PROJECT

SPECIFICATIONS

CAPITAL IMPROVEMENT PROJECT – PHASE 1

750 N. Alameda Street, Suite 300 Los Angeles, CA 90012 Phone: 213.482.5902 Fax: 213.482.5903 First5LA.org

TABLE OF CONTENTS

END TABLE OF CONTENTS

SECTION 009110

PROJECT KICKOFF AND DESIGN COMPLETION

PART 1 GENERAL

1.1 SUMMARY

This document includes post-award requirements for project kickoff and developing, submitting and finalizing the design.

1.2 REFERENCES

Not Used

1.3 DEFINITIONS

1.3.1 Design Documents

Documents which typically includes design drawings, design analyses (basis of design and calculations), product data, design specifications, construction CPM schedule and construction phasing plan, and traffic control plan.

1.4 CRITERIA

The Design Criteria is described in the Owner's program and Bridging Documents included in the Contract Documents of this project.

1.5 NOT USED

1.6 PERFORMANCE DRAWINGS (BRIDGING DOCUMENTS)

Performance Drawings for use on the project are provided as attachments to this contract. Designs and information shown on the performance drawings shall be considered conceptual and may contain a combination of performance and prescriptive requirements that are intended for use in preparing the final design and construction documents. However, the designs and information indicated in the performance drawings shall be considered to be performance criteria, unless specifically noted otherwise. Variations will be permitted from the performance drawings in preparing the design so long as aesthetic, functional, and/or other prescriptive requirements shown are not affected. Variations to performance criteria, as may be permitted, shall become the responsibility of the Design-Builder, without additional compensation.

1.7 PERFORMANCE SPECIFICATIONS

Performance specifications furnished with the RFP shall be used to develop the Design and Construction Documents. Performance specifications contain requirements for materials, products, and systems and criteria for verifying compliance. References quoted in performance specifications shall be understood to be the dated version of the reference in effect as of the contract award date.

1.8 ORDER OF PRECEDENCE

Acceptance of the proposal documents in making the contract award shall not be construed as a waiver to the RFP requirements. In the event of a conflict between the RFP, the proposal, and the final design, the interpretation most favorable to the Owner shall prevail.

1.9 MEETINGS

1.9.1 Post Award Kickoff (PAK) Meeting

Within 10 calendar days after contract award, prior to commencing work, and at a specific time and place to be determined by the Owner. PAK meeting details will be provided to the Design-Builder with the Notice of Award.

The goals of this meeting are:

a) Integrate the Design-Builder and all Owner representatives into the project team.

b) Achieve consensus from the project team on any issues and concerns on the Design-Builder's technical proposal.

c) Establish and explain policies and procedures for completion of a successful project.

d) Establish clear lines of communication and points of contact for Owner and Design-Builder team members.

The following Design-Builder key personnel shall attend the PAK: Project Manager, design staff, Superintendent and QC Manager. Optional attendees include: Principal, Assistant Project Manager, major subcontractors and specialized supplemental QC personnel.

The Design-Builder shall present and submit for approval a Design CPM Schedule to allow attendees to prepare for key milestone events. The Design-Builder shall lead discussions to develop an understanding of the accepted technical proposal and conduct a working session to develop the approved construction documents.

1.9.2 Partnering

The Owner encourages a cohesive partnership between the Owner and the Design-Builder. This partnership shall be structured to draw on the strengths of each organization to identify and achieve common goals. The objectives are effective and efficient contract performance intended to achieve completion on schedule and in accordance with sound engineering and construction practices. Design-Builder key personnel shall attend a one day "formal partnering" session with key Owner personnel. Design-Builder key personnel are the design A-E, Project Manager, Construction Superintendent, QC Manager, major subcontractors (mechanical, electrical, etc.), and specialized QC personnel. The Design-Builder shall organize and sponsor the session. The initial session will be held following the PAK meeting. Follow-up sessions, as necessary, shall be held throughout the contract, with the same participants.

1.9.3 Design Review Meetings

After Owner review of each Required Design Submittal (see paragraph 1.15 "Design Submittals") has been completed, meet with the Owner to discuss review comments for the specific design submittal.

The Design review meetings shall include discussion and finalization of the construction phasing plan and the Baseline Network Analysis Schedule as described in Sections 01321 and Traffic Control Plan as described in Section 01500, Subsection 1.8.2.

