breakers.
- H. Section 26 29 13 - Enclosed Controllers.

1.3 REFERENCES

- A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Purpose Wiring Devices.
 - 2. NEMA WD 5 - Specific-Purpose Wiring Devices.

1.4 SUBMITTALS

- A. Submit data under provisions of General Conditions of the Contract and Section 26 05 00.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.5 COORDINATION

- A. General Conditions of the Contract - Administrative Requirements: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.

- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
- B. Make conduit connections to equipment that is subject to vibration or movement using flexible conduit. Use Liquidtight flexible conduit in damp or wet locations.
- C. Install pre-finished cord set where connection with attachment plug is indicated or specified by the equipment manufacturer's installation instructions, or use attachment plug with suitable strain-relief clamps.
- D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where required.
- F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches and connect with conduit and wiring as indicated in the equipment manufacturer's installation instructions.

- G. Where reconnecting existing equipment, extend connections using materials and methods as specified.

3.4 ADJUSTING

- A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION

SECTION 26 05 05 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Demolition.

1.2 RELATED SECTIONS

- A. General Conditions of the Contract - Alteration Project Procedures.
- B. Division 02 - Minor Demolition for Remodeling.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Carefully review and refer to the requirements in General Conditions of the Contract for demolition, scheduling, noise control, cleanliness, etc. prior to start of work as these requirements will be strictly enforced.
- B. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction, especially any that serve critical areas or equipment. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new work is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Note that any changes to the critical system may require special coordination and flexibility on the part of the contractor to schedule and perform this work.
- E. Existing Fire Alarm System: Maintain existing system in service until new work is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service

at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Demolish and extend existing electrical work under provisions of General Conditions of the Contract, Division 02, and this Division.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Where abandoned conduit is installed below existing slab not scheduled for demolition, remove the conductors, cut conduit flush with floor, and patch surface.
- F. 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.
- G. Disconnect and remove abandoned panelboards and distribution equipment.
- H. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- I. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- J. Repair adjacent construction and finishes damaged during demolition and extension work. T-bar ceiling tiles damaged under normal construction conditions or having voids where junction boxes were removed shall be replaced by the Contractor.
- K. Maintain access to existing electrical installations which remain active.
- L. Extend existing installations using materials and methods as specified.
- M. Where materials or equipment are to be turned over to Owner or reused and installed by the Contractor, it shall be the Contractor's responsibility to maintain condition of materials and equipment equal to the existing condition of the equipment before the work began. Repair or replace damaged materials or equipment at not additional cost to the Owner.
- N. Relocate existing lighting fixtures as indicated on Drawings. Test fixture to see if it is in good working condition before installation at new location.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.

- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where circuits have been modified or rewired.

3.5 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.6 INSTALLATION

- A. Install relocated materials and equipment under the provisions of General Conditions of the Contract.

END OF SECTION

SECTION 26 05 19 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Wire.
- B. Cable.
- C. Wiring Connections and Terminations.

1.2 RELATED SECTIONS

- A. Section 26 01 26 – Maintenance Testing of Electrical Systems.
- B. Section 26 05 53 – Identification for Electrical Systems.
- C. Section 26 05 73 – Power System Studies

1.3 REFERENCES

- A. Federal Specification FS-A-A59544 – Cable and Wire, Electrical (Power, Fixed Installation).
- B. Federal Specification FS-J-C-30B – Cable Assembly, Power, Electrical.
- C. ANSI/NEMA WC 70-2009 – Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- D. NETA ATS – Acceptance testing specifications for Electrical Power Distribution and Systems.
- E. NFPA 70 – National Electrical Code.
- F. NFPA 262 – Standard Method of test for flame travel and smoke of wires and cables for use in air-handling spaces.
- G. UL 62 – Flexible Cords and Cables.
- H. UL 83 – Thermoplastic Insulated Wire and Cable.
- I. UL 1063 – Standard for Machine and Tool Wire and Cable.
- J. UL 1424 – Standard for Cables for Power-Limited Fire Alarm.
- K. UL 1479 – Standard for Fire Tests of Through Wall Penetration Fire Stops.
- L. UL 1569 – Standard for Metal Clad Cable.
- M. UL 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.4 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5m) when tested in accordance with NFPA 262.

1.5 SUBMITTALS

- A. Submittals are not requested for this section.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Thermoplastic-insulated Building Wire: NEMA WC 5.
- B. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN or XHHW-2 as indicated.
- C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN or XHHW-2. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor.
- D. Branch Circuit Wire Color Code:
 - 1. Color code wires by line or phase as follows:
 - a. Black, red, blue and white for 120/208V systems.
 - b. Brown, orange, yellow and gray for 277/480V systems.
 - 2. For conductors 6 AWG and smaller, insulation shall be colored. For conductors 4 AWG and larger, identify with colored phase tape at all terminals, splices, and boxes.
 - 3. Grounding conductors 6 AWG and smaller shall have green colored insulation. For 4 AWG and larger, use green tape at both ends and at all other visible points in between, including pull and junction boxes.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.
- F. Fire Alarm Notification Appliance Circuits: Copper, solid or stranded conductor 600 volt insulation, THHN/THNN or XHHW-2.

2.2 METAL CLAD CABLE

- A. UL 83, 1063, 1479, 1569, and 1581 listed, meets Federal Specification A-A-59544 (formerly J-C-30B). UL rated for installation in cable trays and environmental air handling spaces. Fire wall rated for 1, 2, and 3-hour through penetrations.
- B. Type MC Cable, Size 12 Through 10 AWG: Solid copper conductor, 600 volt thermoplastic insulation, rated 90° C dry, 75° wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.

- C. Type MC Cable, Size 8 Through 1 AWG: Stranded copper conductor, 600 volt thermoplastic insulation, rated 90° C dry, 75° wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar.
- D. Patient Care Areas: Type MC Cable installed on the normal branch in patient care areas shall be hospital grade type.
- E. Fire Alarm/Control Type MC Cable, Size 18 through 12 AWG: Complying with UL 66, 83, 1424, 1479, 1569, 1581, and NFPA 262 (formerly UL 910), solid copper conductor, 300 volt thermoplastic insulation, rated 105° C, insulated green grounding conductor, and red-striped galvanized steel armor over mylar. Conductor insulation shall be color-coded in accordance with Section 28 31 00.
- F. 0-10V Dimming/Power MC Cable (Type MC-PCS), Size 12 Through 10 AWG With 16-2 Control Cables: Solid copper conductor, 600 volt thermoplastic insulation, rated 90° C dry, 75° wet, insulated green grounding conductor, and galvanized steel or aluminum armor over mylar
- G. All metal clad cable shall be provided with color-coded insulation on all ungrounded conductors in accordance with NEC 210.5(C) and Part 3 of this section.

2.3 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 90° C, individual conductors twisted together, shielded, and covered with an overall PVC jacket; UL listed.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90° C, individual conductors twisted together, shielded or unshielded (as required), and covered with a PVC jacket; UL listed.
- C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 90° C, individual conductors twisted together, shielded or unshielded (as required), and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.4 WIRING CONNECTIONS AND TERMINATIONS

- A. For conductors 8 AWG and smaller:
 - 1. Dry interior areas: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Where stranded conductors are terminated on screw type terminals, install crimp insulated fork or ring terminals. Thomas & Betts Sta-Kon or equal.
 - 2. Motor connections: Spring wire connectors, pre-insulated "twist-on" rated 105 degrees C per UL 468C. Provide a minimum of 8 wraps of Scotch 33+ electrical tape around conductors and connector to eliminate connector back off.
 - 3. Wet or exterior: Spring wire connectors, pre-insulated "twist-on", resin filled rated for direct burial per UL 486D.
 - 4. Fluorescent luminaires: UL listed, 4A, 600V, luminaire disconnect with tin-plated brass contacts, finger-safe polycarbonate female housing, 105° C temperature rating, and two or three-pole configuration to match load served.
- B. For conductors 6 AWG and larger:

1. Bus lugs and bolted connections: 600 V, 90 degrees C., two hole long barrel irreversible compression copper tin plated. Thomas & Betts or approved equal.
2. Motor connection: 600 V, 90 degrees C., copper tin plated compression motor pigtail connector, quick connect/disconnect, slip on insulator. Thomas & Betts or approved equal.
3. Two way connector for splices or taps: 600 V, 90 degrees C., compression long barrel, copper tin plated. Thomas & Betts or approved equal. Insulate with Scotch 23 rubber insulating base covering and Scotch 33+ outer wrap.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- C. Splice only in junction or outlet boxes.
- D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- E. Make Conductor lengths for parallel circuits equal.
- F. Wiring in lighting fixture channels shall be rated for 90° C minimum.
- G. Do not share neutral conductors. Provide a dedicated neutral conductor for each branch circuit that requires a neutral.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Verify that raceway is complete and properly supported prior to pulling conductors. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Do not install XHHW-2 conductors when ambient temperatures are below -5 degrees C and THHN/THWN conductors when ambient temperatures are below 0 degrees C.
- D. Conductors shall be carefully inspected for insulation defects and protected from damage as they are installed in the raceway. Where the insulation is defective or damaged, the cable section shall be repaired or replaced at the discretion of the Owner and at no additional cost to the Owner.
- E. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
- F. Route conductors from each system in independent raceway system and not intermix in the same raceway, enclosure, junction box, wireway, or gutter as another system unless otherwise shown on the plans.

- G. No more than six current carrying conductors shall be installed in any homerun unless otherwise indicated on the drawings or without prior approval from the Engineer.
- H. Completely and thoroughly swab raceway system before installing conductors.
- I. When two or more neutrals are installed in one conduit, identify each with the proper circuit number in accordance with Section 26 05 53.

3.3 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or cable ties to support cables from structure. Do not support cables from ceiling suspension system. Include bridle rings or drive rings.
- C. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Stranded wire shall not be wrapped around screw terminals.
- B. Splice only in accessible junction boxes.
- C. Thoroughly clean wires before installing lugs and connectors.
- D. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- E. Terminate spare conductors with twist on connectors or heat shrink insulation to proper voltage rating.
- F. Control systems wiring in conjunction with mechanical, electrical or miscellaneous equipment to be identified in accordance with wiring diagrams furnished with equipment.
- G. Code sound and signal systems wiring and any special equipment in accordance with manufacturer's diagrams or recommendations.
- H. Do not exceed manufacturer's recommended pull tensions.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of General Conditions of the Contract and Section 26 01 26.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque conductor connections and terminations to manufacturer's recommended values.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All Locations: Building wire and/or remote control and signal cable in raceways.
- B. Metal Clad cable may only be used for branch circuit wiring other than homeruns connected to the normal branch. Wiring connected to the Life Safety or Critical Branches shall be building

wire in raceways per NEC 517.19(C)(3). All homeruns shall be building wire in raceway. Metal Clad cable used for branch circuit wiring from a light switch to the light fixture shall include a neutral conductor and 0-10V conductors.

- C. At the Contractor's option, portions of the fire alarm wiring in dry, concealed locations may be installed in Fire Alarm Metal Clad cable.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical Equipment and Raceway Grounding and Bonding.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, Section 26 05 00 – Common Work Results for Electrical, Division 27 and Division 28.
- B. Section 26 01 26 – Maintenance Testing of Electrical Systems.
- C. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

1.3 REFERENCE STANDARDS

- A. ANSI/NEMA GR-1, Ground Rod Electrodes and Ground Rod Electrode Couplings.
- B. ANSI/NFPA 70 – National Electrical Code.
- C. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.
- D. AWS A5.8/A5.8M – Specification for Filler Metals for Brazing and Braze Welding.
- E. IEEE Std 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- F. IEEE Std 142 – Recommended Practice for Grounding of Industrial and Commercial Power System.
- G. UL 467 – Standard for Grounding and Bonding Equipment.

1.4 SYSTEM DESCRIPTION

- A. Provide a complete grounding system for services and equipment as required by State and Local Codes, NEC, applicable portions of other NFPA codes, and as indicated herein.

1.5 SUBMITTALS

- A. Product Data: Submit product data for all components provided, showing material type and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bonding Conductors: Solid bare copper wire for sizes No. 8 AWG and smaller diameter. Stranded bare copper wire for sizes No. 6 AWG and larger diameter. Conductors may be insulated conductors if used provide green insulation.
- B. Grounding Conductors: Copper conductor bare or green insulated.
- C. Mechanical Grounding and Bonding Connectors: Non-reversible crimp type lugs only. Use factory made compression lug for all terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide a separate, insulated equipment-grounding conductor in all feeder and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Multiple conductors on single lug not permitted. Each grounding conductor shall terminate on its own terminal lug.
- B. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- C. Grounding conductors for branch circuits shall be sized in accordance with NEC, except minimum size grounding conductor shall be No. 12 AWG.
- D. Grounding conductor is in addition to neutral conductor and in no case shall neutral conductor serve as grounding means.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Ground Isolation Test: Ground systems shall be tested for isolation from other ground system.
- C. Continuity Test: Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDED

- A. Section included hangars and supports for Power Systems, Communication Systems and Electronic Safety and Security Systems.
- B. Conduit Supports.
- C. Formed Steel Channel.
- D. Spring Steel Clips.
- E. Sleeves.
- F. Mechanical Sleeve Seals.
- G. Equipment Bases and Supports.

1.2 RELATED WORK

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical, Division 27 and Division 28.
- B. Section 26 05 48 - Vibration and Seismic Controls for Electrical Systems.

1.3 SUBMITTALS

- A. General Conditions of the Contract: Requirements for submittals.
- B. Product Data: Submit product data for specialty supports.

1.4 COORDINATION

- A. Coordinate size, shape and location of concrete pads with Division 03.

1.5 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Minerallac Fastening Systems.

3. O-Z Gedney Co.
 4. Substitutions: per General Conditions of the Contract
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F. self-locking.

2.2 FORMED STEEL CHANNEL

- A. Manufacturers:
1. B-Line Systems.
 2. Allied Tube & Conduit Corp.
 3. Unistrut Corp.
 4. Substitutions: per General Conditions of the Contract.
- B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.3 SLEEVES

- A. Sleeves Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.4 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General Conditions of the Contract: Verification of existing conditions before starting work.

- B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

- A. Obtain permission from Owner's Representative before using powder-actuated anchors.
- B. Obtain permission from Owner's Representative before drilling or cutting structural members.

3.3 INSTALLATION - GENERAL

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using precast insert system, expansion anchors, preset inserts, beam clamps, or spring steel clips.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not support raceways, low voltage pathways, cables, telecommunication pathways or boxes from ceiling suspension wires or suspended ceiling systems. Provide support from building structure independently to allow ceiling removal and replacement without removal of electrical system. If dedicated support wires are used, wires and wire clips must be painted or color-coded. Exception: Outlet boxes for ceiling-mounted light fixtures, speakers, motion sensors, CCTV cameras, nurse call devices and smoke detectors may be mounted in the ceiling system.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling suspension system.
- E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- F. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- G. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- H. Securely fasten fixtures and equipment to building structure in accordance with manufacturer's recommendations and to provide necessary earthquake anchorage per Section 26 05 48.
- I. Provide wall attached fixtures and equipment weighing less than 50 pounds with backing plates of at least 1/8" x 10" sheet steel or 2" x 10" fire retardant treated wood securely built into the structural walls. Submit attachment details of heavier equipment for approval.
- J. Earthquake Anchorages:
 - 1. Equipment weighing more than 50 pounds shall be adequately anchored to the building structure to resist lateral earthquake forces.
 - 2. Total lateral (earthquake) forces shall be 1.5 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.
- K. Provide one seismic support wire for all fixtures weighing less than 10lbs. two minimum color-coded dedicated seismic support wires for each ceiling mounted light fixture weighing less than 50 pounds. Attach support wires to building structure independent from ceiling system and on

opposing corners of the light fixtures to not allow fixture to drop more than 6 inches upon ceiling failure. Secure each end with three tight wraps within 1 inch at each end of the wire. Provide four supports on fixtures >50 lbs.

- L. Attach the supporting cables for all pendant fixtures to both the building structure and to the ceiling grid which they pass through.
- M. Power-driven fasteners are prohibited for tension load applications (such as supporting luminaires or conduit racks from ceiling above). Use drilled-in expansion anchors, or drilled and screw-in anchors such as Kwik-Con II or Tapcon.

3.4 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install stainless steel escutcheons at finished surfaces.

END OF SECTION

SECTION 26 05 33 – RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Metal Conduit.
- B. Flexible Metal Conduit.
- C. Liquidtight Metal Conduit.
- D. Electrical Metallic Tubing.
- E. Auxiliary Gutter.
- F. Fittings and Conduit Bodies.
- G. Wall and Ceiling Outlet Boxes.
- H. Pull and Junction Boxes.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions.
- B. General Conditions of the Contract - General Requirements, Summary, Administrative Requirements.
- C. Section 26 05 00 – Common Work Results for Electrical.
- D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- E. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- F. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- G. Section 26 05 48 – Vibration and Seismic Support for Electrical Systems.
- H. Section 26 05 53 – Identification for Electrical Systems.
- I. Section 26 27 16 – Electrical Cabinets and Enclosures.
- J. Section 26 27 26 – Wiring Devices.
- K. Section 27 05 28 - Pathways for Communications Systems.
- L. Section 27 10 00 – Structured Cabling.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
- B. American Society for Testing and Materials (ASTM):
 1. ASTM A 123 – Specification for Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
- C. National Electrical Manufacturers Association (NEMA):
 1. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 2. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 3. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. Underwriters Laboratory (UL):
 1. UL 6 - Rigid Steel Conduit, Zinc Coated.
 2. UL 514B – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- E. National Fire Protection Association (NFPA):
 1. NFPA 70 - National Electrical Code.
- F. Telecommunications Industry Association (TIA) and Electronics Industries Association (EIA):
 1. ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard.
- G. Building Industry Consulting Service International (BICSI):
 1. BICSI Telecommunication Design Methods Manual.
- H. International Building Code (IBC):
 1. IBC chapters 16 and 17 seismic requirements.

1.4 RACEWAY AND BOX INSTALLATION SCHEDULE

- A. Raceway Minimum Size:
 1. Below Grade: Provide 1 inch minimum, unless otherwise noted.
 2. Above Grade or Slab on Grade: Provide 1/2 inch minimum, unless otherwise noted. Raceway may be reduced to 1/2 inch for final connection of raceway up to 6 feet for connection to fixture or device where maximum conduit entry size is 1/2 inch.
- B. In or through CMU walls:
 1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may penetrate through CMU walls where the EMT is installed in a sleeve and does not come

in direct contact with the CMU. All conduit in contact with concrete or block shall be rigid steel conduit half lapped wrapped with pipe wrap or be plastic-coated conduit.

2. Boxes and Enclosures: Provide concrete tight cast and sheet metal steel metal boxes.
- C. Outdoor Above Grade, Damp or Wet Interior Locations:
1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 2. Boxes and Enclosures: Provide weatherproof malleable iron for branch circuit junction and outlet boxes. Provide weatherproof NEMA 3R sheet metal enclosures for safety and disconnect switches and NEMA 4 sheet metal enclosures with gaskets for motor controllers and control panels.
 3. Fittings: Provide galvanized malleable iron with gaskets. Provide Myers threaded hubs for all conduit entries into top and side of sheet metal enclosures.
- D. Concealed Dry Locations:
1. Raceway: Provide rigid steel conduit, intermediate metal conduit, or electrical metallic tubing.
 2. Boxes and Enclosures: Provide sheet-metal boxes.
 3. Fittings: Provide galvanized malleable iron and steel.
- E. Exposed Dry Locations:
1. Raceway: Provide rigid steel conduit or intermediate metal conduit. EMT conduit may be used where exposed conduit is allowed where it is not subject to physical damage or where installed on the ceiling or a minimum of ten feet above the floor.
 2. Boxes and Enclosures: Provide sheet-metal boxes with raised steel covers.
 3. Fittings: Provide galvanized malleable iron and steel.
 4. Surface Raceway and Boxes. Where specifically noted on the Drawings, provide surface raceway and boxes.
- F. Branch Circuits 60 Amperes or Larger and Feeders:
1. Raceway: Provide rigid steel conduit or intermediate metal conduit.
 2. Boxes and Enclosures: Provide sheet-metal boxes.
 3. Fittings: Provide galvanized malleable iron and steel.
- G. Equipment Connections: Provide short extensions (three feet maximum) of flexible metal conduit for connections to light fixtures, motors, transformers, vibrating equipment or equipment that requires removal for maintenance or replacement. Use Liquidtight flexible conduit and fittings for motors and equipment in damp or wet locations or subject to spilling of liquids as at pumps, kitchen equipment, in mechanical rooms, boiler rooms, pump rooms, etc.
- H. Liquidtight flexible nonmetallic conduit and electrical nonmetallic tubing are not approved raceway systems for this project.

1.5 DESIGN REQUIREMENTS

- A. Raceway Minimum Size:
 - 1. Line Voltage Circuits: Raceway is sized on the drawings for copper conductors with 600-Volt type XHHW insulation, unless otherwise noted. Where a raceway size is not shown on the drawings, it shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9 using the conduit dimensions of the NEC Table 4, Chapter 9 and conductor properties of the NEC Table 5, Chapter 9.
 - 2. Fire Alarm, Telecom, Intercom and other Low-Voltage Circuits: Where installed in raceways, the raceway size shall be calculated to not exceed the percentage fill specified in the NEC Table 1, Chapter 9, using the conduit dimensions of the NEC Table 4, Chapter 9, and cable diameter provided by the manufacturer.
- B. Box Minimum Size: Provide all boxes sized and configured per NEC Article 370 and as specified in this section.
- C. Seismic Support: Provide support in accordance with section 26 05 29.
- D. Telecommunication Pathways Layout and Configuration: BICSI Telecommunication Design Methods Manual and ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard.

1.6 SUBMITTALS

- A. Section 01 33 00 - Submittals and Section 26 05 00 - Electrical General Provisions.
- B. Product Data: Submit data for products to be provided.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC)

- A. Rigid Steel Conduit: ANSI C80.1, UL 6.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; Galvanized malleable iron with threaded hubs for all conduit entries. Provide threaded connections and couplings only. Set Screw and running thread fittings are not permitted.
- C. Provide insulated throat bushings at all conduit terminations.

2.2 PVC COATED RIGID METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external 40-mil PVC coating and 2-mil urethane internal surface.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; steel fittings with insulated throat bushings and external PVC coating to match conduit.

2.3 INTERMEDIATE METAL CONDUIT (IMC)

- A. Product Description: ANSI C80.6, UL 1242; Galvanized Steel Conduit.
- B. Fittings and Conduit Bodies: NEMA FB 1, UL 514B; use fittings and conduit bodies specified above for rigid steel conduit.
- C. Provide insulated throat bushings at all conduit terminations.

2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Product Description: UL 1, FS WW-C-566; galvanized or zinc-coated flexible steel, full or reduced-wall thickness.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron with insulated throat bushings. Die cast zinc or threaded inside throat fittings are not acceptable.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Product Description: UL 360, flexible metal conduit with interlocked steel construction and PVC jacket.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; liquid tight steel or malleable iron with insulated throat bushings. Die cast fittings are not acceptable.