1.10 DESIGN DRAWINGS

The Owner desires to streamline the procurement process by encouraging the Design-Builder to prepare project-specific drawings during the design phase in lieu of traditional generic procurement level drawings. An example would be to produce design submittals that are more like shop drawing submittals so that after final design approval, submittals are minimized. The goals of this strategy are:

a. Avoid duplication of information and design effort,

b. Improve coordination through early collaboration of designers and subcontractors, and

c. Speed construction by reducing the need to submit and review shop drawings after construction has begun.

Therefore, the Design-Builder is encouraged to prepare and submit with the design documents appropriate connection, fabrication, layout, and product-specific drawings customized for the project and stamped by licensed professionals as appropriate.

1.10.1 Drawings Format

Prepare, organize, and present design drawings in the manner described in the Industry standards. Design drawings shall be complete, accurate, and explicit enough to show compliance with requirements and to permit construction. Drawings shall be prepared using imperial dimensioning. Each drawing shall bear the seal and signature of the registered Civil Engineer or professional engineer or Architect who prepared the design for the specific technical field. Prepare computer-aided design (CAD) drawings "DWG" file format. All drawings shall be totally functional with all reference drawings intact. The folder shall also include electronic copies of the drawing files in Adobe pdf format. Generate pdf drawing files using a pdf page size that corresponds to the original document sheet size and a pdf print resolution that results in clear detail of all drawing features. File names shall correspond to the CAD file name, but with the standard ".pdf" file extension. Provide a text file listing all information shown below.

CAD FILE NAME.	CAD REFERENCE NAME.	SHEET NO.	DWG NO.	SHEET TITLE

1.10.2 Drawings Required

As a minimum, prepare design drawings to incorporate the types of drawings needed by each design discipline in the detail required by the performance specification sections furnished with the RFP 2021-CIP 01.

1.11 SPECIFICATIONS AND MANUFACTURER'S DATA SHEETS

The Owner desires to streamline the procurement process by encouraging final product and material selections during the design phase in lieu of prescriptive construction specifications. Submit

manufacturer's data sheets for materials, equipment, fixtures, devices, and systems that will be provided, clearly marked to indicate the exact item(s) to be included in the construction. Prepare prescriptive construction specifications only for materials, products, or installation instructions that cannot be adequately described with manufacturer's data sheets. For each design submittal, consolidate specifications and manufacturer's data sheets into one comprehensive Product Data and Specifications manual organized by Construction Specifications Institute (CSI) 16 Division Master Format using Specintact. Submit specifications in MS Word format.

1.11.1 Division 01 Specifications

The Division 01 specification sections shall remain part of this contract without change unless a contract modification is issued by the Owner.

1.11.2 Construction Submittal Register

Prepare a submittal register that lists (in table format) submittals requiring Owner approval. Include submittal description, applicable specification section, and paragraph number, and planned submission date. Coordinate planned submission dates with network analysis schedule required by Sections 01321.

1.12 SUSTAINABLE DESIGN

This facility shall be designed and constructed in an environmentally responsible manner, utilizing sustainable design concepts, systems and materials to the maximum extent practical, to provide a facility that meets the following goals:

a. Energy efficient;

b. Reduces or eliminates toxic and harmful substances;

c. Efficiency in resource and materials utilization;

d. Use of recycled content materials, including EPA designated products;

e. Minimizes waste products during both the construction and operation of the facility;

f. Promotes O&M practices that reduce or eliminate harmful effects on people and the natural environment;

1.12.1 EPA Designated Products

EPA designated products contain materials recovered from the solid waste stream. First preference is to use EPA designated products if they are competitively priced, available in a reasonable time frame, and meet performance standards. The intent is to conserve resources and reduce solid waste by developing markets for recycled products and encouraging manufacturers to produce quality recycled content products at competitive prices. Accordingly, the Design-Builder shall use products that meet or exceed the EPA guideline standards to the maximum practicable extent in the performance of the contract. For a list of EPA designated products and a list of manufacturers and suppliers of EPA designated products seehttp://www.epa.gov/cpg/products.htm

1.13 DESIGN ANALYSES

Perform design analyses verifying the basis of design and calculations for each design discipline. The design analyses shall be a presentation of facts to demonstrate that the concept of the project is fully understood and the design is based on sound engineering principles. The design analyses for each discipline shall be provided with each design package and shall include:

a. A basis of design consisting of:

(1) A developed introductory description of the project concept that addresses the salient points of the design;
(2) An orderly and comprehensive documentation of criteria and rationale for system selection; and
(3) The identification of any necessary licenses and permits that are anticipated to be required as a part of the design and/or construction process.

b. Calculations as needed to support the design.