2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3, UL 797; galvanized steel tubing.
- B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, compression or set screw type with insulated throat bushings. Zinc die cast, or indentor fittings are not acceptable.
- C. Maximum size shall be 2". Provide factory elbows on sizes 2" and larger.

2.7 AUXILIARY GUTTERS

- A. Manufacturers:
 - 1. Square D.
 - 2. Circle AW.
 - 3. Hoffmann.
 - 4. Substitutions under provision of General Conditions of the Contract.
- B. Auxiliary Gutters: General purpose wireway, with or without knockouts.
- C. Size and length as required.
- D. Cover: Hinged cover.
- E. Connector: Slip-in construction; hinged cover.
- F. Fittings: Lay-in type with removable top, captive screws.

- G. Finish: Rust inhibiting primer coat with gray enamel finish.

2.8 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, UL514A galvanized steel, with plaster ring where applicable.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required. Minimum Size: 4 inches square or octagonal, 2-1/8 inches deep.
 - 3. Telecommunications Outlets: Minimum size 4-11/16 inches square, 2-1/8 inches deep.
- B. Cast Boxes: NEMA FB 1, Type FD, galvanized malleable iron. Furnish gasketed cover by box manufacturer. Furnish threaded hubs. "Bell" boxes are not acceptable.
- C. Wall Plates: As specified in Section 26 27 26.

2.9 PULL AND JUNCTION BOXES

- A. Sheet Metal Pull and Junction Boxes: ANSI/NEMA OS 1, UL514A galvanized steel.
 - 1. Minimum Size: 4 inches square or octagonal, 1-1/2 inches deep, unless otherwise noted.
- B. Sheet Metal Boxes Larger Than 12 Inches in Any Dimension: Hoffman or approved equal.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250, Type 4X; flat-flanged, surface mounted junction box, UL listed as raintight:
 - 1. Material: Galvanized cast iron or copper-free cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover and screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250, Type 4; flat-flanged, flush-mounted junction box, UL listed as raintight:
 - 1. Material: Galvanized cast iron [or copper-free cast aluminum].
 - 2. Cover: Furnish with outside flange, neoprene gasket, and recessed stainless steel cover and screws.

2.10 EXPANSION FITTINGS

- A. Galvanized malleable iron, galvanized with grounding bond jumper.

2.11 RACEWAY SEALING FITTINGS

- A. Galvanized malleable iron, galvanized filled with sealing compound.
 - 1. Class 1 Division 1 boundary lines and isolation of arcing devices use Class 1 Division 1 sealing compound.

2.12 BUSHINGS

- A. Non-grounding: Threaded impact resistant plastic.
- B. Grounding: Insulated galvanized malleable iron/steel with hardened screw bond to raceway and conductor lug.

2.13 LOCKNUTS

- A. Threaded Electro Zinc Plated Steel designed to cut through protective coatings for ground continuity.

2.14 WIREWAY

- A. Product Description: General purpose type wireway. Size per NEC minimum fill capacity required.
- B. Knockouts: Field-installed, no factory knockouts acceptable.
- C. Cover: Screw cover.
- D. Fittings and Accessories: Include factory couplings, offsets, elbows, adapters and support straps required for a complete system. Provide internal ground bonding jumper bonded to each section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Provide seismic support and fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes with origin and destination in accordance with Section 26 05 53.
- D. Unless otherwise noted, do not inter-mix conductors from separate panelboards or any other system in the same raceway system or junction boxes.

3.2 INSTALLATION - GENERAL RACEWAY

- A. Install raceway for all systems, unless otherwise noted.
- B. Install an equipment grounding conductor inside of all [flexible] raceways containing line voltage conductors.
- C. Provide raceways concealed in construction unless specifically noted otherwise, or where installed at surface cabinets, motor and equipment connections and in Mechanical and Electrical Equipment rooms. Do not route conduits on roofs, outside of exterior walls, or along the surface of interior finished walls unless specifically noted on the plans.
- D. Raceway routing and boxes are shown in approximate locations unless dimensioned. Where raceway routing is not denoted, field-coordinate to provide complete wiring system.

- E. Do not route raceways on floor. Arrange raceway and boxes to maintain a minimum of 6 feet 6 inches of headroom and present a neat appearance. Install raceways level and square to a tolerance of 1/8" per 10 feet. Route exposed raceways and raceways above accessible ceilings parallel and perpendicular to walls, ceiling, and adjacent piping.
- F. Maintain minimum 6-inch clearance between raceway and mechanical and piping and ductwork. Maintain 12-inch clearance between raceway and heat sources such as flues, steam pipes, heating pipes, heating appliances, and other surfaces with temperatures exceeding 104 degrees F.
- G. Do not install raceway imbedded in spray applied fire proofing. Seal raceway penetrations of fire-rated walls, ceilings, floors in accordance with the requirements of Section 26 05 00 and Division 07.
- H. Route raceway through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket. Coordinate all requirements with Division 07 of these specifications.
- I. Where raceway penetrates fire-rated walls and floors, seal opening around conduit with UL listed firestop sealant or intumescent firestop, preserving the fire time rating of the construction. Install in accordance with Section 07 84 00 Firestopping.
- J. Raceways and boxes penetrating vapor barriers or penetrating areas from cold to warm shall be taped and sealed with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall include a vapor barrier on the outside.
- K. Arrange raceway supports to prevent misalignment during wiring installation. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- L. Do not attach raceway to ceiling support wires or other piping systems and do not fasten raceway with wire or perforated pipe straps. Remove all wire used for temporary raceway support during construction, before conductors are pulled. Raceway shall be installed to permit ready removal of equipment, piping, ductwork, or ceiling tiles.
- M. Group raceway in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps, as specified in Section 26 05 29. Provide space on each rack for 25 percent additional raceway.
- N. Cut conduit square; de-burr cut ends. Bring conduit to the shoulder of fittings and couplings and fasten securely. Where locknuts are used, install with one inside box and one outside with dished part against box.
- O. Use threaded raintight conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Sealing locknuts are not acceptable.
- P. Install no more than the equivalent of three 90-degree bends between boxes.
- Q. Install conduit bodies to make sharp changes in direction, such as around beams. "Goosenecks" in conduits are not acceptable.
- R. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.

- S. Provide protective plastic bushings or insulated throat bushings at each raceway termination not installed to an enclosure. Bushings shall be threaded to the raceway end or connector.
- T. Avoid moisture traps; install junction box with drain fitting at low points in raceway system.
- U. Install fittings and flexible metal conduit to accommodate 3-axis movements where raceway crosses seismic joints.
- V. Install fittings designed and listed to accommodate expansion and contraction where raceway crosses control and expansion joints.
- W. Provide weatherhead on all raceway stub ups which are outdoors and do not terminate into equipment.
- X. Use cable sealing fittings forming a watertight non-slip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor outside diameter. Use Appleton CG series or equal cable sealing fittings.
- Y. Use suitable caps to protect installed raceway against entrance of dirt and moisture.
- Z. Provide nylon "jet-line" or approved equal pull string in empty raceway, except sleeves and nipples.
- AA. Paint all exposed conduit to match surface to which it is attached or crosses. Clean greasy or dirty conduit prior to painting in accordance with paint manufacturer's instructions. Where raceway penetrates non-rated ceilings, floors or walls, provide patching, paint and trim to retain architectural aesthetics similar to surroundings.

3.3 INSTALLATION – GENERAL BOXES

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance. All electrical box locations shown on Drawings are approximate unless dimensioned.
- B. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Where installation is inaccessible, install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaries. Coordinate locations and sizes of required access doors with Division 08.
- C. Coordinate layout and installation of boxes to provide adequate headroom and working clearance. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- D. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems and where normal and emergency power circuits occur in the same box.
- F. Verify location of floor boxes in offices and work areas prior to rough-in. Set boxes level and flush with finish flooring material.
- G. Adjust box location up to 6 feet prior to rough-in to accommodate intended purpose.
- H. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

- I. Unless otherwise specifically noted, locate outlet boxes for light switches within 6 inches of the door jamb on the latch side of the door.
- J. Position outlets to locate luminaires as shown on reflected ceiling plans.
- K. Locate and install boxes to maintain headroom and to present a neat appearance.
- L. Provide knockout closures for unused openings.
- M. Install boxes in walls without damaging wall insulation or reducing its effectiveness.
- N. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. For outlet boxes in walls with combustible finished surfaces such as wood paneling or fabric wall coverings, position box to be flush with finished surface per NEC requirements.
- O. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes. Accurately position bridges to allow for surface finish thickness.
- P. Do not install flush mounted boxes back-to-back in walls; install with minimum 6 inches separation.
- Q. Install with minimum 24 inches separation in fire rated walls. Limit penetrations in fire rated walls to 16 square inches each and a maximum total combined penetration area of 100 square inches in any given 100 square feet of wall. Where penetrations are in excess of these requirements provided UL listed fire stop wrap acceptable to Authority having Jurisdiction.
- R. Do not fasten boxes to ceiling support wires or other piping systems.
- S. Support boxes independently of conduit.
- T. Clean interior of boxes to remove dust, debris, and other material and clean exposed surfaces and restore finish.
- U. Provide blank covers or plates for all boxes that do not contain devices.

3.4 INSTALLATION – AUXILIARY GUTTER

- A. Bolt auxiliary gutter to steel channels fastened to the wall or ceiling or in self-supporting structure. Install level.
- B. Gasket each joint in oil-tight gutter.
- C. Mount raintight gutter in horizontal position only.

3.5 INSTALLATION – TELECOMMUNICATION RACEWAYS AND SLEEVES

- A. Provide continuous pathway system for all telecommunication cables. Provide cable pathway support in accordance with section 27 05 29.
- B. Provide separation clearances in accordance with Section 27 10 00.
- C. Install the telecommunication pathways in accordance with requirements for Installation of General Conduit and General Boxes above unless superceded by more stringent requirements

of this section or ANSI/EIA/TIA568-B and the latest published edition of the BICSI Telecommunication Distribution Methods Manual guidelines and recommendations.

- D. Provide pathways for all telecommunication cables with Surface Raceway, Conduit, Cable tray, J-hooks, and chases for the entire length of each cable. Provide pathway capacity throughout entire system for each telecommunication outlet served sized to accommodate a minimum of four 4-pair 100-Ohm UTP cables from each outlet location to telecommunication room denoted on the plans.
- E. Conduit Pathways:
1. Install pull boxes in continuous straight runs of conduit longer than 100 feet.
 2. Maximum allowable continuous conduit section length of 100 feet between pull boxes.
 3. Contain no more than two 90-degree bends or de-rate conduit capacity 15% for up to one additional 90-degree bend. Conduits less than 33 feet long, oversized one trade size or with one of the 90-degree bends within 12 inches of a pull box may have up to three 90 degree bends without de-rating.
 4. Rate each offset as a 90-degree bend.
 5. Bond each conduit to telecommunication ground system.
 6. Condulets (LB fittings) shall not be installed in any telecommunications raceway.
 7. Do not use flexible metal conduit unless specifically noted on the plans or approved by the engineer where it is the only practical alternative. Increase raceway one trade size above required size where flexible metal conduit is used.
 8. Terminate conduits routed to cable trays within 6 inches of tray. Provide conduit support to building structure within 24 inches of cable tray.
 9. Terminate conduits and chases that protrude through floor in telecommunication rooms to 3 inches above finished floor. Terminate conduits and chases that protrude through finished ceiling or above within 12 inches of ladder rack, distribution frame or cable organizer.
 10. Provide bend radius of 6 times of the internal conduit diameter of conduits up to 2 inches; 10 times of the internal conduit diameter of conduits above 2 inches and for all fiber optic raceways.
 11. Provide conduit pathways through walls with insulated bushings on each end for all wall penetrations of cables.
 12. Provide minimum conduit size of ¾ inch. Size all other conduits, sleeves and chases according to the following table:

Conduit Trade size	Conduit Maximum Cable Capacity Based on two 90 degree bends and < 100 ft (Inches OD of Cable)									
	(0.13")	(0.18")	(0.22")	(0.24")	(0.29")	(0.31")	(0.37")	(0.53")	(0.62")	(0.70")
0.75"	6	5	4	3	2	2	1	0	0	0
1"	8	8	7	6	3	3	2	1	0	0

1.25"	16	14	12	10	6	4	3	1	1	1
1.5"	20	18	16	15	7	6	4	2	1	1
2"	30	26	22	20	14	12	7	4	3	2
2.5"	45	40	36	30	17	14	12	6	3	3
3"	70	60	50	40	20	20	17	7	6	6
3.5"							22	12	7	6
4"							30	14	12	7

- F. Provide J-Hooks in accordance with Section 27 05 29 to provide telecommunication pathway anywhere cable tray, conduit, or ladder rack is not denoted on the plans and one or more telecommunication cables are routed.
- G. Provide innerduct the entire length in conduits denoted to contain innerducts. Size innerducts to use entire available capacity of the outer conduit.
- H. Do not install innerduct and other cables in the same raceway.

3.6 INSTALLATION – TELECOMMUNICATION BOXES

- A. Boxes:
 - 1. All boxes shall be readily accessible.
 - 2. Do not use boxes for angle pulls or change pathway direction. Locate pull boxes in straight through sections of horizontal conduit pathways.
 - 3. Provide pull boxes for 3/4-inch and 1-inch through pull for horizontal UTP cabling. Provide all other boxes sized per the following table:

Maximum Trade Size Conduit	Minimum Size of Pull Box in Inches			For each additional conduit increase width in inches
	Width	Length (direction of conduit)	Depth	
0.75"	4	12	3	2
1"	4	16	3	2
1.25"	6	20	3	3
1.5"	8	27	4	4
2"	8	36	4	5
2.5"	10	42	5	6
3"	12	48	5	6
3.5"	12	54	6	6
4"	15	60	8	8

END OF SECTION

SECTION 26 05 48 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, Section 26 05 00 – Common Work Results for Electrical, Division 27 and Division 28.

1.2 DESCRIPTION

- A. Provide seismic anchorage and restraint of electrical systems including, equipment, raceways, cable trays, lighting fixtures, etc.
- B. Seismic Category D, E and F:
1. All electrical items that are of Importance Factor (I_p) = 1.5 are required to be seismically braced. This applies to the following:
 - a. The component is required to function for life safety purposes after an earthquake, including fire protection systems, fire alarm systems, emergency lighting, etc.
 - b. The component contains hazardous materials.
 - c. The component is in or attached to an Occupancy Category IV structure (Hospitals, fire station, police station, emergency shelters, etc. per ASCE 7-05, Table 1-1) and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- C. All other electrical equipment shall be assigned a component importance factor (I_p) = 1.0 and are required to be seismically braced unless one of the following conditions is satisfied:
1. Component is MOUNTED (connection to structure) at less than 4' above the floor (to the center of gravity of the component), and weighs less than 400 lbs.
 2. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 50 lbs (if it is concealed).
 3. Component is mounted higher than 4' (to the center of gravity of the component), but weighs less than 100 lbs (if it is exposed).
 4. Flexible connections between the components and associated conduit are provided.
 5. All runs or groupings of conduits on or off of trapezes shall be seismically braced, unless the distribution system (including conduit, wiring and fittings) weighs less than 5 pounds per linear foot.
 6. Lighting fixtures, lighted signs and ceiling fans that are not rigidly connected to ducts or piping, that are supported by chains or otherwise suspended from structure, are not required to be seismically braced, as long as:
 - a. The attachment points can carry at least 140% of the weight of the fixture, and

- b. The swinging light will not create a falling debris problem by bumping into ceiling of other finishes, and
 - c. Connections to structure allow for movement of the fixture without damaging the connections.
- D. In accordance with ASCE 7-05 13.6.4, all electrical components with $I_p = 1.5$ shall also satisfy the following requirements:
- 1. Provisions shall be made to eliminate seismic impact between components.
 - 2. Loads imposed on the components by attached utility or service lines that are attached to separate structures shall be evaluated.
 - 3. Batteries on racks shall have wrap-around restraints to ensure that the batteries will not fall from the rack. Spacers shall be used between restraints and cells to prevent damage to cases. Racks shall be evaluated for sufficient lateral load capacity.
 - 4. Internal coils of dry type transformers shall be positively attached to their supporting substructure within the transformer enclosure.
 - 5. Electrical control panels, computer equipment, and other items with slide-out components shall have a latching mechanism to hold the components in place.
 - 6. Electrical cabinet design shall comply with the applicable National Electrical Manufacturers Association (NEMA) standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.
 - 7. The attachments of additional external items weighing more than 100 lbs shall be specifically evaluated if not provided by the manufacturer.
 - 8. Where conduit, cable trays, or similar electrical distribution components are attached to structures that could displace relative to one another and for isolated structures where such components cross the isolation interface, the components shall be designed to accommodate the seismic relative displacements defined in ASCE 7-05 Section 13.3.2.
- E. Unless otherwise exempted above, electrical component supports and the means by which they are attached to the component shall be designed for the Seismic Category they are installed in accordance with ASCE 7-05 Section 13.6.5.

1.3 REFERENCE STANDARDS

- A. Seismic anchorage and restraints shall be designed and installed in accordance with codes and standards as enforced by authorities having jurisdiction in Anchorage, Alaska. Authorities shall include Owner's insurance company.
- B. Where applicable, building standards supersede those of other evaluation or listing agencies referenced in specification.
- C. International Building Code (IBC), Chapter 16 – Structural Design.
- D. ASCE 7-05 Chapter 13.

1.4 SUBMITTALS

- A. Provide structurally engineered shop drawings for seismic restraint of all electrical equipment required by the International Building Code (IBC), Chapters 16, 17. Structural design shall be based on the Seismic Use Category and Seismic Design Category as designated in these chapters.
- B. Provide complete calculations, drawings and details.
- C. Shop drawings shall be stamped by a professional engineer registered in the State of Alaska.
- D. Submittals shall be coordinated with building Structural engineer.
- E. Submit for approval, seismic restraint calculations, drawings and details to authorities having jurisdiction as required by those authorities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and devices shall be in accordance with applicable codes and standards and shall be appropriate for intended use.
- B. Anchors and attachments to building structure shall be as approved by building Structural engineer.
- C. Seismic restraints used in conjunction with vibration isolators may consist of loose cables, telescoping pipes or box sections, angles or sections, flat plates used as limit stops or snubbers, or other types of housing used either integral with or separate from vibration isolators to accomplish necessary seismic restraint.

2.2 EQUIPMENT

- A. Equipment available with seismic rating shall be provided with rating applicable to seismic zone of project location.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure stationary equipment, raceways and equipment supports to structure, concrete bases, or special supports to provide protection against earthquakes and to restrain lateral or vertical movement. Where vibration isolators are used, seismic restraints shall be designed to limit lateral or vertical movement during earthquake without short-circuiting vibration isolation system.
- B. Coordinate seismic restraints with building Structural engineer and incorporate building Structural engineer's requirements.
- C. Seismic restraint methods and materials shall be supplementary to support devices specified in other sections of this specification and together shall serve as equipment support criteria.
- D. Installation of devices shall be in accordance with seismic Structural engineer's drawings and details and in accordance with seismic guidelines.

- E. Coordinate installation of devices with other trades and incorporate their requirements.
- F. Modify raceway and equipment locations as required for seismic restraint system.
- G. Seismic restraint systems shall not interfere with installation of other building systems or access.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Nameplates and Tape Labels.
- B. Wire and Cable Markers.
- C. Conduit Markers.

1.2 RELATED WORK

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- D. Section 26 24 16 – Panelboards.
- E. Section 26 27 26 – Wiring Devices.
- F. Section 27 10 00 – Structured Cabling.
- G. Section 28 31 00 – Fire Detection and Alarm.

1.3 SUBMITTALS

- A. General Conditions of the Contract and Section 26 05 00 – Common Work Results for Electrical.
- 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.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Prior to installation, submit power one-line diagram and panel map for review.
- E. Prior to Substantial Completion, submit copies of all panel schedules for review by the Owner. The Owner will note any changes to the room numbers/names and the Contractor shall provide revised typed panel schedules to reflect all changes, at no additional cost to the Owner.
- F. Electrical One-Line Diagrams and Panel Maps: Provide electronically in AutoCAD format, submitted with the O&M manuals.

1.4 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved white letters on black background. Nameplate for service disconnect shall be engraved white letters on red background.
- B. Letter Size:
 - 1. 1/4-inch high letters for identifying individual panel or equipment.
 - 2. 1/8-inch high letters for remaining lines with 1/8 inch spacing between lines.
- C. Minimum nameplate size: 1/8 inch thick with a consistent length and height for each type of nameplate wherever installed on the project.

2.2 TAPE LABELS

- A. Product Description: Adhesive tape labels, with 3/16 inch Bold Black letters on clear background made using Dymo RhinoPro 5000 label printer or approved equal.
- B. Embossed adhesive tape will not be permitted for any application.

2.3 WIRE MARKERS

- A. Power and Lighting Description: Machine printed heat-shrink tubing, cloth or wrap-on type, for all neutrals and Phase conductors.
- B. Low Voltage System Description: Self-adhesive machine printed label with unique wire number that is shown on shop drawing for system.
- C. Telecommunications Cable Markers: Self-laminating vinyl with translucent band and minimum 1"W x .5"H printable area with matte white finish. Brady #B-427 series or approved equal.

2.4 FIRE ALARM CONDUIT AND BOX IDENTIFICATION

- A. Product Description: Red spray paint for fire alarm boxes.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Degrease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.

3.2 NAMEPLATE INSTALLATION

- A. Secure nameplates to equipment fronts using machine screws tapped and threaded into panelboard, or using rivets. The use of adhesives is not acceptable. Machine screws to not protrude more than 1/16 inch on back side.
- B. Distribution Panel Nameplates:
 - 1. Provide overall equipment identification.
 - a. Line 1: Distribution panel name.
 - b. Line 2: Source which panelboard is fed.
 - c. Line 3: Voltage, phase and wire configuration.
 - d. Line 4: AIC rating of the panel.
 - e. Line 5: Where applicable, indicate that panel is series-rated.
 - 2. Provide circuit breaker identification for each feeder breaker.
 - a. Line 1: Name of panelboard or equipment served.
 - b. Line 2: Location of served panelboard.
- C. Branch Panelboard Nameplates:
 - 1. Provide nameplate for each panelboard with the following information:
 - a. Line 1: Panelboard name.
 - b. Line 2: Source from which the panelboard is fed.
 - c. Line 3: Voltage, phase and wire configuration.
 - d. Line 4: AIC rating of the panelboard.
- D. Disconnects, Starters, or Contactors:
 - 1. Provide nameplate for each device with the following information:
 - a. Line 1: Load served.
 - b. Line 2: Panelboard and circuit number from which the device is fed.
 - c. Line 3: Fuse or Circuit amperage and poles. Where fused disconnect is installed, denote the maximum fuse size to be installed.

3.3 LABEL INSTALLATION

- A. Conduit Feeder Labels - Provide conduit labels on all feeder raceways as follows:
 - 1. Distribution Panels – “PANEL xxxx IN ROOM #xxx”.

2. Panelboards – “PANEL xxxx FED FROM MDP xxx”.
- B. Spare Raceways: Provide raceway label on each individual raceway denoting the source and termination point at each end.
- C. Fire Alarm Device Labels: As specified in Section 28 31 00.
- D. Low-Voltage System Device Labels: Provide label on each device, denoting device ID or address where applicable. Affix label to device faceplate for ceiling-mounted devices or wall-mounted devices above 8'-0" AFF. Affix label inside backbox for exterior devices.

3.4 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identification shall be as follows:
 1. Markers shall be located within one inch of each cable end, except at panelboards, where markers for branch circuit conductors shall be visible without removing panel deadfront.
 2. Each wire and cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
 3. Color code phases, neutral, and ground per NEC requirements and Section 26 05 19.
 4. Color-code all low-voltage system wires and cables in accordance with the individual sections in which they are specified.
 5. For power and lighting circuits, identify with branch circuit or feeder number.
 6. Control Circuits: Control wire number as indicated on schematic and shop drawings.
 7. Fire Alarm Circuits: Provide cable markers showing NAC or SLC loop identification number at all fire alarm junction boxes and pullboxes.
- B. Provide pull string markers at each end of all pull strings. Marker shall identify the location of the opposite end of the pull string.

3.5 JUNCTION BOX IDENTIFICATION

- A. Fire Alarm: In accessible ceiling spaces, exposed ceiling spaces, mechanical/electrical rooms, and other non-public spaces, paint fire alarm junction boxes and pullboxes with red spray paint. In all finished spaces where fire alarm boxes are visible, they shall be painted to match the surrounding finish. If there are any questions as to whether fire alarm boxes shall be painted red in a specific area, the Contractor shall get clarification from the Owner prior to painting.
- B. Label each lighting and power junction box with the panelboard name and circuit number.
- C. Label all junction boxes for intercom, door control, CCTV, MATV, and CATV systems with the type of system cables contained in the box.
- D. For junction boxes above ceilings, mark the box cover with the circuit or system designation using permanent black marker. For junction boxes in finished areas, mark the inside of the cover with the circuit or system designation using permanent black marker.

3.6 DEVICE PLATE IDENTIFICATION

- A. Label each receptacle device plate or point of connection denoting the panelboard name and circuit number.
- B. Install adhesive label on the top of each plate.

3.7 PANELBOARD IDENTIFICATION

- A. Provide panelboard circuit directories in accordance with Section 26 24 16.
- B. Install one-line and panel map adjacent to each MDP.

3.8 LOW-VOLTAGE SYSTEM IDENTIFICATION

- A. Install all labeling in accordance with the requirements of this section and of each section where the individual systems are specified.

END OF SECTION

SECTION 26 05 73 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes short circuit and protective device coordination study encompassing all modified portions of the critical and essential electrical distribution system from up to and including service main circuit breaker(s), fuses in service main disconnect(s), breakers in service entrance switchboard, fuses in service entrance switchboard, main breaker in sub-distribution panels, fuses in sub-distribution panels and main breaker in each new or modified panelboard.

1.2 RELATED SECTIONS

- A. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 05 53 – Identification for Electrical Systems.
- C. Section 26 24 16 – Panelboards.
- D. Section 26 28 16 – Enclosed Switches and Circuit Breakers.
- E. Section 26 29 13 – Enclosed Controllers.

1.3 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.4 DESIGN REQUIREMENTS

- A. Partial Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70.
- B. Report Preparation:
 - 1. Preliminary study shall be prepared prior to ordering distribution equipment to verify equipment ratings required.
 - 2. Perform study with aid of computer software program "SKM System Analysis, Inc.," Power Tools Electrical Engineering Software or approved equal.
 - 3. Study shall be shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer.
 - 4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:

- a. Automatic transfer switch.
 - b. Engine generator.
 - c. Low-voltage switchgear.
 - d. Switchboards.
 - e. Motor controls.
 - f. Distribution panelboards.
 - g. Branch circuit panelboards.
 - h. Busway.
 - i. Each other significant equipment location throughout new or modified portions of the critical/essential power system.
- C. Report Contents:
- 1. Include the following:
 - a. One-line diagram with available fault current at each equipment.
 - b. Descriptions and scope of the study.
 - c. Tabulations of circuit breaker ratings versus calculated short circuit duties.
 - d. Time versus current coordination curves, tabulations of circuit breaker trip unit settings, fuse selection.
 - e. Fault current calculations.
 - f. Recommendations.

1.5 SUBMITTALS

- A. Division 1: Requirements for submittals.
- B. Qualifications Data: Submit the following for review prior to starting study.
 - 1. Submit qualifications of individual or individuals performing study and Professional Engineer supervising and approving the study.
- C. Software: Submit for review information on software proposed to be used in performing study.
- D. Product Data: Submit the following:
 - 1. Report: Summarize results of study in report format including the following:
 - a. Descriptions, purpose, basis, and scope of study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.

- c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
2. Submit copies of final report signed by professional engineer. Make additions or changes required by review comments.

PART 2 - PRODUCT – NOT USED

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Division 1: Field inspecting, testing, adjusting, and balancing.
- B. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.
- C. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.
- D. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This Section includes stand-alone (non-networked) automatic lighting control devices.
 - 1. Occupancy sensors.
 - 2. Occupancy sensor wall switches.
 - 3. Power Packs and Supplies.

1.2 RELATED SECTIONS

- A. Section 26 05 00 - Common Work Results for Electrical.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- D. Section 26 27 26 – Wiring Devices: Manual Light Switches.
- E. Section 26 51 00 – Interior Lighting.
- F. Section 26 52 00 – Emergency Lighting.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include installation instructions for all sensors and switches, including any detailed programming information.
- B. Fixture Compatibility: Submitted occupancy [and daylight] sensors shall have wattage ratings to match the circuits on which they are connected and shall be compatible with submitted lamps and ballasts/drivers in the fixtures which they will control.
- C. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include manufacturer's installation and troubleshooting instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all sensor and lighting control devices on the project record drawings.
- B. Operation and Maintenance Manuals: Submit manufacturer's instructions for occupancy [and daylight] sensor maintenance and adjustment.

1.5 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – OCCUPANCY SENSORS

- A. Wattstopper.
- B. Sensor Switch.
- C. Hubbell.
- D. Leviton.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.2 OCCUPANCY SENSORS

- A. Ceiling-Mounted Dual-Tech Occupancy Sensor: Dual-technology PIR and ultrasonic or microphonic sensor with white housing, self-adjusting settings, automatic dual-mode operation, built-in circadian calendar for testing, red/green LEDs for indication of PIR/ultrasonic or microphonic activity, and non-volatile memory to retain automatic and manual settings during power outages. Provide specific coverage area and either 180° or 360° coverage patterns, as required in the space to prevent unintentional tripping in adjacent spaces. Sensor shall have selectable timer settings. Sensor shall retain all manually adjusted or “learned” settings in event of a power outage.
- B. Ceiling-Mounted Ultrasonic or Microphonic Occupancy Sensor: Ultrasonic or microphonic sensor with white housing, self-adjusting settings, built-in circadian calendar for testing, green LED for indication of ultrasonic or microphonic activity, and non-volatile memory to retain automatic and manual settings during power outages. Provide specific coverage area as required in the space to prevent unintentional tripping in adjacent spaces. Sensor shall have four selectable timer settings. Sensor shall retain all manually adjusted or “learned” settings in event of a power outage. Device color shall match wall switches.
- C. Single-Relay, Dual-Tech Occupancy Sensor Wall Switch: Decora style, dual-technology, PIR and ultrasonic or microphonic sensor with self-adjusting delayed-OFF time interval, self-adjusting ambient light override, 180° adjustable field of view, manual ON/OFF pushbutton, LED indicator light to verify that detection is active, and non-volatile memory to retain automatic and manual settings during power outages. Sensor shall have selectable timer settings. Device color shall match other switches.
- D. Dual-Relay, Dual-Tech Occupancy Sensor Wall Switch: Decora style dual-technology, PIR and ultrasonic or microphonic sensor suitable for switching two separate banks of lights from a single unit. Sensor shall have self-adjusting delayed-OFF time interval, self-adjusting ambient light override, 180° adjustable field of view, two manual ON/OFF pushbuttons, LED indicator light to verify that detection is active, and non-volatile memory to retain automatic and manual settings during power outages. Sensor shall have selectable timer settings. Device color shall match other switches.
- E. Combination Wall Dimmer/Occupancy Sensor Switch for 0-10V LED Circuits: Decora-style, commercial grade preset wall dimmer switch/PIR occupancy sensor, 0-10V control for 0-10V fluorescent ballasts/LED drivers (50 mA max control current); no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim. PIR occupancy sensor with adjustable time, mode and sensitivity settings with no dip switches. Color: White. Handle: Paddle switch for on/off operation with small, discrete, captive linear slide for dimmer adjustment. Provide single pole unless otherwise indicated on Plans. Dimmer shall be fully

compatible with all loads connected for smooth operation in accordance with the manufacturer's recommendations. Lutron #Maestro or approved equal.

- F. Sensor Masking: Infrared and dual-technology sensors shall include masking segments for adjusting the coverage of the infrared sensor to avoid false-tripping. If masking is not included with sensor, it shall be provided by Contractor at no additional cost to the Owner.

2.3 POWER (RELAY) PACKS AND SUPPLIES

- A. Sensor Power Packs: Provide sensor power packs as recommended by the sensor manufacturer and as required for all connected devices and the specified sequence of operation. Note that control of fixtures with multi-level switching may require additional power packs. Power Packs shall be UL listed, plenum rated, and accept 120 or 277 VAC.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install occupancy sensor wall switches 48 inches above floor.
- B. Unless otherwise noted install wall sensor switches within 6 inches of the door jamb on the strike side, however the final layout shall be coordinated with furniture and equipment locations to avoid false OFF signals, due to obstruction of sensors.
- C. Locate power packs and similar devices in concealed, accessible areas.

3.2 SENSOR TESTING AND CALIBRATION

- A. Occupancy Sensors:
 1. Activate test setting on sensor. Walk past the room entrance and confirm that the sensor is not picking up unwanted motion from adjacent spaces such as hallways. Provide masking on infrared lens to restrict field of view if necessary and re-test.
 2. Walk into room and confirm that the sensor immediately picks up the motion and turns the lights ON.
 3. Walk around the room and confirm that the sensor is picking up small motion. Relocate sensor or add additional sensors as required to provide complete coverage throughout the space.
 4. Adjust the PIR and ultrasonic or microphonic sensitivity settings as required to avoid false tripping due to air movement.
 5. Adjust range on sensor to match room size, as a percentage of total sensor coverage. Example: For a 10' x 10' room, the maximum sensing distance in front of the sensor (40') is adjusted down to the minimum setting of 36% coverage.
 6. Confirm that the sensor is performing the lighting control sequence of operation as noted on the Plans. Make adjustments as required until the sequence is met.
 7. Put sensor back into normal mode [and document the final settings on all occupancy sensor (time delay, PIR sensitivity, occupancy logic and trigger settings, etc.) in tabular form and include in the Project Record Drawings].

3.3 LIGHTING CONTROL SEQUENCE OF OPERATIONS

- A. See Plans for lighting control sequence for each space. Provide all programming, adjustment and field changes as required to perform the specified lighting control sequence.
- B. Where no lighting control sequences are shown on the Plans, coordinate with the Owner to determine if the occupancy sensor default factory settings are suitable for their needs in each space and adjust accordingly.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to General Conditions of the Contract Section "Demonstration and Training."

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service and Distribution Panelboards.
- B. Lighting and Appliance Branch Circuit Panelboards.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Section 26 05 53 – Identification for Electrical Systems.
- D. Section 26 05 73 – Power System Studies

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers.
- B. NEMA KS 1 - Enclosed Switches.
- C. NEMA PB 1 - Panelboards.
- D. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- E. NEMA PB 2.2 - Application Guide for Ground-fault Protective Devices for Equipment.
- F. UL 50 – Enclosures for Electrical Equipment.
- G. UL 67 – Panelboards.
- H. UL 98 - Enclosed and Dead-front Switches.
- I. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.
- J. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.
- K. Federal Specification W-C-865C - Fusible Switches.

1.4 SUBMITTALS

- A. Submit data under provisions of General Conditions of the Contract and Section 26 05 00.

- B. Product Data: Submit product data for all components provided which fall under this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.
- C. Shop drawings: Submit shop drawings for each panelboard [load center] indicating features and device arrangement and size. Include outline and support point dimensions, voltage, main bus ampacity, and integrated short circuit ampere rating.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of General Conditions of the Contract.
- B. Upon arrival at the site inspect equipment and report on any damage.
- C. Handle carefully on site to avoid any damage to internal components, enclosures and finishes.
- D. Store in a clean, dry environment. Maintain factory packaging and provide an additional heavy canvas or plastic cover to protect enclosures from dirt, water, construction debris and traffic.

1.6 OPERATION AND MAINTENANCE MATERIALS

- A. Submit data under provisions of General Conditions of the Contract and Section 26 05 00.
- B. Provide product data and shop drawing information including replacement parts list.
- C. Provide installation, operation and maintenance information per manufacturer.
- D. Project record data: Submit final record panel schedules as hardcopy and in Microsoft Excel format.

1.7 WARRANTY

- A. Manufacturer shall warrant specified equipment to be free of defects for a period of one year from the date of installation.

1.8 SPARE PARTS

- A. Keys: Furnish 2 each to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

- A. Square D.
- B. Cutler Hammer.
- C. General Electric.
- D. Siemens.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.2 BREAKERS

- A. Provide new breaker listed for use in the existing GE Switchboard.
- B. Provide coordination study on the critical branch for all equipment added or modified. See Specification Section 26 05 73 - POWER SYSTEM STUDIES.

2.3 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1 or 3R as indicated on Drawings. Boxes shall be galvanized steel constructed in accordance with UL50 requirements. Interiors shall be field convertible for top or bottom incoming feed. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
- C. Cabinet Size: 6 inches deep; 20 inches wide minimum.
- D. Provide flush or surface cabinet front as indicated on the Drawings with door-in-door cover, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide one continuous bus bar per phase each. Panelboards shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. Bussing shall be fully rated.
- F. Integrated Short Circuit Rating: Provide panelboards with short circuit ratings as shown on the Drawings. Minimum ratings shall be 10,000 amperes RMS symmetrical for 250 volt panelboards; 14,000 amperes RMS symmetrical for 600 volt panelboards.
- G. Main/Sub Feed Circuit Breakers: NEMA AB 1; Provide vertical mount main and/or sub feed circuit breaker in panelboards as shown on the drawings.
 - 1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
 - 2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.
- H. Branch Circuit Breakers: NEMA AB 1; Provide panelboards with bolt-on type thermal magnetic trip circuit breakers.
 - 1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free with common trip handle for all poles.
 - 2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.
 - 3. Provide circuit breakers UL listed as Type SWD for lighting circuits.

4. Provide circuit breakers UL listed as type HACR for use with heating, air conditioning and refrigeration equipment.
5. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings.

2.4 MEDICAL ISOLATED POWER PANEL

- A. UL listed, dual voltage isolated power system with integral isolation transformers, line isolation monitor early detection system with audible and visual indicators, 120/208V, single phase bolt-on panelboard.
- B. Each panel shall supply up to 16 each 120V isolated circuits plus at least one 30A,208V isolated circuit for equipment such as a laser receptacle.
- C. Enclosure: NEMA PB 1; Type 1. Boxes shall be galvanized steel constructed in accordance with UL50 requirements. Interiors shall be field convertible for top or bottom incoming feed.
- D. Cabinet Size: 8 inches deep maximum; 34 inches wide minimum.
- E. Provide flush or surface cabinet front as indicated on the Drawings with door-in-door cover, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- F. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide one continuous bus bar per phase each. Panelboards shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. Bussing shall be fully rated.
- G. Integrated Short Circuit Rating: Provide panelboards with short circuit ratings as shown on the Drawings. Minimum ratings shall be 10,000 amperes RMS symmetrical for 250 volt panelboards; 14,000 amperes RMS symmetrical for 600 volt panelboards.
- H. Branch Circuit Breakers: NEMA AB 1; Provide panelboards with bolt-on type thermal magnetic trip circuit breakers.
 1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free with common trip handle for all poles.
 2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.

2.5 PANELBOARD IDENTIFICATION

- A. For each new panelboard and each existing panelboard where circuits are added or modified, provide typed schedule denoting each circuit load by the load type and final name and room number actually designated by the Owner. Schedule shall not be typed with names shown on the Contract Drawings unless names are acceptable to the Owner.
- B. Provide panel schedule in O&M manual for every new panelboard and every existing panelboard where circuits are added or modified.
- C. Where more than one nominal voltage system is present on the premises, the conductor color-coding legend shall be permanently posted at each branch circuit and distribution panelboard per NEC requirements.

- D. All panelboards shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment per the results of the coordination study.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.
- B. Height: 6 feet, 6 inches to top of panelboard.
- C. Provide filler plates for unused spaces in panelboards.
- D. Panel Schedules: Revise schedules to reflect circuiting changes required to balance phase loads.
- E. Stub 5 empty one inch conduits to accessible location above ceiling [below floor] out of each recessed panelboard.
- F. Provide medial isolated panelboard for all operating rooms.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall Switches.
- B. Wall Dimmers.
- C. Receptacles.
- D. Device Plates and Box Covers.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract - General Requirements and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- C. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- D. Section 26 05 33.16 – Boxes for Electrical Systems.
- E. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 – Federal Specification for Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
- B. FS W-S-896 – Federal Specification for Switches, Toggle (Toggle and Lock), Flush Mounted.
- C. NEMA WD 1 - General Color Requirements for Wiring Devices.
- D. ANSI/NEMA WD 6 – Wiring Devices – Dimensional Requirement.
- E. UL 20 – General-Use Snap Switches.
- F. UL 498 - Attachment Plugs and Receptacles.
- G. UL 943 – Ground-Fault-Circuit-Interrupters.

1.4 SUBMITTALS

- A. Product Data: Submit product data for all components provided that are specified in this section showing configurations, finishes, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all wiring devices on the project record drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - WALL SWITCHES

- A. Hubbell.
- B. Leviton.
- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.2 WALL SWITCHES

- A. Wall Switches for Lighting Circuits: UL 20; NEMA WD 1; and Federal Specification FS W-S-896 AC industrial grade snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: White [ivory] nylon. Provide single-pole, 3-way, or 4-way switches as indicated on Plans.

2.3 ACCEPTABLE MANUFACTURERS - WALL DIMMERS

- A. Lutron.
- B. Leviton.
- C. Substitutions: Under provisions of General Conditions of the Contract.

2.4 WALL DIMMERS

- A. Wall Dimmers for 0-10V Loads: UL 1472; NEMA WD 1; Decora-style, commercial grade preset wall dimmer switch, 0-10V control for LED drivers with no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim. Color: White. Handle: Paddle switch for on/off operation with small, discrete, captive linear slide for dimmer adjustment. Provide single pole unless otherwise indicated on Plans. Dimmer shall be fully compatible with all loads connected for smooth, flicker-free dimming operation.

2.5 ACCEPTABLE MANUFACTURERS - RECEPTACLES

- A. Hubbell.
- B. Leviton.
- C. Pass & Seymour.
- D. Arrow Hart
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.6 RECEPTACLES

- A. Convenience and Straight-blade Receptacles: UL 498, NEMA WD 1 and Federal Specification FS W-C-596 industrial grade receptacle. .
- B. Device color: All wiring devices and wallplates shall be red color where connected to Emergency Power, provide white where connected to normal power system.
- C. Locking-Blade Receptacles: NEMA WD 5.
- D. Convenience Receptacle Configuration: NEMA WD 1; Type 5-20R, nylon face.
- E. Specific-use Receptacle Configuration: NEMA WD 1 or WD 5; type as indicated on Drawings.
- F. GFCI Receptacles: 20A, duplex convenience receptacle with integral class 'A' ground fault current interrupter, LED indicator lamp and integral lockout.
- G. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596. Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- H. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
- I. Tamper-Resistant Receptacles: Complying with the requirements of UL 498 (section 131) and NEC 406.12-14.
- J. Weather-Resistant Receptacles: Listed to the weather-resistant supplement of UL498 and complying with the requirements of NEC 406.9.

2.7 DEVICE PLATES

- A. Decorative Cover Plate: Impact resistant thermoplastic with metal, counter sunk screws to match device plate. Provide red color where connected to Emergency Power, provide white where connected to normal power system
- B. Weatherproof Cover Plate: UL listed, cast aluminum, hinged outlet cover/enclosure, with gasket between the enclosure and the mounting surface, suitable for wet locations while in use.
- C. Exposed Work Cover Plate: ½ inch raised, square, pressed, galvanized or cadmium plated steel cover plate supporting devices independent of the outlet box.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wall switches 48 inches above floor, OFF position down.
- B. Unless otherwise noted install wall switches within 6 inches of the door jamb on the strike side.
- C. Install wall dimmers 48 inches above floor; derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- D. Install convenience receptacles 18 inches above floor, 4 inches above counters or backsplash, grounding pole on bottom. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

- E. Patient Care Areas: Install hospital grade receptacles at all patient care locations as required by NEC Article 517.
- F. Install specific-use receptacles at heights shown on Contract Drawings.
- G. Unless otherwise noted, mounting heights are for finished floor to center line of outlet.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas. Use midsize or jumbo plates for outlets installed in masonry walls, where required to cover up imperfections in the wall opening.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- J. Install devices and wall plates flush and level.
- K. Ground receptacles to boxes with a grounding wire. Grounding through the yoke or screw contact is not an acceptable alternate to the ground wire.
- L. Install circuit label on each receptacle and light switch in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Disconnect Switches.
- B. Fuses.
- C. Enclosed Circuit Breakers.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 01 40 00 – Quality Requirements.
- C. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 05 53 – Identification for Electrical Systems.
- F. Section 26 05 73 – Power System Studies

1.3 REFERENCE STANDARDS

- A. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Types.
- B. ANSI/UL 198E - Class R Fuses.
- C. ANSI/UL 98 Enclosed and Dead Front Switches.
- D. NEMA AB 1 - Molded Case Circuit Breakers
- E. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- F. NEMA FU 1 – Low Voltage Cartridge Fuses.
- G. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- H. UL 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures

1.4 SUBMITTALS

- A. Product Data: Submit product data for all components provided, showing electrical characteristics, material, and dimensions. Each catalog sheet should be clearly marked to indicate exact part number provided, including all options and accessories.

- B. Shop Drawings: Submit shop drawings include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit current interrupting rating.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Accurately indicate actual location of enclosed switches and ratings of actual installed fuses.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

1.7 EXTRA STOCK

- A. Provide extra stock under provisions of General Conditions of the Contract.
- B. Fuses: Provide one set of 3 fuses of each size and type of fuse installed.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - ENCLOSED SWITCHES

- A. Square D.
- B. Siemens.
- C. Cutler Hammer.
- D. General Electric.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.2 ENCLOSED SWITCHES

- A. Fusible Switch Assemblies: NEMA KS 1; Heavy Duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses and reject all other classes of fuse.
- B. Nonfusible Switch Assemblies: NEMA KS 1; Heavy Duty type; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1; Type 1, 3R or 4 as indicated on Drawings.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

- A. Cooper-Bussmann.
- B. Ferraz-Shawmut.
- C. Economy.
- D. Substitutions: Under provisions of General Conditions of the Contract.