Also include a Section titled "Sustainable Design" that documents the sustainable features of the project. The sustainable design section shall include the following:

(1) List of EPA designated products specified for use in the project. Provide justification for any designated products that are used in this project but do not meet or exceed EPA guidelines for recovered content.
(2) Other information necessary to describe the sustainable features of the project and their benefits.

1.13.1 Format

The basis of design for each design discipline shall include a cover page indicating the project title and location, contract number, table of contents, and tabbed separations for quick reference. Each design analyses shall be prepared on 213 x 275 mm (8.5 x 11 inch) white paper and be bound in separate volumes for each design discipline. Multiple volumes for individual disciplines, appropriately numbered, may be provided when needed.

1.13.2 Calculations

Calculations for each design discipline shall include a cover page, a table of contents, a summary of criteria, the project title and location, and contract number. Calculation pages shall be legible and photo-ready. Cite criteria from which calculations, rationale, and formulas are extracted by publication number, title, edition and page number. The cover page of calculations shall also include the names of the persons originating and checking the calculations. The person checking the calculations shall be a registered professional engineer (or other appropriate design discipline) other than the originator. In addition, the signature and seal of the designer responsible for the work shall be placed on the cover page of the calculations for the respective design discipline.

Computer printouts, if used, shall be identified similar to the calculations and may be referenced as an appendix or attachment to the design analyses. Identify the computer program name, source, and version. Schematic models used for computer input shall also be provided.

1.15 DESIGN SUBMITTALS

There are two categories of design submittal packages –

a. Early Start Design Submittal Packages for construction activities that the Design-Builder may consider beginning prior to the acceptance of the Final Design and

b. Required Design and Construction documents Submittal Packages that are comprehensive, multi-discipline packages.

1.15.1 Early Start Design Submittal Packages

Early Start Design Submittal Packages should be limited to project elements that can be shown to impact the critical path of the Network Analysis Schedule per Section 01321, requiring construction to begin prior to the Owner acceptance of the Final Design. An Early Start Design Submittal Package shall include all Design Analyses, Calculations, Drawings, Specifications and product data required to fully describe the project element for Owner review. Early Start Design Submittal Packages may be proposed by the Design-Builder as part of the Design CPM Schedule that is presented and discussed during the Post Award Kickoff (PAK) Meeting. Project elements that may be submitted as Early Start Design Submittal Packages shall be organized into a submittal package that can be reviewed and accepted by the Owner without being contingent upon subsequent design submittals.

1.15.2 Required Design Submittal Packages

The following design submittal packages are required and shall be identified and scheduled in the design CPM schedule. These submittal packages shall be consolidated, multi-discipline design submittals that include all project elements and Early Start Design Submittal Packages.

Each design submittal shall include a written response to all the review comments provided by the Owner on the prior submittals.

a. Not Used.

b. In-progress Construction Documents (50%). Provide design analyses, calculations, manufacturer product data, details, specifications and drawings for all disciplines representing a stage of design that is essentially 50% complete in all aspects and details. Also, include a preliminary construction CPM schedule and Construction staging and Phasing Plan.

c. 100% Construction Documents . Incorporate comments from all previous design submittal packages. Provide updated design analyses, calculations, full-size drawings, specifications, and manufacturer's data sheets. The submittal shall include consolidated specifications and manufacturer's data sheets organized by Construction Specifications Institute (CSI) 16 Division Master Format, and a complete set of fully developed and detailed design drawings organized by discipline. Also include a construction CPM schedule and Construction staging and Phasing Plan per Part 3, Section 01321, and Schedule of Prices per Part 3, Section 01200 and traffic control plan per Part 3, Section 01500.

d. Final Construction Documents. Incorporate comments from the 100% submittal review and submit copies and original design documents, construction CPM schedule and Construction staging and Phasing Plan, schedule of prices, and Traffic Control Plan. The final design submittal shall serve as the record design for the project. All materials,

products and equipment represented by specific manufacturer catalog cuts and product data shall be for the exact item or product intended to be used in construction.

1.15.3 Design Certification

a. Provide certification signed by an authorized personnel of the Design-Builder's company attesting the Design meets the specified requirements. The certification shall accompany each submittal package.

b. Not Used

c. Electronic data provided by the Design-Builder must be virus free.

1.15.4 Copies of Construction Documents

Submit to the Owner electronic copies of each design submittal package for review including response to review comments.

1.15.5 Original Construction Documents

Provide the following original documents electronically; design certifications; originals of specifications and manufacturer's data sheets; original design analyses, original construction CPM schedule and Construction staging and Phasing Plan, original schedule of prices and original Traffic Control Plan complete in all respects and with accepted changes incorporated as a result of review comments, to the Owner. Include along with this submission written responses to each review comment.