2.4 FUSES

- A. Fuses 600 Amperes and Less: ANSI/UL 198E, Class RK1; RK5; dual element, current limiting, time delay, one-time fuse, 250 or 600 volt, as required per the load served.
- B. Interrupting Rating: 200,000 rms amperes.

2.5 ENCLOSED CIRCUIT BREAKERS

- A. Enclosure: NEMA PB 1; Type 1. Boxes shall be galvanized steel constructed in accordance with UL50 requirements. Interiors shall be field convertible for top or bottom incoming feed.
- B. Branch Circuit Breakers: NEMA AB 1; Provide bolt-on type thermal magnetic trip circuit breakers.
 - 1. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free with common trip handle for all poles.
 - 2. Lugs shall be UL Listed to accept copper and aluminum conductors and shall be suitable for 90°C rated wire, sized according to the 75 °C temperature rating per NEC Table 310-16. Lug body shall be bolted in place.
- C. Integrated Short Circuit Rating: Provide breakers with short circuit ratings as shown on the Drawings. Minimum ratings shall be 10,000 amperes RMS symmetrical for 250 volt equipment; 14,000 amperes RMS symmetrical for 600 volt equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed switches and circuit breakers where indicated on Drawings, and where required for NEC required disconnect of equipment specified under other divisions, but installed under Division 26.
- B. Install fuses in fusible disconnect switches.
- C. All enclosed switches and circuit breakers shall have signage for arc hazard installed. The marking shall be located to be clearly visible to qualified personnel before examination, adjustment, servicing or maintenance of the equipment. At a minimum the signage shall state the following:

Warning

Arc Flash and Shock Hazard

Appropriate PPE Required

3.2 FIELD QUALITY CONTROL

- A. Field inspecting, testing, adjusting and balancing.

- B. Inspect and test in accordance with NETA ATS, exception Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Manual Motor Starters.
- B. Magnetic Motor Starters.
- C. Combination Magnetic Motor Starters.

1.2 RELATED WORK

- A. Division 21 – Fire Suppression.
- B. Division 22 – Plumbing.
- C. Division 23 – Heating, Ventilating, and Air Conditioning (HVAC).
- D. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- F. Section 26 05 53 – Identification for Electrical Systems.
- G. Section 26 05 73 – Power System Studies

1.3 REFERENCES

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements.
- B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- C. NEMA AB 1 - Molded Case Circuit Breakers.
- D. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- E. NEMA KS 1 - Enclosed Switches.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of General Conditions of the Contract.
- B. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and overcurrent protective devices.
- C. Submit manufacturers' instructions under provisions of General Conditions of the Contract.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.

- B. Include recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - MOTOR STARTERS

- A. Square D.
- B. Allen Bradley.
- C. Siemens.
- D. Cutler Hammer.
- E. Substitutions: Under provisions of General Conditions of the Contract.

2.2 MANUAL MOTOR STARTERS

- A. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, number of poles as required by the load served, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, red pilot light, and toggle operator.
- B. Enclosure: ANSI/NEMA ICS 6; Type 1, 3R or 4. As indicated on the Drawings.

2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Full Voltage Starting: Non-reversing type.
- C. Coil Operating Voltage: 120 volts, 60 Hertz.
- D. Size: NEMA ICS 2; size as required by the load served.
- E. Overload Relay: NEMA ICS 2; solid state, with 3 to 1 adjustment for trip current and phase loss and unbalance protection
- F. Enclosure: NEMA ICS 6; Type 1 or 3R as shown on the drawings.
- G. Combination Motor Starters: Combine motor starters with non-fusible switch disconnect in common enclosure
- H. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts in addition to seal-in contact.
- I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.
- J. Indicating Lights: NEMA ICS 2; RUN: red LED light in front cover.
- K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
- L. Control Power Transformers: 120 volt secondary, VA capacity as required by the load served in each motor starter.

- M. Power Monitor: Include a three-phase power monitor in each magnetic starter connected to shut down the motor on loss of any phase, phase reversal, or low voltage on any phase. Power monitor shall automatically reset and restart motor when phase and voltage conditions return to normal. Provide oversize starter enclosures as required to install power monitor.

2.4 CONTROLLER OVERCURRENT PROTECTION AND DISCONNECTING MEANS

- A. Molded Case Thermal-Magnetic Circuit Breakers: NEMA AB 1; circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
- B. Nonfusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- D. After final connections are made, check and correct the rotation of all motors.
- E. Field adjust the trip settings of all motor starter magnetic trip only circuit breakers to approximately 11 times motor full load current. Determine full load current from motor nameplate following installation.
- F. Motor starting equipment shall be listed for use with the motors specified under Division 22 and 23.

END OF SECTION

SECTION 26 51 00 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Interior Luminaires and Accessories.
- B. Lamps.
- C. Drivers.

1.2 RELATED WORK

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Division 09 – Finishes: Painting and ceilings.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- D. Section 26 05 29 - Hangers And Supports For Electrical Systems.
- E. Section 26 05 48 - Vibration And Seismic Controls For Electrical Systems
- F. Section 26 52 00 - Emergency Lighting.

1.3 SUBMITTALS

- A. Product Data: Submit the following:
 - 1. Luminaires: Include manufacturer's product data sheets and/or shop drawings including outline drawings showing support points, weights, and accessory information for each luminaire type.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Drawings: Indicate actual locations and mounting heights of all lighting fixtures and accessories on the project record drawings.
- B. Operation and Maintenance Manuals:
 - 1. Provide recommended luminaire cleaning and re-lamping schedule. If any luminaire lenses require special lubricants for cleaning, include this in the schedule.
 - 2. Provide detailed bill of materials for all items purchased in this section including distributor's contact name, phone number and pertinent information.
 - 3. Provide luminaire manufacturer's installation instructions.
 - 4. Include any specific warranty information provided by the manufacturer for luminaires, lamps and ballasts.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect under provisions of General Conditions of the Contract.

1.6 EXTRA STOCK

- A. Provide spare parts under provisions of General Conditions of the Contract.
- B. Lenses: One of each size and type.
- C. Drivers: One of each size and type installed.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES

- A. Luminaires: Provide UL listed luminaires as scheduled on the drawings or as approved equal.
- B. Listing: Luminaires shall be listed for use in the environment in which they are installed. For example, luminaires installed in return air plenums, direct contact with insulation, or in hazardous, wet, damp, or corrosive locations shall be UL listed for such application.
 - 1. Lighting in patient care areas shall have antimicrobial finishes.
 - 2. Lighting in exam rooms shall be NSF2 Splash/Non-Food Zone rated where scheduled on plans.
 - 3. Lighting in Surgical rooms and isolation rooms shall be IP65 rated.
- C. Accessories: Provide all mounting kits, supports, interconnecting wiring, power supplies, trim kits, gaskets, etc. for a complete installation.

2.2 LAMPS – LED

- A. Light Emitting Diode (LED): 3500° K, with minimum 75CRI and a minimum rated life of 50,000 hours at 75 degrees F average indoor ambient temperature.
 - 1. All LED's shall be nominal 3500 degrees Kelvin (nominal) unless special circumstances require a different color temperature application, see Luminaire Schedule on Plans. Color temperature of lighting in patient exam and surgical areas shall be within a 3-step MacAdams Ellipse.
 - 2. Minimum CRI for indoor luminaires shall be 80, 90 in patient care areas.
 - 3. Minimum rated life (L70) shall be 50,000 hours at 75 degrees F average indoor ambient temperature.

2.3 DRIVERS - LED

- A. LED Driver: Provide UL listed power supply as recommended by the LED fixture manufacturer for operation of the specified LED lamps. Power supply shall be integral to the luminaire unless otherwise noted on the Plans. Power supply shall be dual voltage (120/277V) where available or operate at the supply voltage indicated on the Plans.
- B. LED Dimming Driver: UL listed 0-10V dimming driver as recommended by the LED fixture manufacturer for operation of the specified LED lamps, fully compatible with the dimming system or dimming switch controlling the fixture. Driver shall be integral to the fixture and capable of dimming the luminaire down to 1% output unless otherwise scheduled on the Plans.

Power supply shall be dual voltage (120/277V) where available and operate at the supply voltage indicated on the Plans.

2.4 LUMINAIRE DISCONNECT

- A. UL listed, 4A, 600V, luminaire disconnect with tin-plated brass contacts, finger-safe polycarbonate female housing, 105° C temperature rating, and two or three-pole configuration to match load served.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies
- B. Unless otherwise noted on Plans, provide drivers integral to luminaires, pre-wired and installed at the factory, suitable for use with the selected LED lamps.
- C. Support surface-mounted luminaires directly from building structure.
- D. Install recessed luminaires to permit removal from below. Use plaster frames in hard ceilings.
- E. Support luminaries in suspended ceilings from structure above in accordance with Section 26 05 29.
- F. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
- G. Provide luminaire disconnecting means in ballast channel of each fixture in accordance with NEC requirements. Where the luminaire is fed from a multi-wire branch circuit, provide multi-pole disconnect to simultaneously break all supply conductors to the ballast, including the grounded conductor.
- H. LED Power Supplies: Install power supplies to be readily accessible. Where power supplies are installed in plenum areas, provide plenum rated listing.

3.2 RELAMPING

- A. Re-lamp luminaires that have failed lamps at completion of Work.

3.3 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire finish at completion of work.

END OF SECTION

SECTION 26 52 00 - EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Emergency Lighting Units.
- B. Emergency Exit Signs.
- C. Generator Transfer Devices.

1.2 RELATED SECTIONS

- A. The Work under this section is subject to requirements of the Contract Documents including the General Conditions, Supplementary Conditions, and sections under General Conditions of the Contract General Requirements, and Section 26 05 00 – Common Work Results for Electrical.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- C. Section 26 05 33 - Raceway and Boxes for Electrical Systems.
- D. Section 26 05 48 - Vibration and Seismic Controls For Electrical Systems
- E. Section 26 05 53 – Identification for Electrical Systems.
- F. Section 26 51 00 – Interior Lighting.

1.3 REFERENCE STANDARDS

- A. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
- B. NECA/IESNA 500 – Recommended Practice for Installation Indoor Commercial Lighting System.
- C. UL 924 - Emergency Lighting and Power Equipment.

1.4 REGULATORY REQUIREMENTS

- A. Conform to State and local building code and NFPA 101 for installation requirements.
- B. Furnish emergency lighting units and exit signs that are UL 924 listed and labeled for their indicated use and location on this project.

1.5 WARRANTY

- A. Emergency Lighting Units: Submit a warranty, mutually executed by the manufacturer and the installer, agreeing to replace emergency lighting units that fail in materials or workmanship within five years, beginning on the date of manufacturer.
- B. LED Exit Signs: Submit a warranty, mutually executed by the manufacturer and the installed, agreeing to replace LED exit signs that fail in materials or workmanship within five years, beginning on the date of substantial completion.

1.6 SUBMITTALS

- A. Product Data: Submit product data under describing emergency lighting including data substantiating that materials comply with specified requirements. Arrange data for luminaires in the order of fixture designation.
- B. Provide product data on emergency lighting units, exit signs, emergency ballasts, emergency lighting inverters and emergency fluorescent lamp power supply units.
- C. Performance Curves/Data: Submit certified photometric data for emergency lighting units.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manuals: Submit maintenance instructions for inclusion in the operating and maintenance manuals.

PART 2 - PRODUCTS

2.1 EMERGENCY LIGHTING UNITS

- A. Provide emergency lighting units as scheduled on the Plans or approved equal.

2.2 EXIT SIGNS

- A. Provide exit signs as scheduled on the Plans or approved equal.

2.3 ACCEPTABLE MANUFACTURERS - GENERATOR TRANSFER DEVICES

- A. Bodine.
- B. IOTA.
- C. Substitutions: Under provisions of General Conditions of the Contract.

2.4 GENERATOR TRANSFER DEVICES

- A. Single Fixture Unit: U.L. listed, relay controlled local control bypass device. The device shall turn on emergency egress lighting fixtures, regardless of the position of local controls, upon the loss of normal power. The equipment shall be housed in an enclosure UL listed for use inside, on top, or remote from the light fixture. Units shall be capable of operation on 120V or 277V, and have individual over current protection up to 3 amperes.
- B. Multiple Fixture Unit: U.L. listed, relay controlled local control bypass device. The device shall turn on emergency egress lighting fixtures, regardless of the position of local controls, upon the loss of normal power. The equipment shall be housed in an enclosure UL listed for installation for indoor damp locations, and shall be rated for any type of lighting load up to 20 amperes at 120V or 277V.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units plumb and level.
- B. Aim directional lampheads to illuminate the path of egress.

3.2 FIELD QUALITY CONTROL

- A. Tests: Perform tests listed below according to manufacturer's written instructions. Test unit functions, operations, and protective features. Adjust to ensure operation complies with Specifications. Perform tests required by NFPA 70, Articles 700 and 701. Perform tests on completion of unit installation and after building circuits have been energized. Provide instruments to permit accurate observation of tests. Include the following tests:
1. Simulate power outage: Verify proper operation of each individual emergency power supply.
 2. Verify emergency supply duration.
 3. Verify operation of remote test switches.
 4. Provide reports for load test conducted on individual batteries.
- B. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.3 ADJUSTING

- A. Aim lamp on wall-mounted emergency lighting units to obtain the following illumination of egress pathway:
1. An average of 1 foot-candle.
 2. A minimum at any point of 0.1 foot-candle measured along the path of egress at floor level.
 3. Maximum-to-minimum illumination uniformity ratio of 40 to 1 shall not be exceeded.
- B. Test emergency lighting equipment in accordance with the manufacturer's instructions and NECA/IESNA 500.

3.4 CLEANING

- A. On completion of installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and abrasions in finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.5 DEMONSTRATION

- A. Walk owner's representative through the emergency lighting system. Note how to maintain, test and troubleshoot all units. Provide maintenance schedule for NFPA required testing and note locations of remote test switches, and which units have self-diagnostic features.

END OF SECTION

SECTION 27 05 29 - PATHWAYS FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. J-Hooks.
- B. Fire-rated Cable Pathway Device.

1.2 RELATED SECTIONS

- A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 27 10 00 – Structured Cabling.

1.3 REFERENCES

- A. NEMA VE 1 - Cable Tray Systems.
- B. National Electric Code (NFPA 70) Article 250 - Grounding.
- C. National Electric Code (NFPA 70) Article 800 - Communications Circuits.
- D. ANSI/TIA/EIA-568-B -- Commercial Building Telecommunications Cabling Standards.
- E. BICSI Telecommunications Distribution Methods Manual - Latest published edition.
- F. UL Standards - UL 94HB, UL 723, and UL 2043.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of General Conditions of the Contract.
- B. Indicate tray type, dimensions, support points, and finishes.
- C. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of General Conditions of the Contract.
- B. Include cleaning and bolt-tightening procedures for cable tray.

1.6 PROJECT RECORD DRAWINGS

- A. Record actual routing of cable tray on "As-built" drawings required in Section 27 10 00.

PART 2 - PRODUCTS

2.1 J-HOOKS

- A. All cables not installed in conduit shall be supported using Caddy CableCat series or approved equal J-hooks with galvanized finish. J-hooks shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces. The minimum J-hook size shall be equivalent to Caddy #Cat32. Size all J-hooks to support the quantity of cables installed, plus a minimum of 25% spare capacity. Fiber optic cables shall be routed in 1" innerduct that is supported on a separate J-hook above the J-hook supporting the copper cables.

2.2 FIRE-RATED CABLE PATHWAY DEVICE

- A. UL Classified enclosed fire-rated pathway device with built-in fire sealing system sufficient to maintain the hourly fire rating of the barrier being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed or removed without the need to adjust, remove, or reinstall firestop or smoke sealing materials. Device shall maintain up to a 4-hour fire rating when used in walls or floors. Provide all associated brackets and fittings for a complete installation. For ganged pathways in gypsum wallboard assemblies, provide either a grid system designed to transfer the pathway load to the studs or a UL System permitting more than one device to be ganged or clustered. Device dimensions shall be 3" x 3" and shall fit through a 4" diameter round hole. STI "EZ-PATH Series 33 system or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- A. Provide continuous pathway system for all low voltage cable systems. Where multiple cable systems (e.g. telecom, security, intercom) are installed along the same J-hook pathway, provide separate J-hooks for each system. J-hooks may utilize the same vertical support.
- B. Coordinate all pathway runs with other trades prior to installation. Report conflicts to Owner.
- C. Maintain a minimum EMI separation clearance in conformance with Section 27 10 00.
- D. Support pathway from building to support structure or sub structure in accordance with Section 26 05 29. Do not support pathway from ceiling tiles, ceiling grid, hanger wires, ductwork, piping, or other equipment hangers that are not part of the cable pathway support system.
- E. In areas with accessible ceilings where cable is not installed in cable tray, provide J-hooks spaced every 4 to 5 feet, varying the distance between each support.
- F. Provide a minimum of 12 inches headroom above all types of cable supports.
- G. Provide a minimum of 3 inches clear vertical space above ceiling system at cable lowest point.
- H. Provide cable support within 18 inches of each transition of pathway system types. This includes transitioning from any one to any other of the following cable support systems such as raceway, sleeves, chases, cable trays, cable runways, or J-hooks.
- I. Set J-hooks so that changes in direction do not exceed 45 degrees.

- J. Install firestopping in accordance with Division 07 to sustain ratings when passing cable tray through fire-rated elements.

END OF SECTION

SECTION 27 10 00 – STRUCTURED CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for the design and installation of a complete and functional telecommunications cabling system including communications cable, equipment racks, patch panels, telecommunications jacks, raceways, and other equipment or components as required to achieve the specified function.

1.2 RELATED SECTIONS

- A. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- B. Section 26 05 29 – Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 – Identification for Electrical Systems.
- D. Section 27 05 29 – Hangers and Supports for Communication Systems

1.3 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of General Conditions of the Contract.
- B. Accurately record location of jacks, pull boxes and equipment racks, routing of all telecommunications raceways and cables, numbering scheme and identification number of all cables and jacks.
- C. Submit test results for all cables prior to Substantial Completion.

1.4 LISTINGS AND STANDARDS

- A. Furnish products listed and classified by Underwriters Laboratories, Inc. and suitable for purpose specified and indicated.
- B. Where a UL Standard is in effect equipment shall meet that standard and shall bear the UL label.

1.5 REFERENCE CODES AND STANDARDS

- A. The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only. The reference codes and standards are minimum requirements:
 - 1. ANSI/NFPA 70 National Electrical Code, latest adopted version.
 - 2. BICSI Telecommunications Distributions Methods Manual, current version.
 - 3. TIA/EIA 568-C Commercial Building Telecommunications Cable Standard, current version.
 - 4. TIA/EIA 569-C Commercial Building Standard for Telecommunications Pathways and Spaces, current version.

5. TIA/EIA 606-A Administration Standards for the Telecommunications Infrastructure of Commercial Buildings, current version.
6. J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications, current version.

1.6 QUALITY ASSURANCE

- A. Install all work in accordance with the above reference standards and codes. The Owner reserves the right to reject all or a portion of the work performed either on technical or aesthetic grounds.
- B. All workmen employed for installation of equipment and cabling specified under this section shall be specifically trained and certified in the installation of the specified Category 6 cabling systems, and shall have at least three years' experience installing, terminating, and testing Category 6 UTP on this size and complexity of project.
- C. The intended function of the telecommunications cable system is to transmit voice and data signals from a central location to individual telecommunications outlet locations. Upon completion of the work, the UTP cable system shall be capable of transmitting a data signal that meets and exceeds the following requirements:
 1. Category 6: Supports data rates up to and including 1 Gb/s.

1.7 SUBMITTALS

- A. Submit product data under provisions of General Conditions of the Contract. Provide factory test results for cables and connectors. Provide product data for the following products:
 1. Telecommunications rack and associated rack hardware.
 2. UTP Telecommunications Cable.
 3. UTP Telecommunications Jacks and Faceplates.
 4. UTP Modular Patch Panel.
 5. UTP Patch Cables.
 6. Cable Management Panels.
 7. UTP Telecommunications Cable Tester.
 8. UTP Sample Test Report (with all required testing parameters shown).
- B. Submit qualifications and certifications to install the specified cabling system.

1.8 LABELING SYSTEM

- A. Labeling shall conform to ANSI/TIA/EIA-606 standards, Section 26 05 53, and this Section.
- B. Telecommunications Outlets:
 1. Labels on all outlets shall have minimum 1/8-in. high characters and shall be installed behind recessed clear plastic covers on faceplate.

2. Label room outlets with two labels on the faceplate as follows:
 - a. Top Label: Shows the telecommunication room the cable is run to (TR1, TR2, etc), followed by rack number (1, 2, etc.) followed by patch panel identification expressed as a letter (A), followed by port in patch panel the outlet is located (xx). Example: TR1-2B:38 (where TR1 indicates closet, 2 is the second rack, B is the second patch panel in the rack, 38 is the port in patch panel).
 - b. Bottom Label: Shows the room number (room 103), followed by the jack/outlet number (J2) from the left when entering the room, followed by the quantity of ports within the outlet faceplate (1-6). Example: 103 J2:1 (where 103 is the room number, J2 is the 2nd jack/outlet from the left in the room, and 1 is the single port in the faceplate). Where the faceplate has multiple ports, the last part of the ID shall indicate the quantity. Example: 103 J2:1-4 (where 103 is the room number, J2 is the 2nd jack/outlet from the left in the room, and 1-4 represents the four ports in the faceplate).
- C. Copper Patch Panels:
 1. Label each patch panel with each unique patch panel name, expressed as a letter. Example: A for 1st patch panel, B for 2nd, C for third, etc.
 2. Label each port on the patch panels with a 1-line identifier as follows:
 - a. Show the room number (room 103), followed by the jack/outlet number (J2) from the left when entering the room, followed by the port number within the outlet faceplate (1-6). Example: 103 J2:3 (where 103 is the room number, J2 is the 2nd jack/outlet from the left in the room, and 3 is the 3rd port in the faceplate).
- D. Telecommunications Closet:
 1. Label cable with wire number to denote the station outlet with appended cable number at each end. Cable ID tags shall be attached within 2 inches of cable end so that ID tag is visible within box.
 2. Provide an updated floor plan and list of telecommunication outlets cross-referenced to the rack, patch panel and port. Mount behind Plexiglas cover as specified in Section 26 05 53.
- E. Copper Horizontal Cable:
 1. Label the end of each cable with the same designation used on the equipment where the cable is terminated (i.e. the patch panel or telecommunications outlet). Labels shall be installed within one inch of the end of the cable insulation, after the insulation has been cut back to allow for termination.
- F. Provide computer-generated Project Record Drawing drawings showing outlet locations, type, and designation. Turn these drawings over to the Owner's Representative two (2) weeks prior to substantial completion, to allow the Owner's Personnel to connect and test Owner-provided equipment in a timely fashion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – STRUCTURED CABLING SYSTEM

- A. Throughout this specification, specific manufacturers and manufacturer's catalog numbers are cited. These citations are for the purpose of establishing quality and performance criteria and are not intended to be proprietary. All products in the structured cabling system shall be provided from one of the approved manufacturing partnerships listed below, or an alternate system shall be substituted under the provisions of General Conditions of the Contract.
1. Belden.
 2. Ortronics/Superior Essex.
 3. CommScope Uniprise.
 4. Hubbell/Mohawk.
 5. Leviton/Berk-Tek.
 6. TE Connectivity (formerly ADC/Krone/Amp).
 7. Substitutions: Under provisions of General Conditions of the Contract.
- B. Structured Category 6 cabling systems shall include, but not be limited to, UTP telecommunications cable, UTP jacks, faceplates, modular patch panels, and UTP patch cables.

2.2 UTP TELECOMMUNICATIONS CABLE

- A. All UTP telecommunications cables that stay within the building envelope shall be UL listed, plenum-rated CL2P, Category 6, 4 pair, 23-24 AWG, solid copper conductor.
1. Superior Essex "DataGAIN" CMP or approved equal.
- B. All UTP telecommunications cables that exit the building envelope or are run in underslab raceway shall be UL listed, outside plant rated, Category 6, 4 pair, 23-24 AWG, solid copper conductor cable, injected with water-resistant flooding compound and jacketed with UV-resistant polyethylene jacket.
1. Superior Essex "OSP Cat 6" or approved equal.

2.3 UTP TELECOMMUNICATIONS JACKS

- A. All UTP telecommunications jacks shall be Category 6, T568A/B, 8P8C, single, white finish, telecommunications jack with flush exit. Unless otherwise noted on the drawings, install each telecommunications jack in a single gang faceplate at each telecommunications outlet. The quantity of faceplate openings shall match the quantity of jacks at each location. The Contractor shall verify the actual wiring configuration (T568A or 568B) with the Owner prior to submittal.
- B. UTP Jacks:
1. Ortronics "TracJack Clarity 6" #OR-TJ600 or approved equal.

2.4 TELECOMMUNICATIONS OUTLET FACEPLATES

- A. Unless otherwise noted, all faceplates shall be single-gang plastic faceplates with white finish. The number of openings in each faceplate shall match the jack count of each outlet shown on the Drawings. (x in part numbers = designation for number of openings in faceplate).
1. Ortronics "TracJack" #OR-4030054x or approved equal.

2.5 UTP MODULAR PATCH PANEL

- A. Provide and install high-density Category 6, modular patch panels in existing equipment rack as required to terminate all new telecom outlets provided. The front of the patch panels shall be equipped with T568A/B, 8P8C Category 6 compliant jacks. The jacks shall be factory wired to a 110 type IDC connector. The complete assembly shall exceed the requirements of TIA/EIA 568-B (Category 6), and be factory tested to 1000 Mbps data rates. Install the number of patch panels in each equipment rack as shown on the drawings or as required to terminate all UTP cables at the rack plus 25% spare capacity. The Contractor shall verify the actual wiring configuration (T568A or 568B) with the Owner prior to submittal.
1. 24-port Panel: Ortronics "Clarity6" #OR-PHD66U24 or approved equal.
 2. 48-port Panel: Ortronics "Clarity6" #OR-PHD66U48 or approved equal.

2.6 UTP PATCH CABLES

- A. All patch cables shall be factory manufactured to match the applicable cable/connectivity solution (i.e. the Ortronics/Superior Essex system shall use Ortronics manufactured patch cords, etc.).
- B. Telephone Cross-Connect: Provide 7-foot Category 6 patch cables with white jacket for cross-connect between the telephone patch panel and the telecommunications patch panels. Provide one patch cable for each port in all the telephone patch panels.
1. Ortronics #OR-MC607-09 or approved equal.
- C. Network Equipment Connections: Provide Category 6 patch cables with blue jacket for installation between network equipment in the rack and dedicated data ports in the telecommunications patch panels. Provide one patch cable for each port in all the telecommunications patch panels. Where the patch panels and switches are in the same rack, provide 7' cables. Where the patch panels and switches are in different racks, provide 15' (14' for CommScope) cables. (xx in part numbers = cable length).
1. Ortronics #OR-MC6xx-06 or approved equal.
- D. Computer Connections: Provide 9-foot Category 6 patch cable with white jacket for installation between the data jacks in each telecommunications outlet and the Owner-provided computers. Provide one patch cable for each data jack in all the telecommunications outlets, plus 25% additional cables for future expansion or replacement cables.
1. Ortronics #OR-MC609-09 or approved equal.

2.7 CABLE SUPPORT

- A. All cables not installed in conduit shall be supported in accordance with Section 27 05 28.

- B. Cables shall be bundled using Velcro "One-Wrap" or approved equal reusable straps with a minimum $\frac{3}{4}$ inch width. Plastic tie-wraps or cinch-straps are not allowed.

2.8 EXTRA MATERIALS

- A. Furnish to the owner the following spares parts:
 - 1. One of each type of UTP telecommunications jack.
 - 2. One of each type of telecommunications faceplate.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 GENERAL INSTALLATION

- A. Follow cable manufacturer's specification regarding handling methods, retaining/support methods, bending radius and maximum pulling tension limitations. Where manufacturer does not provide bending radius information, minimum bending radius shall be 10 times the diameter of the cable. 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. 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.
- D. Install new patch panel in existing equipment rack.
- E. Store a maximum of one foot of slack UTP cable for each UTP jack at each telecommunications outlet.
- F. In the telecommunications closet, ten feet of slack UTP cable shall be provided at the racks. Route the service loop around the cable runway above the racks. No cables shall encroach or interfere with rack equipment space. All cables shall be protected from physical damage and should not be routed on the floor. Coiling the slack cable adjacent to the rack is not acceptable. The intent of this installation method is to provide slack cable for future work without causing increased inductance by coiling the cables.
- G. All cabling shall be run continuous with no splices from each telecommunications jack to the cable connector at the patch panels. Telecommunications cables shall be terminated at each end on their respective jack. No cable run shall exceed 90 meters (295 feet) in length from the jack on the peripheral end to the patch panel.
- H. All cable shall be routed in such a way as to minimize EMI and RFI interference. Cables shall be routed to maintain the following minimum distances from noise producing devices:

1. Open or Nonmetallic Communications Pathways:
 - a. 12 inches from electrical equipment and power lines of 3 kVA or less.
 - b. 18 inches from fluorescent and HID ballasts.
 - c. 36 from electrical equipment and power lines greater than 5 kVA.
 - d. 48 inches from transformers and motors.
2. Grounded Metal Conduit Communications Pathways:
 - a. 3 inches from electrical equipment and power lines of 2 kVA or less.
 - b. 6 inches from electrical equipment and power lines of 2 kVA to 5 kVA.
 - c. 12 inches from 5 kVA or greater power lines.

3.3 TERMINATIONS

- A. The jacket of UTP cables shall be maintained to a point within one inch of the telecommunications jack. The twists on the individual pairs shall be maintained as close as possible to the contacts of the termination points but shall in no case exceed 1/2 inch.
- B. Pairs from each cable shall be terminated sequentially from left to right, top to bottom starting with the lowest assigned number at the upper left-hand corner of the panel.

3.4 PATHWAYS AND RACEWAYS

- A. Unless otherwise noted, all cables shall be installed in conduit from the telecommunications jack to the space above the accessible ceiling, within 18" of the J-hook or cable tray pathway. Portions of cables not installed in conduit shall be supported in accordance with TIA/EIA standards at intervals not exceeding four (4) feet in length using J-hooks. The cable shall not be supported from ducts, pipes, conduits, ceiling grid hangar wires, etc. At any point where the cable changes direction, slack shall be provided to prevent rubbing or binding on the corner supports. Extreme care shall be taken to ensure that the cable is not compressed, kinked or otherwise deformed during installation. Any cable that is stretched, compressed, kinked or otherwise deformed shall be replaced at no cost to the Owner.
- B. Cables to be installed in raceway, cable tray, continuous cable support system or J-hooks (as specified above) for the entire length of each cable. Provide raceway through areas that will not be accessible for future cable replacement or additions.
- C. Provide pathway capacity throughout entire system for each telecommunication outlet served, sized to accommodate a minimum of four 4-pair cables from each outlet location to the designated telecommunication room, as shown on the plans.
- D. Telecommunication cables shall not be installed in the same raceway or pathway as power cables.
- E. Install polyethylene pulling string in each empty conduit containing a bend or over 10 feet in length.
- F. Install all telecommunications outlets in outlet boxes under the provisions of Section 26 05 33. Unless otherwise noted on the Drawings or in the Specifications, outlets shall be mounted at 18

inches above floor, 4 inches above counters or backsplash, with the jacks oriented in the standard "pins down" position.

- G. Support raceways, outlet boxes, junction boxes and equipment racks under the provisions of Section 26 05 29.

3.5 LABELING

- A. Furnish and install labels and documentation to identify all cables, jacks, and connections in accordance with TIA/EIA standards, as shown on the Drawings, and under the provisions of Section 26 05 53. As a minimum each jack in each faceplate shall have a unique identifier that matches the identifier at the patch panel. Identifiers shall be installed on the front of the telecommunications faceplate, on the cable behind the faceplate, and on the front of the patch panel at the associated jack.

3.6 CABLE ACCEPTANCE TESTING

- A. Each UTP cable shall be tested for compliance with TIA/EIA 568C Category 6 standards after installation using a Fluke #DTX or approved equal tester that has been calibrated within the last 30 days. At a minimum, the Contractor shall perform the following tests with the maximum frequency of the tester set at 350MHz:
 - 1. Signal Attenuation / Insertion Loss.
 - 2. Near End Cross Talk (NEXT).
 - 3. Power Sum Near End Cross Talk (PS-NEXT).
 - 4. Equal Level Far End Cross Talk (ELFEXT).
 - 5. Power Sum Equal Level Far End Cross Talk (PS-ELFEXT).
 - 6. Attenuation to Crosstalk Ratio (ACR).
 - 7. Power Sum Attenuation to Crosstalk Ratio – Near End (PSACR-N).
 - 8. Power Sum Attenuation to Crosstalk Ratio – Far End (PSACR-F).
 - 9. Propagation Delay.
 - 10. Delay Skew.
 - 11. Return Loss.
 - 12. Wiremap.
 - 13. Overall Cable Length.
- B. Test, analyze, and record compliance for the following network protocols:
 - 1. 10 Base-T.
 - 2. 100 Base-T.
 - 3. 1000 Base-T (1 Gb/s).

4. 10 Gb/s (fiber).
- C. The Contractor shall provide 100% testing for each “permanent link” (i.e. from the work area outlet to the patch panel). Provide test results for all tests noted above in the form of printouts from the test equipment and provide an electronic copy of the test data for each cable on CD. If proprietary software is used, the submitted CD shall include any necessary software required to view test results. If the results are delivered in a standard format such as Excel or Access, the viewing software need not be provided. At the front of the test report, the Contractor shall provide an index showing the pass/fail results of each cable, along with the cable length and a corresponding cable label.
 - D. Where any portion of the system does not meet the Specifications, the Contractor shall correct the deviation and repeat any applicable testing at no additional cost to the Owner.
 - E. Submit a copy of the test report for each cable prior to substantial completion of the project.
 - F. Acceptance of the telecommunications system shall be based on the results of the above tests, functionality, and the receipt of documentation.

END OF SECTION

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Contractor designed and installed extension to the existing addressable fire alarm and smoke detection system. This is a performance type specification describing the minimum acceptable fire alarm system. The Contractor shall design and install the fire alarm and smoke detection system in accordance with the requirements of NFPA 72 and ICC/ANSI A117.1. The fire alarm devices on the drawings are shown in suggested locations. The final locations of all devices shall be solely determined by the Contractor and shall be in accordance with NFPA 72 and ICC/ANSI A117.1.

1.2 RELATED SECTIONS

- A. Division 08 - Door Hardware: Door Closers.
- B. Division 21 - Sprinkler System.
- C. Division 25 – Mechanical: Fire/Smoke Dampers.
- D. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
- E. Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- F. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCES

- A. NFPA 72 - National Fire Alarm Code.
- B. NFPA 101 - Life Safety Code.
- C. International Mechanical Code (IMC).
- D. Americans with Disabilities Act (ADA) and ADA Guidelines for Buildings and Facilities (ICC/ANSI A117.1).
- E. ANSI S3.41 - Audible Emergency Evacuation Signals.

1.4 REGULATORY REQUIREMENTS

- A. System: UL and FM listed.
- B. Conform to the requirements of UL 864.
- C. Conform to requirements of NFPA 101.
- D. Conform to requirements of ICC/ANSI A117.1.
- E. Install system in accordance with NFPA 72.

1.5 SYSTEM DESCRIPTION

- A. Fire Alarm System: Contractor designed and installed, microprocessor controlled manual and automatic fire alarm system with individually addressable initiating devices. The Contractor shall design and install the fire alarm and smoke detection system in accordance with the requirements of these specifications, NFPA 72, NFPA 101, ANSI A17.1, and ICC/ANSI A117.1. The fire alarm devices on the drawings are shown in suggested locations. The Contractor shall modify these device locations as necessary to accommodate actual architectural, structural, or mechanical conditions, at no cost to the Owner.
- B. System Supervision: Provide electrically-supervised class B, addressable fire alarm system with fault tolerant supervised signaling line circuits and notification appliance circuits. Occurrence of single ground or open condition in signaling line circuit or notification appliance circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.
- C. Alarm Sequence of Operation: New devices shall match existing sequence.
- D. Addressable control relays connected to the system shall be continuously monitored for proper state and position of contacts. Incorrect positions shall be automatically corrected by command from the control panel. If control relay fails to respond to the corrective command; the trouble signal shall sound, and the panel shall identify and permanently record the location of the fault. The control panel shall also monitor addressable control relays for proper state (position) after the system has commanded the relay to operate. Failure of the control relay to operate (change state) shall cause the panel to generate a trouble signal, identify and permanently record the location of the fault.

1.6 QUALIFICATIONS

- A. The installation of the system shall conform to the State of Alaska requirements and be supervised by a representative with a current State Fire Alarm License.
- B. Manufacturer: Company specializing in addressable smoke detection and fire alarm systems with five years documented experience.
- C. System Supplier: Factory trained to provide the submitted fire alarm system.
- D. Installer: Installation of the system shall be 100% field checked by a factory trained and authorized NICET Level III technician certified in the Fire Alarm System Program. The actual supervising technician must be approved prior to start of work.

1.7 SUBMITTALS

- A. Submit product data under the provisions of General Conditions of the Contract.
- B. Submit manufacturer's installation instructions.
- C. Submit shop drawings prepared and signed by a NICET Level III technician certified in fire alarm systems under the provisions of General Conditions of the Contract. Shop drawings shall have the following requirements:
 - 1. The Shop Drawings shall be reproduced electronically from a Master Copy supplied in digital format. Electronic copy of the Contract Drawings will be available at no charge to use as base plan for generation of electronic submittal. Shop Drawings shall be printed

at Contract Drawing size and scale of floor plans on Shop Drawings shall match Contract Drawings.

2. All text on the drawings shall be legible without magnification when the shop drawings are reduced to 11" x 17".
 3. Provide minimum 1/8" scale floor plans with all new fire alarm control and auxiliary panels, field devices, raceway and conductor routing, quantities and connection requirements for every component.
 4. Provide point-to-point system wiring diagrams showing interconnection of all devices.
 5. Provide a riser diagram showing all new devices on each NAC, SLC, and auxiliary circuit connected to the fire alarm control panel. Individual device addresses on riser diagram are not required for initial shop drawing submittal but shall be provided on the as-built drawings.
 6. Provide calculations to support battery size selection. Provide voltage drop calculations for each SLC and NAC circuit modified. Show the voltage drop at the furthest notification appliance added from the control panel. Show all formulas and acceptable limits for all calculations. All calculations shall be shown on the shop drawings.
- D. Submit shop drawings and product data to the State Fire Marshal for review and approval. All shop drawings and product data shall be reviewed and approved by the authority having jurisdiction prior to procurement and installation of materials or devices for the system.
- E. Device Names: All new device names that are displayed on the LCD text annunciators in the fire alarm panel and remote text annunciator panels shall be approved by the Owner. The Contractor shall request a list of approved room names for the facility prior to programming the fire alarm panel or any field devices.

1.8 PROJECT RECORD DRAWINGS

- A. Submit documents under the provisions of General Conditions of the Contract.
- B. Accurately indicate actual locations of notification appliances, initiating devices, fire alarm control panel, annunciators, etc.
- C. Provide Point to Point as-built wiring diagrams of the entire Life Safety System as installed. This shall include all connected devices with actual addresses and locations of all T-taps. All drawings shall be provided in AutoCAD .DWG format. Paper plots of each sheet shall also be provided.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site, store and protect, under provisions of General Conditions of the Contract.

1.10 WARRANTY

- A. The Contractor shall be able to provide initial contact on warranty service and/or service contract requests from their principal location within eight (8) hours of notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Edwards Systems Technology (EST).
- B. Substitutions: Under provisions of General Conditions of the Contract.

2.2 FIRE ALARM AND SMOKE DETECTION CONTROL PANEL

- A. Existing fire alarm panel is an EST #Quickstart addressable fire alarm panel. There is also an older Edwards 6500 system that serves the older devices that haven't been migrated over to the newer panel. All new devices shall be added to the EST Quickstart panel.

2.3 INITIATING DEVICES

- A. Ceiling Mounted Smoke Detector: Addressable, NFPA 72, photoelectric type [ionization type] with adjustable sensitivity, plug-in base, and visual indication of detector actuation, suitable for mounting on 4-inch outlet box. Suitable for operation on existing control panel power supply and signaling line circuit.
- B. Duct Mounted Smoke Detector: Addressable, NFPA 72, photoelectric type with auxiliary SPDT relay contact, duct sampling tubes extending the width of duct, and visual indication of detector activation, in duct-mounted housing. Provide with remote visual indicator, test, and reset station. Suitable for operation on existing control panel power supply and signaling line circuit.

2.4 INTELLIGENT MODULES

- A. A control relay/transponder shall be installed where building services (i.e. fan shutdown, door holder or release, etc.) are to be automatically controlled by the fire alarm system during a fire emergency. The control relay shall be of a type that only consumes power momentarily while transferring from the deenergized to the energized state or back again. The command to change state shall come from the control panel in accordance with the system program. The control relay shall be condition (deenergized or energized) supervised, and its condition shall be confirmed and corrected, if necessary, during each polling cycle. The control relay/transponder shall be capable of operating on the same communication channel with initiating devices/transponders so that it can be located within 3 feet of the building service device it is controlling as required by NFPA 101-Life Safety Code while its integrity is being monitored from the control panel. The address code of the control relay transponder shall be field selectable and changeable in the same manner as for other transponders. The control relay/ transponder type code shall be factory preset and not be field changeable.

2.5 NOTIFICATION APPLIANCES

- A. All appliances shall be U.L. Listed for Fire Protective Service.
- B. All appliances shall be of the same manufacturer as the existing Fire Alarm Control Panel specified to assure absolute compatibility between the appliances and the control panels, and to assure that the application of the appliances is done in accordance with the single manufacturer's instructions.
- C. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.

- D. Fire Alarm Strobe Lights: NFPA 72 compliant, flush wall-mounted, self-synchronizing, xenon, fire alarm strobe lamp and flasher with flashrate of one flash per second, complying with the requirements of ICC/ANSI A117.1. Provide red lettered FIRE on clear lens. The strobe shall be field-selectable to provide 15, 30 75, or 110 candela synchronized flash outputs. The settings of all strobes shall be determined by the Contractor during the shop drawing process.
- E. Fire Alarm Horn: ANSI S3.41 and NFPA 72 compliant, flush [surface] mounted fire alarm horn with adjustable sound output level. Sound Rating: 87 dBA (reverberant) at 10 feet on the "high" setting and 82 dBA (reverberant) at 10 feet on the "low" setting. Provide minimum sound pressure level of 15 dBA above the average ambient sound level in every occupied space within the building. Provide integral fire alarm strobe light as specified above where indicated on the drawings.
- F. Fire Alarm Chime and Strobe: ANSI S3.41 and NFPA 72 compliant, flush [surface] mounted fire alarm chime with adjustable sound output level. Sound Rating: 70 dBA (reverberant) at 10 feet on the maximum volume setting and 64 dBA (reverberant) at 10 feet on the minimum volume setting. Provide minimum sound pressure level of 15 dBA above the average ambient sound level in areas where mini-horns are used. Provide integral fire alarm strobe light as specified above.
- G. [Notification appliances shall be listed for use on the existing fire alarm control panel power supply.

2.6 AUXILIARY DEVICES

- A. NAC Booster Power Supplies:
 - 1. Existing Power Supplies: New notification appliances may be connected to existing booster power supplies if the unit and batteries have sufficient capacity.
 - 2. Power supply quantity, rating and battery size shall be determined by the Contractor. All locations of new power supplies shall be approved by the Owner prior to shop drawing submittal. Provide one or more dedicated circuits for all new power supplies. Each circuit shall have a handle lock on the breaker.
 - 3. Smoke Detection: Provide a smoke detector to protect each NAC booster power supply in accordance with NFPA 72 requirements. Note that because the quantity and locations of NAC boosters are determined by the Contractor, these smoke detectors are not shown on the Contract Drawings but they shall be provided at no additional cost to the Owner.

2.7 FIRE ALARM WIRE AND CABLE

- A. Fire Alarm System Power Branch Circuits: Building wire as specified in Section 26 05 19.
- B. Notification Appliance Circuits: Minimum #12 AWG copper building wire, as specified in Section 26 05 19.
- C. Initiating and Signaling Line Circuits: Twisted, shielded or unshielded fire alarm cable as recommended by the fire alarm system manufacturer. Minimum size #16 AWG.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the fire alarm system in accordance with the manufacturer's instructions.

- B. Install manual station with operating handle not less than 42 inches and not more than 48 inches above finished floor. Install audible notification appliances with top of device not less than 90 inches above finished floor, and not less than 6 inches below finished ceiling. Install visual notification appliances such that the entire lens is not less than 80 inches and not greater than 96 inches above finished floor.
- C. Install all smoke detectors a minimum of three feet from any air supply, return, or exhaust diffuser and a minimum of one foot from any light fixture.
- D. Install all fire alarm system wiring in a dedicated fire alarm MC cable or conduit system separate from any other system wiring. Provide minimum 8 inch wire tails at each device box and 50 inch wire tails at the fire alarm control panel.
- E. The Contractor is responsible to field coordinate the final location of all initiating devices and notification appliances to comply with the requirements of NFPA 72. Any initiating devices or notification appliances that are not installed in accordance with NFPA 72 shall be relocated to comply with the requirements of NFPA 72 at no cost to the Owner.
- F. Detectors shall not be installed until after the construction cleanup of all trades is complete and final. Protective dust covers shall be installed on all detectors prior to final clean-up. Detectors that have been installed without dust covers prior to final clean-up shall be replaced at no cost to the Owner.
- G. Field locate remote visual indicators and test/reset stations for duct detectors in an accessible location.
- H. Program the system to identify each device with the submitted and approved designation in the LCD annunciators on the control panel and remote text annunciator.