The electronic submittal shall be both in the native and .pdf format. For requirements for drawings and specifications see Section 1.10 and 1.11. or as directed by the Owner.

1.15.6 Final Construction Documents

The Final design, when accepted by the Owner, shall become part of the contract. Changes to accepted design submittal packages including the final design, require prior acceptance or approval by the Owner. Owner review or acceptance of design submittal packages including the final design shall not be construed as a waiver from requirements where those requirements may have been erroneously expressed or omitted from the Design-Builder prepared design documents, unless such variations have been specifically noted by the Design-Builder and accepted in writing by the Owner. These documents shall define the construction for this project.

1.15.7 As-built drawings

After construction has been completed, provide to the Owner the Final Design/Construction Documents that incorporates as-built construction. Electronic submittal to be in AutoCAD and Adobe pdf formats. All drawings shall be totally functional with all reference drawings intact. Generate pdf drawing files using a pdf page size that corresponds to the original document sheet size and a pdf print resolution that results in clear detail of all drawing features. File names shall correspond to the CAD file name, but with the standard ".pdf" file extension. Provide a text file listing all information shown below.

CAD FILE NAME.	CAD REFERENCE NAME.	SHEET NO.	DWG NO.	SHEET TITLE

Interim as-built red-lined drawings depicting work progress shall be submitted along with each construction progress payment application per Part 3, Section 01200 Price and Payment Procedures.

1.16 SCHEDULING CONSTRAINTS

1.16.1 Owner Review Time for the Design

The Design-Builder's Design CPM schedule shall include Owner review time (from receipt of submittal to return of comments to Design-Builder) for the Design as follows: 50% Construction Documents Submittal Package review 14 days; 100% Construction Documents review 20 days; Final Construction Documents review 14 days. The review meeting for Required Design Submittals will be held within 5 days after return of comments to the Design-Builder.

1.16.2 Construction prior to Final Design Acceptance

Construction work cannot be started on any definable feature of work until Owner acceptance of design, permit approval, and a written authorization to commence with the specific construction is received from the Owner.

--End of Section—

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 REFERENCES

RFP – Attachment D – Bridging Documents

Contract Article 1 entitled "Scope of Work"

1.2 WORK COVERED BY DESIGN-BUILD RFP

1.2.1 Project Description

The description below is a brief overview of the project background and the Scope of Work for the Phase-1 CIP Project. Details of the program are shown and/or described in the documents attached to the RFP RFP 2021-CIP 01 and included as part of the RFP's Attachment D - Bridging Documents. The building is a 3-story structure constructed in 2003/2004 for office building use. The total building area is approximately 50,800 gross square feet (GSF) that include an additional 2,700 GSF of outdoor terrace space located on the 3rd floor. The first floor contains a Multi-Purpose Room (MPR), four meeting rooms, and a childcare center (tenant leased space) with an outdoor playground. The second and third floors contain offices and cubicles. The Project includes building infrastructure upgrades consisting of mechanical system upgrades with rooftop equipment, electrical power and lighting, plumbing system, and new low voltage system. Specifically, Phase 1 project includes, but is not limited to, the following main items:

1. Roofing Replacement and Thermal and Moisture protection
2. Building Envelope Repair including widow repair
3. COVID Related Building Re-entry
    - 3.a Plastic Shields
    - 3.b Restroom Plumbing Fixture Automation and plumbing works
    - 3.c Restroom Vanity Counters and plumbing works
    - 3.d Automated Drinking Fountains and plumbing works
    - 3.e Door Automation and related works and hardware
4. HVAC Replacement & Upgrade (including MERV-16 filters) , related connecting ducting and control system and mechanical works.
5. Solar Panels (with structural supports) and related electrical work to tie in to the existing electrical panel and meter.
6. Emergency Power Generation & Power Distribution
7. First Floor Multipurpose Conference (MPR) Room and adjacent Commissioner's Conference Room AV (Audio Visual) upgrades : Rough-ins, cabling works, all related infrastructure works as needed including equipment, devices, screens, accessories, etc. as needed to finish and operate are included in this RFP complete – no exclusions)
8. IT Server Room -Infrastructural upgrade including cooling units, emergency power.
9. Network Redesign and IT Hardware Upgrade (includes but not limited to what is described as a brief overview in Scope of work – AttachmentA, Item #9 of RFP 2021-CIP 01) :
    - 9.a Rough-ins, cabling works, all related infrastructure works as needed and coordination with Owner's 3rd party (who will "Supply and Install" IT hardware equipment) are included and required in this RFP.
    - 9.b Network and IT Hardware equipment of this item – "Supply and Install" are excluded (Not required as part of this RFP).