3.2 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of General Conditions of the Contract.
- B. Test in accordance with NFPA 72 and local fire department requirements. Provide a completed NFPA 72 Inspection and Testing Form for inclusion in the Operation and Maintenance manual at the completion of testing and commissioning the fire alarm system.
- C. Provide all equipment, devices and manpower as necessary to test each and every device in the fire alarm system both for function and supervision. Demonstrate that all devices connected to the system function properly.
- D. The facility will not be accepted as substantially complete until the fire alarm system has been tested and demonstrated to the Owner's authorized representative as 100 percent complete and fully functional, a completed NFPA 72 Inspection and Testing form is submitted.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services under provisions of General Conditions of the Contract.
- B. Include services of a certified technician to supervise installation, adjustments, final connections, programming and system testing.

3.4 FIRE ALARM SYSTEM IDENTIFICATION

- A. Wire and Cable: Provide fire alarm unit conductors with color coded insulation, or use color coded tape at each conductor termination and in each junction box as follows:
1. Power Branch Circuit Conductors: Black, red, white.
 2. Initiating Device Circuit: Black, red.
 3. Detector Power Supply: Violet, brown.
 4. Notification Appliance Circuit: Blue (positive), white (negative).
- B. Identify all circuit conductors at all terminal and junction boxes per NEC 760.30. Use the circuit designations (i.e. "NAC 1", "SLC 1", etc.), as indicated on the shop drawings.
- C. Fire Alarm Device Labels:
1. Install machine-printed device address labels on all addressable devices, including smoke/heat detectors, control relays, monitor modules, etc. Unless otherwise noted, in public spaces where devices are mounted below +80" on walls, install label on inside cover of device. At all other locations, install label on exterior cover of device. Device labels shall show the unique device address corresponding to the text annunciator description. For smoke detectors, the label shall be affixed to the base and not to the detector itself.
 2. Provide label on each remote test station indicating description and location of device being tested.
 3. Provide label on telephone conductors at each end denoting FACP lines for use with the digital alarm communicator transmitter (DACT).
- D. The circuit disconnecting means for the remote power booster supply, or other control equipment circuits shall have a painted red handle and handle lock. The circuit(s) shall be labeled "Fire Alarm Circuit". The circuit assignment and panel location shall be permanently identified on all fire alarm control equipment.

END OF SECTION

ABATEMENT SUMMARY OF WORK

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work of this Contract is summarized as follows:

Provide all labor, materials, equipment and tools to remove and dispose of the following asbestos-containing materials from South Peninsula Hospital Operating Room HVAC Renovation Project located at 4300 Bartlett Street, Homer, AK 99603.

Base Bid: Per the included Testing Sample log and location drawing, Contractor shall include all Labor and Material, Testing, etc., to provide for the legal removal of all asbestos containing material. Testing indicates asbestos within the Drywall taping compound throughout much of the project area, as well the flooring and flooring mastic, as well as duct sealant. Contractor shall also expect to encounter asbestos for any work that penetrates the existing roofing core. A previous abatement project in 2003 indicated asbestos within the roofing core near this projects location.

Sampling for Lead, has not been conducted. However as the majority of drywall is being removed during abatement, there is likely very little potential for Lead surfaces to remain. Contractor shall verify and address any potential concern regarding Lead, as part of their included Lump Sum Price.

- B. Supplied drawings illustrate locations where the above-described work is to be performed and allow quantification for bidding purposes. However, the drawings do not portray exact conditions at any particular location and may not be drawn exactly to scale. Contractor is responsible for field verification of dimensions and quantities.
- C. It shall be Contractor's responsibility to determine conditions and requirements at each particular location and provide all items necessary for completion of the work in accordance with the contract documents.

1.2 PRE-WORK SUBMITTALS

- A. Upon Owner's award of the bid, Contractor shall submit three copies of the pre-work submittals for Owner's approval. Contractor shall be required to execute the project according to the approved pre-work submittals. Any subsequent revisions or alterations must be submitted for Owner's approval prior to their being enacted. The following items shall be included with the pre-work submittals and submitted as a complete package in a three-ring binder, with index and divider tabs:
1. Asbestos Work Plan: Submit a written work plan prepared by an EPA-accredited Project Designer, describing in detail the work procedures to be used during the asbestos abatement project. The plan shall include the following elements:
 - a. Annotated floor plan drawings no larger than 11 inches by 17 inches showing proposed locations of regulated areas, air monitoring pumps, critical barriers,

- hygiene facilities, worker access points, waste load-out routes, air movers and exhaust air routing, etc.;
- b. Sequence and timeline for completing the asbestos work;
 - c. Air monitoring plan, including proposed baseline air monitoring, initial exposure assessments, personal air monitoring, work area air monitoring, perimeter environmental air monitoring and clearance air monitoring;
 - d. Waste transportation and disposal plan;
 - e. Contingency plans, including a list of personnel and/or organizations to be contacted by Contractor in the event of potential emergencies, accidents, or incidents such as:
 - Medical emergencies/accidents inside the regulated area
 - Fire inside or outside the regulated area
 - Breach of any critical barriers
 - Loss of power
 - Loss of negative pressure inside asbestos containment area
 - Discovery that fiber concentrations inside or outside the regulated area have exceeded permissible limits
 - Water intrusion from the abatement area into adjacent areas
 - Spills during transport or disposal of asbestos waste materials
 - f. Contractor's 24-hour telephone contact number, in the event of an on-site problem after hours. Contractor response time to the site shall not exceed 1 hour from the time the call is received.
2. Testing Laboratory: Submit the name, address, telephone number and accreditation certificate of the independent testing laboratory selected to perform monitoring, testing and reporting of airborne asbestos fibers.
 3. Notifications: Submit draft copies of required EPA and Alaska DOL notifications.
 4. Competent Person(s): Submit name, address, telephone number and qualifications of the individual(s) designated to perform the role of Competent Person and who will direct and supervise the on-site asbestos removal work.
 5. Worker Qualifications: Submit certificates verifying that each employee has received the training required under EPA's Model Accreditation Plan and evidence that each employee holds current certification as an asbestos worker in the State of Alaska.
 6. Personal Protective Equipment Plan: Submit details of planned PPE requirements and respirators to be used during each specific class of asbestos removal work. Provide justification when less than the maximum available protection is proposed.
 7. Safety Data Sheets (SDS): Provide copies of the SDS for each chemical solvent, adhesive, sealant, foam, glue, encapsulant, and any other chemical product to be used at the job site.
 8. Equipment Manuals: Provide available manufacturer's information on all specialized equipment and materials to be used for asbestos abatement, including, but not limited to: negative-pressure local exhaust equipment, pressure differential/airflow monitoring equipment, decontamination/hygiene equipment (including means of filtering unit waste water), and air monitoring equipment.

1.3 POST-WORK SUBMITTALS

- A. Upon project completion, Contractor shall submit two copies of the post-work submittals and Owner shall affirm the project as complete before final payment is authorized. The following items shall be included with the post-work submittals and submitted as a complete package in a three ring binder with index and divider tabs:
1. Written daily progress reports describing areas worked, tasks accomplished, problems encountered, corrective actions taken, materials used, equipment operated and quantities of asbestos materials removed during each work shift;
 2. Daily entry/egress control logs for each regulated area, listing all personnel performing asbestos-related work inside the regulated area and any visitors admitted into the regulated area, including times of entry/egress and PPE worn for all entrants;
 3. A continuous 24-hour daily log of actual negative air pressure maintained inside each negative-pressure enclosure;
 4. Third-party air-monitoring technician's daily air sampling log, illustrating exact placement of each air sampling pump and providing a chronological summary of all air sampling results;
 5. Copies of all shipping manifests documenting disposal of asbestos waste materials at an approved solid waste facility;
 6. All clearance air monitoring documentation, including the sampling technician's field report, chain-of-custody form, and the analytical lab's report of final air clearance results.

1.4 CONTRACTOR ACCESS TO PREMISES and COORDINATION WITH OWNER

- A. Contractor will be afforded reasonable access to the premises as necessary for orderly and timely execution of the work under the Contract. The building will be made available upon Notice to Proceed. All work must be completed no later than [enter completion deadline date].
- B. The building will be vacant except for authorized Borough employees. Electrical and mechanical systems shall remain functional.
- C. Owner will make available exterior space for staging of Contractor's vehicles and equipment subject to the following:
1. Use of such area shall be covered by insurance required in General Conditions.
 2. Staged equipment and materials will be maintained in a neat and orderly manner at all times and shall not interfere with other scheduled activities at the facility.
- D. Owner shall provide temporary access to power and water for Contractor's use. Contractor is responsible for any costs and effort required to adapt those utilities for use during the abatement project.
- E. Owner shall clear removable objects and furnishings from rooms where abatement will

take place prior to Contractor's mobilization to the site.

- F. Security to the site shall be maintained for the duration of the project. Contractor shall cooperate fully with Owner, Borough authorities, and other parties who have approved access to the premises. Close coordination with Owner's representative is essential.

1.5 REFERENCED REGULATORY STANDARDS

- A. The regulatory standards listed below form a part of the specification to the extent applicable. The standards are referred to here by their basic designation only.
1. Code of Federal Regulations (CFR) Publications:
 - o 29 CFR 1910.134 Respiratory Protection
 - o 29 CFR 1910.1200 Hazard Communication
 - o 29 CFR 1926.1101 Asbestos [renovation and demolition work]
 - o 40 CFR 763 Sub-part E Asbestos-Containing Materials in Schools
 - o 40 CFR 61 Sub-part M National Emission Standard for Asbestos
 - o 49 CFR Parts 171-177 Transportation of Hazardous Materials
 2. State of Alaska Statutes and Administrative Code:
 - o AS 18.31.200 Asbestos Abatement Certification
 - o 18 AAC 60.450 Asbestos Waste Disposal

PART 2 PRODUCTS

2.1 MATERIALS

- A. Any chemical products proposed for Contractor's use, including chemical solvents and post-abatement lockdown encapsulants applied to newly-exposed substrates must be warranted not to inhibit the adhesion performance of new flooring adhesive products, when replacement materials are subsequently installed.

PART 3 EXECUTION

3.1 NOTIFICATIONS AND PERMITS

- A. Contractor shall give notice to the regional office of the United States Environmental Protection Agency (US EPA) at least ten working days before the planned asbestos removal activity begins, as required under 40 CFR 61.145.
- B. Contractor shall give notice to the Alaska Department of Labor, Occupational Safety and Health Division (AK OSHD), identifying the state-certified abatement workers to be used during the planned asbestos removal project, in accordance with current State of Alaska statutes.
- C. Contractor shall secure necessary permits for asbestos waste disposal as may be required by State, regional and local authorities
- D. Contractor shall notify Owner 48 hours prior to commencement of abatement work, and

immediately upon completion or termination of the work. Contractor shall notify Owner of any changes to plans, procedures, methods, timeline, conditions, etc., that deviate from the approved Pre-work Submittals. Such changes must be submitted in writing for review and approval by Owner's representative prior to the inception of the changes. Where emergency changes must be implemented immediately for the protection of personnel, property or environment, and the changes establish more stringent conditions than what previously existed, such changes may be implemented by Contractor's designated Competent Person, and the Owner's representative notified immediately. Such changes shall be documented and submitted in writing within 24 hours for Owner's review.

3.2 ASBESTOS REMOVAL PROCEDURES AND ENGINEERING CONTROLS

- A. Contractor shall perform all asbestos removal work in accordance with accepted industry practice, and in strict compliance with all applicable provisions of the state and federal regulatory standards referenced in Part 1.5 of this document.
- B. Certified asbestos abatement workers are required for all Class I and Class II asbestos work, as defined in OSHA 1926.1101. Class I work shall comply with the applicable requirements of OSHA 1926.1101(g)(4) and 1926.1101(g)(5). Class II work shall comply with the applicable requirements of OSHA 1926.1101(g)(7) and 1926.1101(g)(8).
- C. Areas adjacent to the abatement area and interior spaces within the abatement area (such as closets, cabinets, ducts, electrical junction boxes, or spaces above suspended ceilings) shall be protected from contamination and water infiltration during the abatement work. Where such areas or spaces are found to be contaminated or water-damaged, they shall be cleaned and/or restored to their original condition as directed by Owner's representative, at Contractor's expense.
- D. Contractor shall sufficiently wet asbestos-containing materials during removal, cutting or other handling to minimize the potential for release of airborne fibers.
- E. All removed asbestos materials shall be promptly placed in plastic disposal bags or other leak-proof containers. Under no circumstances shall asbestos waste or debris be allowed to accumulate in the work area. Procedures for transport and disposal of asbestos waste shall comply with applicable federal, state, regional, and local standards. All asbestos-containing materials shall be transported in an enclosed vehicle.
- F. Contractor shall dispose of non-asbestos construction debris as directed by Owner's Representative. Upon demobilization, Contractor shall remove all trash, tools, materials and equipment and leave the site and structures clean and restored to like-new condition.

3.3 QUALITY ASSURANCE & AIR MONITORING

- A. Contractor shall designate a Competent Person pursuant to OSHA 1926.1101(o), who shall be thoroughly familiar with all requirements of the work and qualified to direct the work operations. All work related to the asbestos abatement project shall be under the direct and continuous on-site supervision of Contractor's designated Competent Person.
- B. Contractor shall employ only fully trained and qualified asbestos abatement workers who hold current Certificate of Fitness cards issued by the Alaska Department of Labor.

- C. Periodic site inspections will be conducted by Owner's representative to insure compliance with contract specifications, applicable Federal or State regulations, and accepted work practices. Contractor's daily work logs and air monitoring logs shall be subject to review by Owner's representative on demand. If any non-compliance is observed, the Owner's representative may issue a stop-work order to be effective immediately, and which will remain in place until the non-compliance issues are resolved. Standby time and expenses required to resolve the violation(s) shall be at Contractor's expense.

- D. Contractor shall retain a third-party air sampling technician on-site for the duration of the Project to carry out the air monitoring plan described in Contractor's approved Pre-work Submittals. Perimeter air monitoring shall be performed continuously while asbestos removal is taking place inside the regulated area, to ensure no asbestos fibers migrate past critical barriers into adjacent areas. Owner reserves the right at any time during the Project to perform additional quality-control air monitoring, at Owner's expense.

3.4 CLEARANCE AIR MONITORING

- A. TEM Clearance Air Monitoring, using aggressive sampling methods, shall be performed by the third-party air-sampling technician retained by Contractor, to verify the effectiveness of the final asbestos removal and clean-up operations for each abatement area, as follows:
 - 1. After asbestos removal and final cleaning of the abatement work areas are complete, but prior to application of lockdown sealant and commencement of clearance air sampling, Contractor and Owner's representative shall perform a thorough visual inspection of the work area for any visible asbestos-containing residue or debris. Should any be found, a complete re-cleaning of the area shall be performed, and the area re-inspected. Contractor shall be responsible for all costs accrued by the Owner's representative relating to any additional visual inspections required after a second failed visual inspection.
 - 2. After the abatement area has passed visual inspection, lockdown sealant shall be applied to all surfaces where asbestos materials were removed. TEM sampling shall not commence until all surfaces within the work area have fully dried.
 - 3. Aggressive air sampling methods shall be employed as follows: Before starting sampling pumps, the exhaust from forced air equipment (such as a 1 horsepower leaf blower) shall be directed against all walls, ceilings, floors, ledges, and other surfaces in the room. This effort shall take at least 5 minutes per 1,000 square feet of floor. Next, a 20-inch fan shall be placed in the center of the space (one such fan shall be employed per every 10,000 cubic feet of room volume), directed toward the ceiling, and set to run on slow speed. Once the fans are set up and operational, the TEM sampling pumps shall be started and run for the required time.
 - 4. Air clearance samples will be verified using TEM analysis criteria. Contractor shall be responsible for all re-cleaning and re-sampling costs (including costs accrued by Owner's representative) resulting from failed clearance sampling.
 - 5. Once TEM clearance criteria have been achieved, air clearance shall be considered complete and Contractor's protective containment barriers may be removed.



December 8, 2016

Subcontract Number: NA
Laboratory Report: RES 366874-1
Project # / P.O. # PO# P063847
Project Description: South Peninsula Hospital

Kenai Peninsula Borough Maint.
47140 E. Poppy Lane
Soldotna AK 99669

Dear Customer,

Reservoirs Environmental, Inc. is an analytical laboratory accredited for the analysis of Industrial Hygiene and Environmental matrices by the National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 101896-0 for Transmission Electron Microscopy (TEM) and Polarized Light Microscopy (PLM) analysis and the American Industrial Hygiene Association (AIHA), Lab ID 101533 - Accreditation Certificate #480 for Phase Contrast Microscopy (PCM) analysis. This laboratory is currently proficient in both Proficiency Testing and PAT programs respectively.

Reservoirs Environmental, Inc. has analyzed the following samples for asbestos content as per your request. The analysis has been completed in general accordance with the appropriate methodology as stated in the attached analysis table. The results have been submitted to your office.

RES 366874-1 is the job number assigned to this study. This report is considered highly confidential and the sole property of the customer. Reservoirs Environmental, Inc. will not discuss any part of this study with personnel other than those of the client. The results described in this report only apply to the samples analyzed. This report must not be used to claim endorsement of products or analytical results by NVLAP or any agency of the U.S. Government. This report shall not be reproduced except in full, without written approval from Reservoirs Environmental, Inc. Samples will be disposed of after sixty days unless longer storage is requested. If you have any questions about this report, please feel free to call 303-964-1986.

Sincerely,

A blue ink signature of Gina Vettraino, written in a cursive style. Below the signature is the text "Gina Vettraino for" in a small, blue, sans-serif font.

Gina Vettraino for

Jeanne Spencer
President

RESERVOIRS ENVIRONMENTAL INC.

NVLAP Lab Code 101896-0

TABLE: PLM BULK ANALYSIS, PERCENTAGE COMPOSITION BY VOLUME

RES Job Number: **RES 366874-1**
 Client: **Kenai Peninsula Borough Maint.**
 Client Project Number / P.O.: **PO# P063847**
 Client Project Description: **South Peninsula Hospital**
 Date Samples Received: **December 07, 2016**
 Method: **EPA 600/R-93/116 - Short Report, Bulk**
 Turnaround: **24 Hour**
 Date Samples Analyzed: **December 07, 2016**

ND=None Detected
 TR=Trace, <1% Visual Estimate
 Trem/Act=Tremolite/Actinolite

Client Sample Number	Lab ID Number	L A Y E R	Physical Description	Sub Part (%)	Asbestos Content		Non Asbestos Fibrous Components (%)	Non-Fibrous Components (%)
					Mineral	Visual Estimate (%)		
120116MSSPH01	EM 1760703	A	Blue fibrous woven tape	3		ND	75	25
		B	White compound w/ white paint	25		ND	0	100
		C	Light gray drywall	72		ND	15	85
120116MSSPH02	EM 1760704	A	Blue fibrous woven tape	4		ND	75	25
		B	White compound w/ white paint	20		ND	0	100
		C	Pink drywall	76		ND	20	80
120116MSSPH03	EM 1760705	A	White tape	10	Chrysotile	ND	85	15
		B	Off white compound	20		3	0	97
		C	White compound w/ white multi-layered paint	25		ND	0	100
		D	Light gray drywall	45		ND	60	40
120116MSSPH04	EM 1760706	A	Blue fibrous woven tape	5		ND	0	100
		B	White compound w/ white paint	40		ND	75	25
		C	Off white drywall	55		ND	40	60

TEM Analysis recommended for organically bound material (i.e. floor tile) if PLM results are <1%.

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					Mineral	Visual Estimate (%)		
120116MSSPH05	EM 1760707	A	Blue fibrous woven tape	5		ND	75	25
		B	White joint compound	10		ND	0	100
		C	White texture w/ white paint	20		ND	0	100
		D	Off white drywall	65		ND	15	85
120116MSSPH06	EM 1760708	A	Light blue fibrous woven tape	2		ND	75	25
		B	White compound	5		ND	0	100
		C	White resinous material w/ white paint	8		ND	0	100
		D	Off white drywall	15		ND	40	60
		E	White drywall	70		ND	10	90
120116MSSPH07	EM 1760709	A	Blue fibrous woven tape	10		ND	75	25
		B	White paper tape	20		ND	85	15
		C	White joint compound	30		ND	0	100
		D	White compound w/ white paint	40		ND	0	100

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					Mineral	Visual Estimate (%)		
120116MSSPH08	EM 1760710	A	White compound w/ off white paint	20		ND	0	100
		B	White tape	20		ND	85	15
		C	White joint compound	25		ND	0	100
		D	Off white drywall	35		ND	40	60
120116MSSPH09	EM 1760711	A	White compound w/ white paint	20	Chrysotile	2	0	98
		B	White tape	20		ND	85	15
		C	Off white joint compound	20	Chrysotile	2	0	98
		D	White drywall	40		ND	40	60
120116MSSPH10	EM 1760712	A	White tape	10		ND	80	20
		B	White joint compound	10	Chrysotile	2	0	98
		C	Off white paint w/ white compounds	40	Chrysotile	2	0	98
		D	Off white drywall	40		ND	50	50
120116MSSPH11	EM 1760713	A	White drywall plaster debris	100		ND	TR	100

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					Mineral	Visual Estimate (%)		
120116MSSPH12	EM 1760714	A	White compound w/ light blue paint	36	Chrysotile	ND	0	100
		B	Light pink drywall	64		ND	15	85
120116MSSPH13	EM 1760715	A	White compound	4		ND	0	100
		B	White tape	6		ND	85	15
		C	White compound w/ white paint	10		ND	0	100
		D	Off white compound w/ off white paint	10		2	0	98
		E	White wall covering	10		ND	30	70
		F	White resinous material w/ white paint	10		ND	0	100
		G	Pink drywall	20	ND	70	30	
		H	White drywall	30	ND	30	70	

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					Mineral	Visual Estimate (%)		
120116MSSPH14	EM 1760716	A	White resinous material w/ pink paint	10		ND	0	100
		B	White compound	10	Chrysotile	2	0	98
		C	White tape	10		ND	85	15
		D	White joint compound	10	Chrysotile	2	0	98
		E	White drywall	60		ND	40	60
120116MSSPH15	EM 1760717	A	White compound w/ white paint	5	Chrysotile	2	0	98
		B	White tape	5		ND	85	15
		C	White joint compound	5	Chrysotile	3	0	97
		D	Light brown drywall	85		ND	15	85

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					Mineral	Visual Estimate (%)		
120116MSSPH16	EM 1760718	A	White compound	5	Chrysotile	2	0	98
		B	White paint w/ white compound	20		ND	0	100
		C	White compound	20		ND	0	100
		D	White multi-layered paint w/ white compound	25		ND	0	100
		E	White drywall	30		ND	50	50
120116MSSPH17	EM 1760719	A	White compound w/ white paint	100	Chrysotile	TR	TR	100
120116MSSPH18	EM 1760720	A	White compound w/ white paint	45	Chrysotile	3	0	97
		B	Brown drywall	55		ND	25	75
120116MSSPH19	EM 1760721	A	White compound	100		ND	0	100
120116MSSPH20	EM 1760722	A	White/tan drywall w/ off white paint	8		ND	70	30
		B	Brown mastic	92		ND	TR	100
120116MSSPH21	EM 1760723	A	Brown mastic	100		ND	TR	100

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					Mineral	Visual Estimate (%)		
120116MSSPH22	EM 1760724	A	Black mastic	3	Chrysotile	15	TR	85
		B	White tile	97	Chrysotile	5	0	95
120116MSSPH23	EM 1760725	A	Black mastic	15	Chrysotile	15	0	85
		B	Orange/white tile	85	Chrysotile	5	0	95
120116MSSPH24	EM 1760726	A	Black mastic	10	Chrysotile	5	10	85
		B	White/light green tile	90	Chrysotile	6	0	94
120116MSSPH25	EM 1760727	A	Light tan mastic w/ black mastic	TR	Chrysotile	TR	2	98
		B	White/light green tile	100	Chrysotile	5	0	95
120116MSSPH26	EM 1760728	A	Black mastic	2	Chrysotile	20	0	80
		B	White/light green tile w/ debris	98	Chrysotile	5	0	95
120116MSSPH27	EM 1760729	A	Light tan mastic w/ black mastic	100	Chrysotile	8	TR	92

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					Mineral	Visual Estimate (%)		
120116MSSPH28	EM 1760730	A	Black mastic	1	Chrysotile	3	15	82
		B	Black mastic	1	Chrysotile	15	TR	85
		C	White tile	98		ND	0	100
120116MSSPH29	EM 1760731	A	Black mastic	1	Chrysotile	TR	15	85
		B	White tile w/ light pink resinous material	99		ND	0	100
120116MSSPH30	EM 1760732	A	Black mastic	1	Chrysotile	TR	2	98
		B	White tile w/ light pink resinous material	99		ND	0	100
120116MSSPH31	EM 1760733	A	Black material	100	Chrysotile	5	0	95
120116MSSPH32	EM 1760734	A	Colorless resinous material	10		ND	TR	100
		B	White resinous material w/ debris	30		ND	TR	100
		C	White/gray resinous material	60		ND	0	100
120116MSSPH33	EM 1760735	A	Light tan resinous material	100	Chrysotile	8	0	92
120116MSSPH34	EM 1760736	A	Light tan resinous material	100	Chrysotile	8	0	92

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					Mineral	Visual Estimate (%)		
120116MSSPH35	EM 1760737	A	White fibrous woven resinous material	100		ND	75	25
120116MSSPH36	EM 1760738	A	White fibrous woven resinous material	100		ND	75	25
120116MSSPH37	EM 1760739	A	Brown insulation	5		ND	75	25
		B	White paper/silver foil wrap	40		ND	55	45
		C	White sealant	55		ND	3	97
120116MSSPH38	EM 1760740	A	White sealant	5		ND	5	95
		B	White fibrous woven wrap	10		ND	90	10
		C	Yellow insulation	30		ND	85	15
		D	Grayish white insulation	55		ND	35	65
120116MSSPH39	EM 1760741	A	White fibrous woven wrap	20		ND	90	10
		B	Light gray insulation	80		ND	30	70
120116MSSPH40	EM 1760742	A	Yellow insulation	15		ND	85	15
		B	Light gray insulation	35		ND	30	70
		C	White sealant w/ white fibrous woven wrap	50		ND	20	80

TEM Analysis recommended for organically bound material (i.e. floor tile) if PLM results are <1%.

RESERVOIRS ENVIRONMENTAL INC.

NVLAP Lab Code 101896-0

TABLE: PLM BULK ANALYSIS, PERCENTAGE COMPOSITION BY VOLUME

RES Job Number: **RES 366874-1**
 Client: **Kenai Peninsula Borough Maint.**
 Client Project Number / P.O.: **PO# P063847**
 Client Project Description: **South Peninsula Hospital**
 Date Samples Received: **December 07, 2016**
 Method: **EPA 600/R-93/116 - Short Report, Bulk**
 Turnaround: **24 Hour**
 Date Samples Analyzed: **December 07, 2016**

ND=None Detected TR=Trace, <1% Visual Estimate Trem/Act=Tremolite/Actinolite
--

Client Sample Number	Lab ID Number	L A Y E R	Physical Description	Sub Part (%)	Asbestos Content		Non Asbestos Fibrous Components (%)	Non-Fibrous Components (%)
					Mineral	Visual Estimate (%)		
120116MSSPH41	EM 1760743	A	Black fibrous tar	100		ND	20	80

TEM Analysis recommended for organically bound material (i.e. floor tile) if PLM results are <1%.

Michael Scales
Michael Scales

Analyst / Data QA

Due Date: 12-8-16
 Due Time: 11:15 a.m.

REILAB Reservoirs Environmental, Inc.

5801 Logan St. Denver, CO 80216 • Ph: 303 964-1986 • Fax 303-477-4275 • Toll Free: 866 RES-ENV

SUBMITTED BY:

Company: Kenai Peninsula Borough
 Address: 4714D E. Poppy Lane
Soldotna, AK 99669
 Project Number and/or P.O. #: PO# 063847
 Project Description/Location: South Peninsula Hospital

INVOICE TO: (IF DIFFERENT)

Company: _____
 Address: _____

CONTACT INFORMATION:

Contact: Mark Schaaferma
 Phone: 907-262-4011
 Fax: 907-262-5882
 Cell/pager: 907-398-9584
 Final Data Deliverable Email Address: mschaaferma@kpb.us ; scurtin@kpb.us

ASBESTOS LABORATORY HOURS: Weekdays: 7am - 7pm
 (PLM) / PCM / TEM ___ RUSH (Same Day) PRIORITY (Next Day) ___ STANDARD
 (Rush PCM = 2hr, TEM = 5hr.)

CHEMISTRY LABORATORY HOURS: Weekdays: 8am - 5pm
 Metal(s) / Dust ___ RUSH ___ 24 hr. ___ 3-5 Day
 RCRA 8 / Metals & Welding ___ RUSH ___ 5 day ___ 10 day
 Fume Scan / TCLP ___ RUSH ___ 3 day ___ 5 Day

Organics ___ 24 hr. ___ 3 day ___ 5 Day

****Prior notification is required for RUSH turnarounds.****

****Analysis turnarounds are subject to laboratory sample volume and are not guaranteed. You will be notified if delays are expected. Additional fees apply for afterhours and holidays for all analysis types.****

Special Instructions: _____

Client sample ID number	(Sample ID's must be unique)	PLM	TEM	PCM	DUST	METALS	ORGANICS	OTHER	Sample Volume (L) / Area	Date Collected mm/dd/yy	Time Collected hh/mm a/p	EM Number (Laboratory Use Only)
1	120116MSSPH01	✓	✓	✓	✓	✓	✓					174070103
2		✓	✓	✓	✓	✓	✓					0304
3		✓	✓	✓	✓	✓	✓					AK95
4		✓	✓	✓	✓	✓	✓					0506
5		✓	✓	✓	✓	✓	✓					0507
6		✓	✓	✓	✓	✓	✓					0708
7		✓	✓	✓	✓	✓	✓					0809
8		✓	✓	✓	✓	✓	✓					0910
9		✓	✓	✓	✓	✓	✓					1011
10		✓	✓	✓	✓	✓	✓					1112
11		✓	✓	✓	✓	✓	✓					1213
12		✓	✓	✓	✓	✓	✓					1314
13		✓	✓	✓	✓	✓	✓					1415

Number of samples received: 41 (Additional samples shall be listed on attached long form.)

NOTE: REI will analyze incoming samples based upon information received and will not be responsible for errors or omissions in calculations resulting from the inaccuracy of original data. By signing client/company representative agrees that submission of the following samples for requested analysis as indicated on this Chain of Custody shall constitute an analytical services agreement with payment terms of NET 30 days, failure to comply with payment terms may result in a 1.5% monthly interest surcharge.

Relinquished By: Mark Schaaferma Date/Time: 12/5/16 Date/Time: 12/5/16

Laboratory Use Only

Received By: John Date/Time: 12-7-16 @ 11:52 Carrier: VPS

Results: Contact: _____ Page Phone Email Fax Date Time Initials

Contact: _____ Page Phone Email Fax Date Time Initials

Sample Condition:	On Ice	Sealed	Intact
Temp. (F°)	___	Y/N	Y/N

RES Job # 366874 Page 2 of 2

Submitted by: Kenai Peninsula Borough PO # P063847

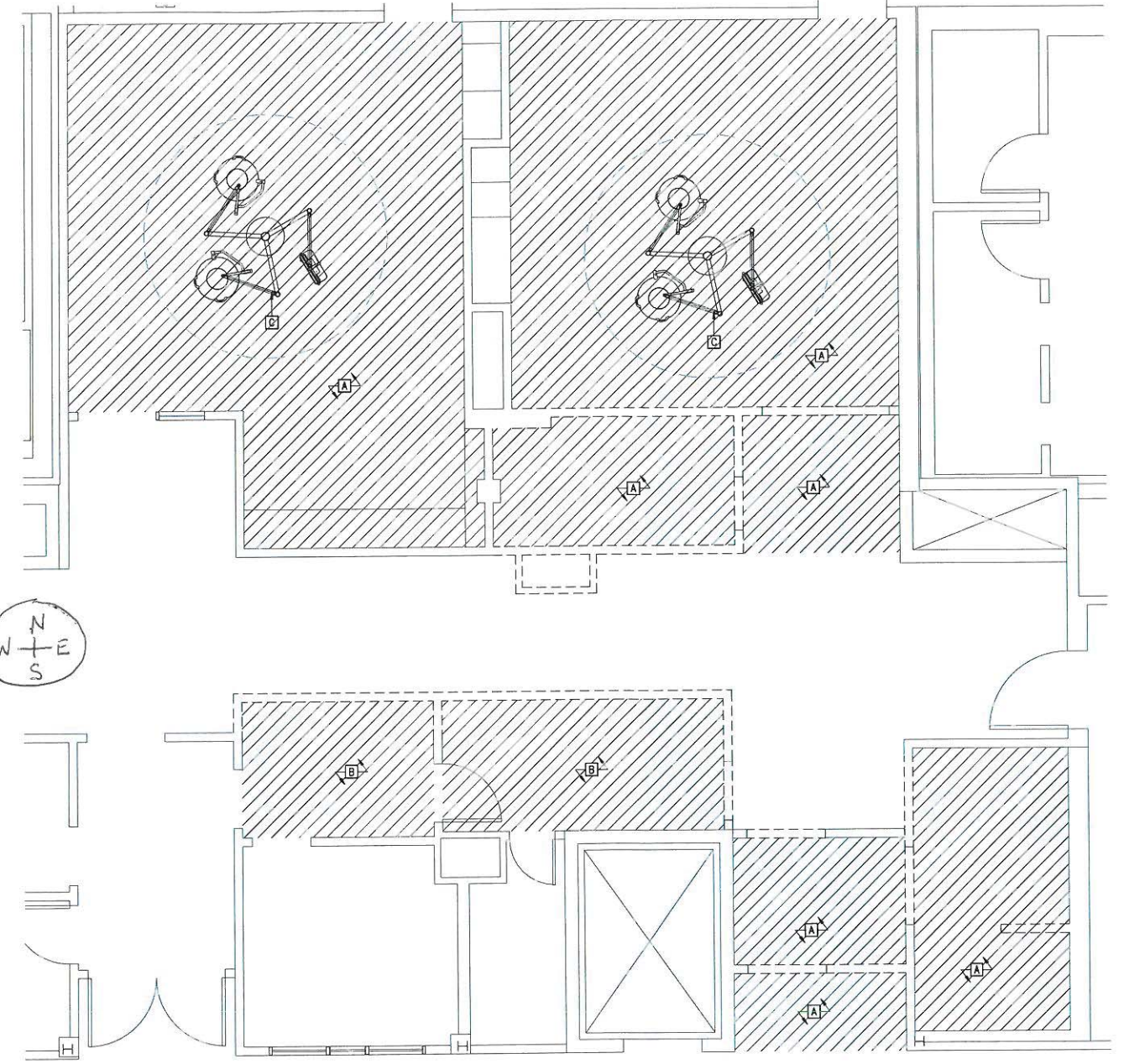
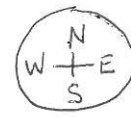
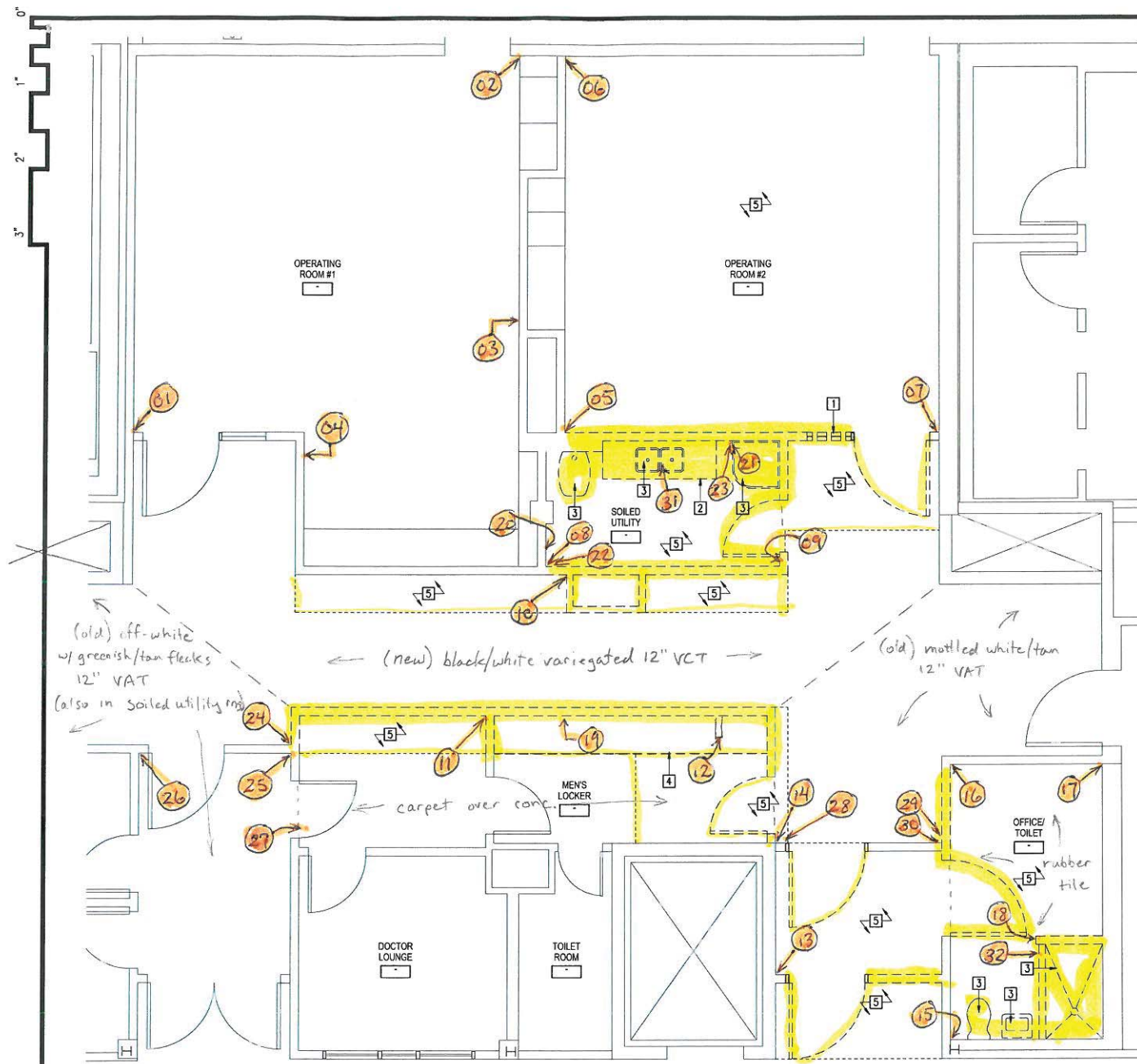
REQUESTED ANALYSIS	VALID MATRIX CODES				LAB NOTES:
	Sample Volume (L) / Area	Matrix Code	# Containers	Date Collected mm/dd/yy	
PLM - Short report, Long report, Point Count	Air = A	Bulk = B			
TEM - AHERA, Level II, 7402, ISO, +/-, Quant, Semi-quant, Micro-vac, ISO-Indirect Preps	Dust = D	Paint = P			
PCM - 7400A, 7400B, OSHA	Soil = S	Wipe = W			
DUST - Total, Respirable	Drinking Water = DW				
METALS - Analyte(s)	Waste Water = WW				
ORGANICS - BTEX, MTBE, 8260, GRO, DRO	Other = O				
OTHER -	**ASTM E1792 approved wipe media only**				

Client sample ID number	(Sample ID's must be unique)
14	1
15	2
16	3
17	4
18	5
19	6
20	7
21	8
22	9
23	10
24	11
25	12
26	13
27	14
28	15
29	16
30	17
31	18
32	19
33	20
34	21
35	22
36	23
37	24
38	25
39	26
40	27
41	28
42	29
43	30
44	31

EM Number (Laboratory Use Only)
 17607519
 1717
 1718
 1819
 1920
 2021
 2122
 2223
 2324
 2425
 2526
 2627
 2728
 2829
 2930
 3031
 3132
 3233
 3334
 3435
 3536
 3637
 3738
 3839
 3940
 4041
 4142
 4243

Sample Log #	Sample Date	Collected By:	Location of Sample Collection	Sampled Material Description	Analytical Results	Notes
120116MSSPH01	12/1/2016	Mark Schaafsma	O.R. #1 in SW corner, @4 ft. from floor	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH02	12/1/2016	Mark Schaafsma	O.R. #1 in NE corner, @4 ft. from floor	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH03	12/1/2016	Mark Schaafsma	O.R. #1 middle of east wall at ceiling interface	Drywall, tape & joint compound core sample	3% chrysotile in joint compound only	
120116MSSPH04	12/1/2016	Mark Schaafsma	O.R. #1 at ceiling interface near corner projection	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH05	12/1/2016	Mark Schaafsma	O.R. #2 in SW corner, @4 ft. from floor	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH06	12/1/2016	Mark Schaafsma	O.R. #2 in NW corner, @4 ft. from floor	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH07	12/1/2016	Mark Schaafsma	O.R. #2 in SE corner, just above door frame	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH08	12/1/2016	Mark Schaafsma	Soiled Utility Rm. in SW corner, 2 ft. from floor	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH09	12/1/2016	Mark Schaafsma	Soiled Utility Rm. in SE corner, behind door @4 ft. from floor	Drywall, tape & joint compound core sample	2% chrysotile in joint compound w/ white paint	
120116MSSPH10	12/1/2016	Mark Schaafsma	Hallway north wall, midway between O.R #1 & O.R.#2, below counter	Drywall, tape & joint compound core sample	2% chrysotile in joint compound w/ off-white paint	
120116MSSPH11	12/1/2016	Mark Schaafsma	NE corner of anteroom leading to men's locker room and Doctor's Lounge	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH12	12/1/2016	Mark Schaafsma	North wall inside Men's locker room, @ wall projection	Drywall, tape & joint compound core sample	no asbestos detected	
120116MSSPH13	12/1/2016	Mark Schaafsma	SW corner of inter-hallway vestibule, outside 'office toilet' rm.	Drywall, tape & joint compound core sample	2% chrysotile in joint compound w/ off-white paint	
120116MSSPH14	12/1/2016	Mark Schaafsma	SW corner of hallway alcove across from O.R. #2, right side of exit door, 4 ft. from floor	Drywall, tape & joint compound core sample	2% chrysotile in joint compound only	
120116MSSPH15	12/1/2016	Mark Schaafsma	SW corner inside 'office toilet' room, by toilet	Drywall, tape & joint compound core sample	2%-3% chrysotile in joint compound w/ white paint	
120116MSSPH16	12/1/2016	Mark Schaafsma	NW corner inside 'office toilet' room, 4' from floor	Textured drywall, tape & joint compound	2% chrysotile in joint compound only	
120116MSSPH17	12/1/2016	Mark Schaafsma	NE corner inside 'office toilet' room, 4' from floor	Textured drywall, tape & joint compound	<1% chrysotile in joint compound w/ white paint	
120116MSSPH18	12/1/2016	Mark Schaafsma	Inside 'office toilet' room, wall projection left of shower stall, 5 ft from floor	Textured drywall, tape & joint compound	3% chrysotile in joint compound w/ white paint	
120116MSSPH19	12/1/2016	Mark Schaafsma	Above ceiling in mens locker room, on west wall	Drywall joint compound only	no asbestos detected	
120116MSSPH20	12/1/2016	Mark Schaafsma	SW corner 'soiled utility' room	Brown cove base adhesive	no asbestos detected	
120116MSSPH21	12/1/2016	Mark Schaafsma	NE corner 'soiled utility' room	Brown cove base adhesive	no asbestos detected	
120116MSSPH22	12/1/2016	Mark Schaafsma	SW corner 'soiled utility' room	Off-white 12" VAT w/ greenish-tan flecks & black mastic	5% chrysotile in VAT; 15% chrysotile in black mastic	
120116MSSPH23	12/1/2016	Mark Schaafsma	NE corner 'soiled utility' room, left side of mop sink	Off-white 12" VAT w/ greenish-tan flecks & black mastic	5% chrysotile in VAT; 15% chrysotile in black mastic	
120116MSSPH24	12/1/2016	Mark Schaafsma	South side hallway, left of door across from O.R. #1	Off-white 12" VAT w/ greenish-tan flecks & black mastic	6% chrysotile in VAT; 5% chrysotile in black mastic	
120116MSSPH25	12/1/2016	Mark Schaafsma	NE corner of inter-hallway vestibule across from O.R. #1	Off-white 12" VAT w/ greenish-tan flecks	5% chrysotile in VAT	
120116MSSPH26	12/1/2016	Mark Schaafsma	NW corner of inter-hallway vestibule across from O.R. #1	Off-white 12" VAT w/ greenish-tan flecks & black mastic	5% chrysotile in VAT; 20% chrysotile in black mastic	
120116MSSPH27	12/1/2016	Mark Schaafsma	Under west doorway of anteroom leading to men's locker room and Doctor's Lounge	Black adhesive mastic scrapings from concrete floor, beneath brown carpet	8% chrysotile in black mastic	

Sample Log #	Sample Date	Collected By:	Location of Sample Collection	Sampled Material Description	Analytical Results	Notes
120116MSSPH28	12/1/2016	Mark Schaafsma	SW corner of hallway alcove across from O.R. #2, right side of exit door	Mottled white/tan 12" VCT w/ black mastic	3% & 15% chrysotile in black mastic, none detected in VCT	
120116MSSPH29	12/1/2016	Mark Schaafsma	SE corner of hallway alcove across from O.R. #2, left of exit door	Mottled white/tan 12" VCT w/ black mastic	<1% chrysotile in black mastic, none detected in VCT	
120116MSSPH30	12/1/2016	Mark Schaafsma	SE corner of hallway alcove across from O.R. #2, left of exit door	Mottled white/tan 12" VCT w/ black mastic	<1% chrysotile in black mastic, none detected in VCT	
120116MSSPH31	12/1/2016	Mark Schaafsma	Soiled Utility Rm. Stainless steel double sink	Under-sink acoustical black coating	5% chrysotile in black coating	
120116MSSPH32	12/1/2016	Mark Schaafsma	Office toilet" Rm. floor at entrance to shower	Off-white rubberized sheet flooring & adhesive	no asbestos detected	
120116MSSPH33	12/1/2016	Mark Schaafsma	Ventilation ducting above ceiling of men's locker room	Yellow-tan duct sealant	8% chrysotile in sealant	
120116MSSPH34	12/1/2016	Mark Schaafsma	Ventilation ducting above ceiling of men's locker room	Yellow-tan duct sealant	8% chrysotile in sealant	
120116MSSPH35	12/1/2016	Mark Schaafsma	Boiler room ventilation duct plenum at west end of AC-2 air handler	Coated canvas jacket over fiberglass duct insulation	no asbestos detected	
120116MSSPH36	12/1/2016	Mark Schaafsma	Boiler room ventilation duct plenum at west end of AC-2 air handler	Coated canvas jacket over fiberglass duct insulation	no asbestos detected	
120116MSSPH37	12/1/2016	Mark Schaafsma	Boiler room heating system piping flanged valve, 7 ft. above floor, south of AC-2 air handler	FSK paper jacket over fiberglass pipe insulation, with white mastic coating	no asbestos detected	
120116MSSPH38	12/1/2016	Mark Schaafsma	Boiler room, flanged valve above abandoned electric boiler #1	Gray-white troweled-on insulating cement packed into ends of pipe insulation to fill voids	no asbestos detected	
120116MSSPH39	12/1/2016	Mark Schaafsma	Boiler room, flanged valve above abandoned electric boiler #2	Gray-white troweled-on insulating cement packed into ends of pipe insulation to fill voids	no asbestos detected	
120116MSSPH40	12/1/2016	Mark Schaafsma	Boiler room, flanged valve above abandoned electric boiler #3	Gray-white troweled-on insulating cement packed into ends of pipe insulation to fill voids	no asbestos detected	
120116MSSPH41	12/1/2016	Mark Schaafsma	Roof-top air intake louvered cabinet	Black rubberized tar coating on rolled roof flashing	no asbestos detected	



SHEET NOTES	
1	DEMOLISH SIDELITE
2	DEMOLISH COUNTER AND CABINETS
3	DEMOLISH PLUMBING FIXTURE, REFER TO MECHANICAL DRAWINGS.
4	DEMOLISH LOCKERS.
5	DEMOLISH SHEET VINYL FLOOR.

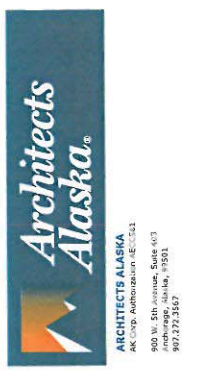
LEGEND	
	METAL STUD/GYPSUM WALLBOARD WALL TO BE DEMOLISHED
	EXISTING WALL TO REMAIN
	DOOR AND FRAME TO BE DEMOLISHED
	EXISTING DOOR AND FRAME TO REMAIN

A1 DEMO FLOOR PLAN
1/4" = 1'-0"

SHEET NOTES	
A	DEMOLISH GYPSUM WALLBOARD CEILING INCLUDING LIGHTS, MECHANICAL GRILLS AND DIFFUSERS, ETC.
B	DEMOLISH ACOUSTIC CEILING TILE, GRID INCLUDING LIGHTS, MECHANICAL GRILL AND DIFFUSERS, ETC.
C	REMOVE LIGHT BOOM, STORE FOR REUSE.

LEGEND	
	METAL STUD/GYPSUM WALLBOARD WALL TO BE DEMOLISHED
	EXISTING WALL TO REMAIN
	CEILING TO BE DEMOLISHED

A3 DEMO REFLECTED CEILING PLAN
1/4" = 1'-0"



SOUTH PENINSULA HOSPITAL
OPERATING ROOM HVAC UPGRADES
HOMER, ALASKA

REVISIONS:
SCHEMATIC DESIGN

DRAWN BY: DAH
CHECKED BY:
DATE: 11/18/16
JOB NUMBER: L6191.00
DWG FILE: L6139ESERIES

DRAWING TITLE:
DEMO FLOOR PLAN
DEMO REFLECTED
CEILING PLAN

SHEET:
A1.01

PRELIMINARY NOT FOR CONSTRUCTION

RISA
Engineering, Inc.
MECHANICAL AND ELECTRICAL CONSULTING ENGINEERS
670 West Firewood Lane, Suite 200
Anchorage, AK 99503
Wasilla, AK 99564
Phone (907) 276-0621
Corporate No.: AECC542

SOUTH PENINSULA HOSPITAL
OPERATING ROOM HVAC UPGRADES
HOMER, ALASKA

REVISIONS:
35% SCHEMATIC DESIGN

DRAWN BY: BPP
CHECKED BY: BPP
DATE: 11/28/16
JOB NUMBER: L6191.00
DWG FILE: L6191MSERIES

DRAWING TITLE:
ROOF MECHANICAL DEMOLITION PLAN

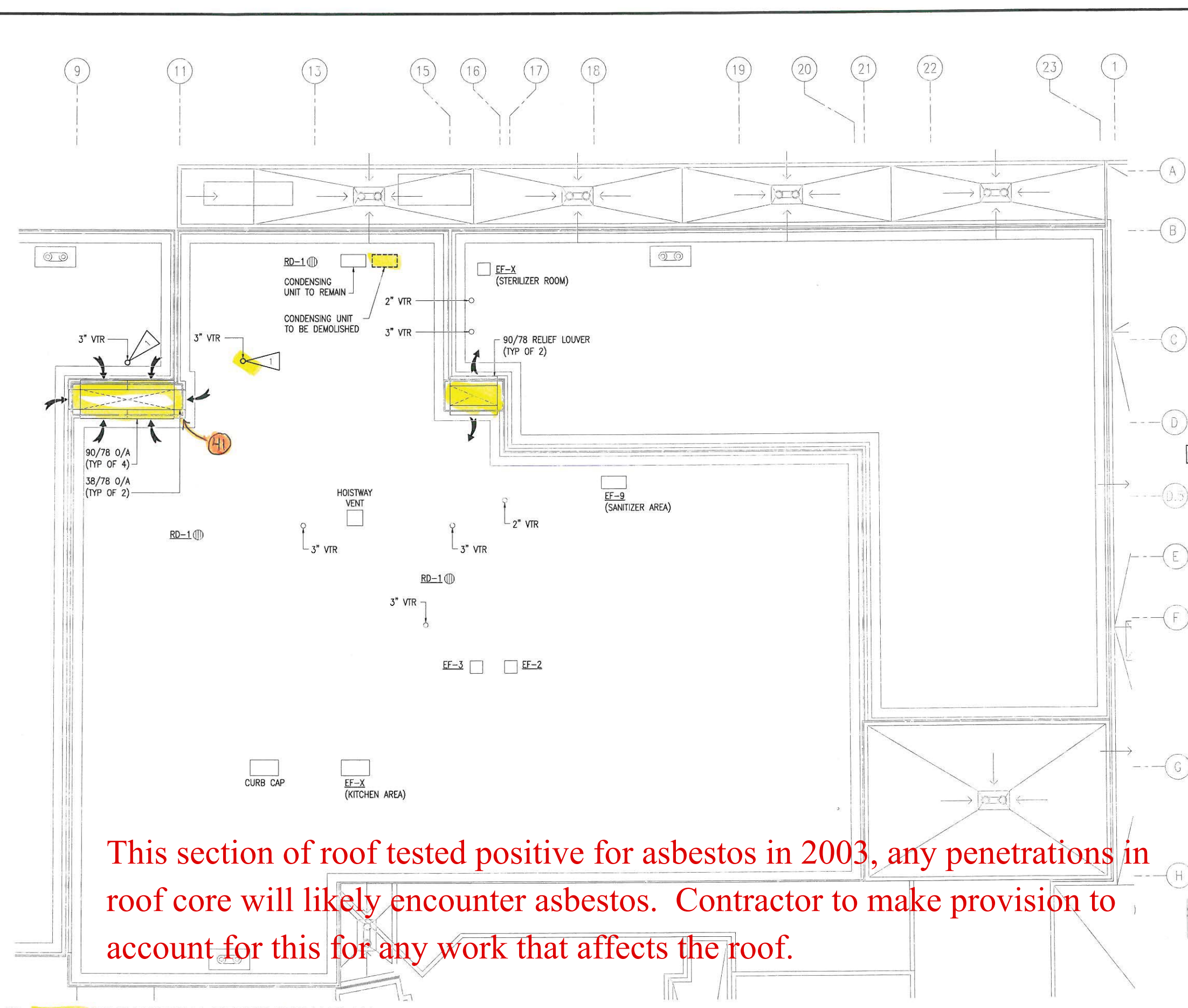
SHEET:
M004

GENERAL NOTES:

- A. THE INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM AS BUILT DRAWINGS AND A NON-DESTRUCTIVE WALK THROUGH OF THE FACILITY. THERE IS NO WARRANTY OR GUARANTEE AS TO THE ACCURACY OF THE INFORMATION SHOWN HERE-IN. THE CONTRACTOR SHALL FIELD VERIFY ALL ITEMS SCHEDULED FOR DEMOLITION PRIOR TO START OF WORK.
- B. THE OWNER SHALL HAVE FIRST RIGHT OF REFUSAL ON ALL SALVAGEABLE MATERIALS. THE CONTRACTOR SHALL DELIVER SALVAGED MATERIALS TO A LOCATION AS DIRECTED BY THE OWNER IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
- C. DASHED OR DOTTED LINES INDICATE ITEMS TO BE REMOVED. SOLID LINES INDICATE EXISTING ITEMS TO REMAIN.

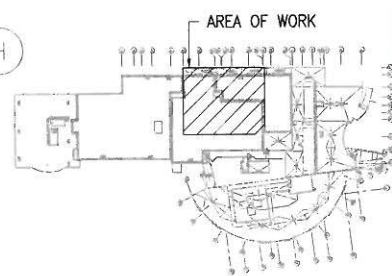
SHEET NOTES:

- 1 DEMOLISH EXISTING VTR AND RE-LOCATE MINIMUM 25' CLEAR FROM O/A INTAKE. PATCH ROOF.



This section of roof tested positive for asbestos in 2003, any penetrations in roof core will likely encounter asbestos. Contractor to make provision to account for this for any work that affects the roof.

1 ROOF MECHANICAL DEMOLITION PLAN
1/8"=1'-0"



KEYPLAN
NO SCALE

3" 2" 1" 0"

PRELIMINARY NOT FOR CONSTRUCTION

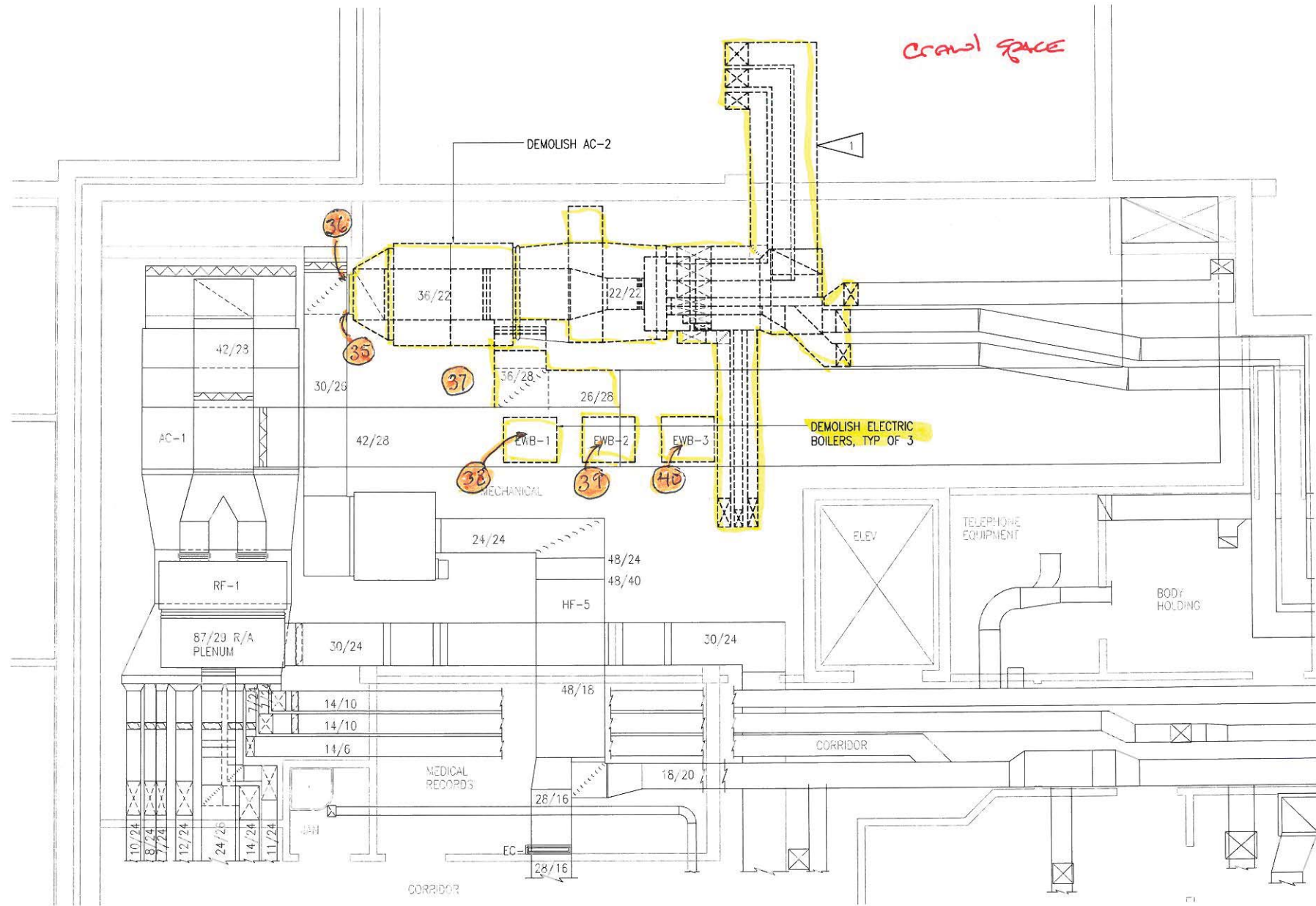
GENERAL NOTES:

- A. THE INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM AS BUILT DRAWINGS AND A NON-DESTRUCTIVE WALK THROUGH OF THE FACILITY. THERE IS NO WARRANTY OR GUARANTEE AS TO THE ACCURACY OF THE INFORMATION SHOWN HERE-IN. THE CONTRACTOR SHALL FIELD VERIFY ALL ITEMS SCHEDULED FOR DEMOLITION PRIOR TO START OF WORK.
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R S A
Engineering, Inc.
 MECHANICAL AND ELECTRICAL CONSULTING ENGINEERS
 670 West Friedland Lane, Suite 200
 Anchorage, AK 99503
 Phone (907) 271-6600
 Fax (907) 271-6604
 Corporate No.: AEC0542

SHEET NOTES:

- 1 DEMOLISH DUCTWORK TO THE EXTENT INDICATED.

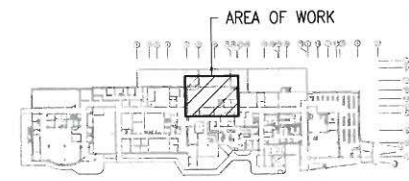


SOUTH PENINSULA HOSPITAL
OPERATING ROOM HVAC UPGRADES
HOMER, ALASKA

REVISIONS:
 35% SCHEMATIC DESIGN

DRAWN BY: MRB
 CHECKED BY: BPP
 DATE: 11/28/16
 JOB NUMBER: L6191.00
 DWG FILE: L6191_MSERIES

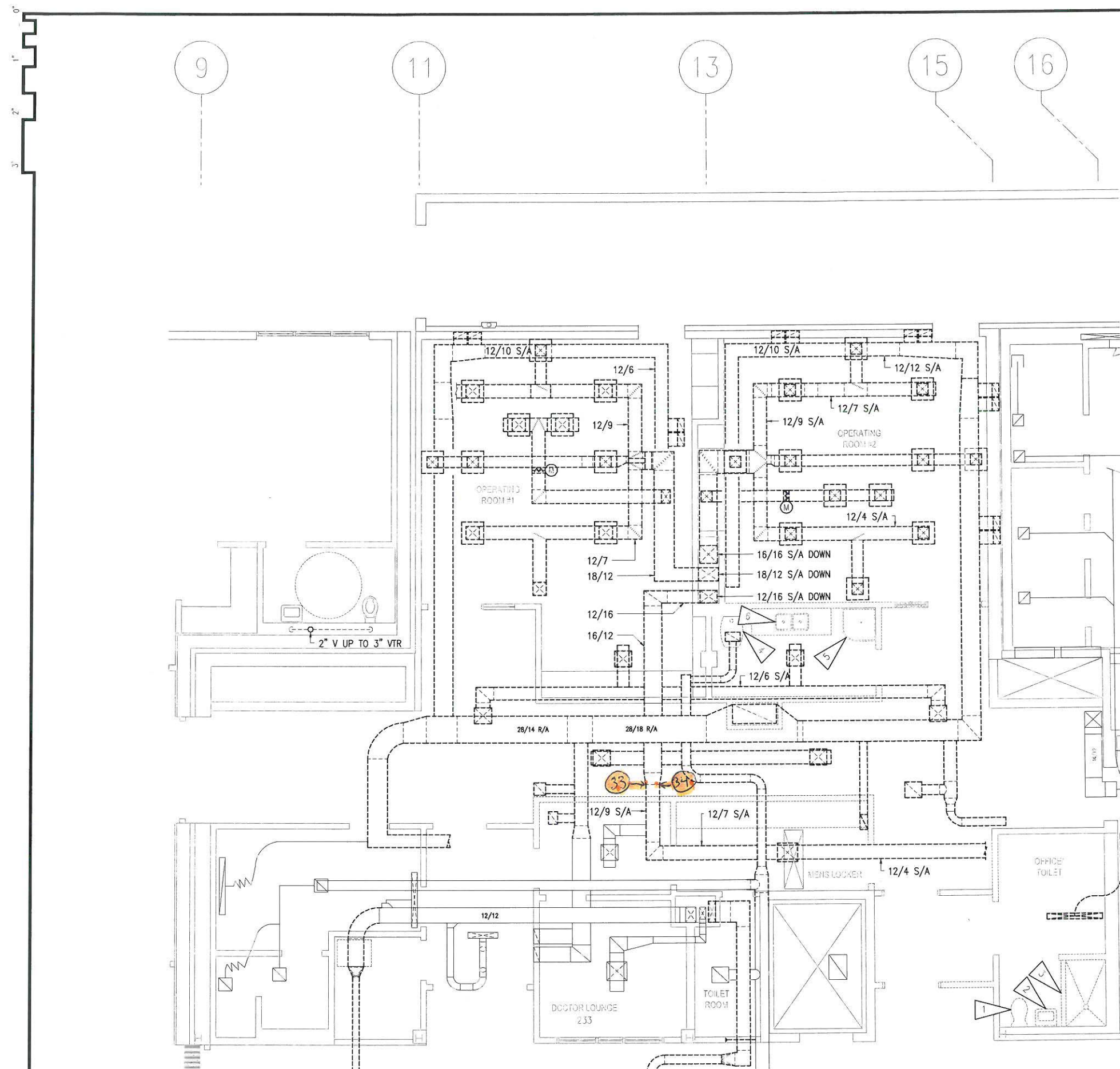
DRAWING TITLE:
 ENLARGED MECHANICAL ROOM
 DEMOLITION PLAN



KEYPLAN
 NO SCALE

1 ENLARGED MECHANICAL ROOM DEMOLITION PLAN
 1/4"=1'-0"

SHEET:
M103



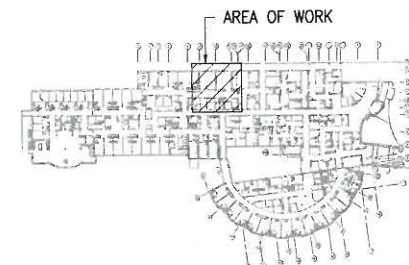
1 ENLARGED SECOND FLOOR DEMOLITION PLAN
1/4" = 1'-0"

GENERAL NOTES:

- A. THE INFORMATION SHOWN ON THIS DRAWING IS TAKEN FROM AS BUILT DRAWINGS AND A NON-DESTRUCTIVE WALK THROUGH OF THE FACILITY. THERE IS NO WARRANTY OR GUARANTEE AS TO THE ACCURACY OF THE INFORMATION SHOWN HERE-IN. THE CONTRACTOR SHALL FIELD VERIFY ALL ITEMS SCHEDULED FOR DEMOLITION PRIOR TO START OF WORK.
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- C. DASHED OR DOTTED LINES INDICATE ITEMS TO BE REMOVED. SOLID LINES INDICATE EXISTING ITEMS TO REMAIN.

SHEET NOTES:

- 1 DEMOLISH WATER CLOSET AND ALL ASSOCIATED APPURTENANCES.
- 2 DEMOLISH LAVATORY AND ALL ASSOCIATED APPURTENANCES.
- 3 DEMOLISH SHOWER AND ALL ASSOCIATED APPURTENANCES.
- 4 REMOVE HOPPER SINK, FAUCET, FLUSH VALVE AND HOSE. SALVAGE FOR RE-INSTALLATION.
- 5 REMOVE SERVICE SINK AND FAUCET. SALVAGE FOR RE-INSTALLATION.
- 6 DEMOLISH SINK AND ALL ASSOCIATED APPURTENANCES.



KEYPLAN
NO SCALE

PRELIMINARY NOT FOR CONSTRUCTION

R/S/A
Engineering, Inc.
MECHANICAL AND ELECTRICAL CONSULTING ENGINEERS
670 West Fireweed Lane, Suite 200
Anchorage, AK 99503
Phone (907) 277-6057
Wasilla, AK 99564
Phone (907) 357-1521
Corporate No.: AEC0542

SOUTH PENINSULA HOSPITAL
OPERATING ROOM HVAC UPGRADES
HOMER, ALASKA

REVISIONS:
35% SCHEMATIC DESIGN

DRAWN BY: MRB
CHECKED BY: BPP
DATE: 11/28/16
JOB NUMBER: L6191.00
DWG FILE: L6191_MSERIES

DRAWING TITLE:
ENLARGED SECOND FLOOR DEMOLITION PLAN

SHEET:
M104