10. Fire suppression system (dry and water delayed) for IT Server room (3rd floor IT room only)
11. Exterior improvements (e.g., new generator room and trash enclosure).

1.2.2 Location

The approximate work location is indicated in the Overview of this RFP 2021-CIP 01 and contract documents.

1.3 EXISTING WORK

This section requires protection of existing vegetation, structures, equipment, utilities, and improvements:

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Owner. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.4 LOCATION OF UNDERGROUND FACILITIES (If required/needed in this Contract)

Obtain digging permits as required prior to start of excavation. Scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made. Perform toning where indicated or shown by the Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section—

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 013300, "Submittal Procedures:"

SD-01 Preconstruction Submittals

Parking authorization; G

Design-Builder regulations including COVID-19 protocol; G

Transportation of personnel, materials, and equipment; G

1.2 SPECIAL SCHEDULING REQUIREMENTS

a. The Design-Builder shall conduct his operation in accordance with the Construction Phasing Plan approved by the Owner

b. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work. Specific items of work to which this requirement applies include:

(1) All HVAC related works.

(2) All solar panels related works.

(3) AV and Technology related works.

c. The Design-Builder shall conduct his operations so as to cause the least possible interference with normal operations of the Activity.

d. Permission to interrupt any Activity and/or utility service shall be requested in writing a minimum of 15 days prior to the desired date of interruption.

e. The work under this contract requires special attention to the scheduling and conduct of the work in connection with existing operations. Identify on the construction schedule each factor which constitutes a potential interruption to operations. As of January 3rd, 2022, the Owner intends to fully reoccupy the entire building; any work scheduled on/after said date would require coordination with the Owner. The Design-Builder shall accommodate for this transition in its work plan and schedule.

1.3 DESIGN-BUILDER ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Ensure that Design-Builder personnel employed on the project become familiar with and obey project regulations, including safety, fire, traffic, and security regulations. Keep within the limits

of the work and avenues of ingress and egress. Ingress and egress of Design-Builder vehicles at the project are limited to the approval by the Owner and the Los Angeles Union Station – Metro. To minimize traffic congestion, delivery of materials shall be during the working hours of 7:00 am to 3:00 pm and not beyond the outside of peak traffic hours in the Union Station campus unless otherwise approved by the Owner. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Design-Builder equipment shall be conspicuously marked for identification.

1.3.1.1 Employee List

The Design-Builder shall provide to the Owner, in writing, the names of two designated representatives authorized to request personnel and vehicle passes for employees and subcontractor's employees prior to commencement of work under this contract. The Design-Builder shall adhere to the requirements of the Owner and the Los Angeles Union Station – Metro for the life of the contract. The Design-Builder shall ask for a copy of these requirements at the preconstruction.

Ensure that Design-Builder personnel employed on the site become familiar with and obey the Owner and the Los Angeles Union Station – Metro regulations. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Design-Builder's equipment shall be conspicuously marked for identification. Comply with the following conditions:

a. Restrict employees/representatives to the work site and control travel directly to and from the work site.

b. Restore all traffic/parking/security signs and markings, including space numbers, designations, and lines, to their original form if such signs/markings are defaced or deleted during construction/repair.

c. Be responsible for control and security of Design-Builder-owned equipment and materials at the work site. Report immediately missing/lost/stolen property to the Owner.

d. Not Used.

e. Not Used.

1.3.4 Working Hours

Regular working hours shall consist of an 8-1/2 hour period established by the Design-Builder between 7 a.m. and 3:30 p.m., Monday through Friday, excluding Owner holidays.

1.3.5 Work Outside Regular Hours

Work outside regular working hours requires Owner approval. Make application 15 days prior to such work to allow arrangements to be made by the Owner for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number, and project title. Based on the justification provided, the Owner may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner safe for the workers. Make utility cutovers after normal working hours or on Saturdays, Sundays, and Government holidays unless directed otherwise.

1.3.6 Occupied areas/floors

The Design-Builder shall be working around areas/floors which are occupied. Do not enter the areas/floors(s) without prior approval of the Owner.

1.3.7 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service, electric service, air conditioning, heating, fire alarm, compressed air, and loop fire water main shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Operation of Building Utilities: The Design-Builder shall not operate nor disturb the setting of control devices in the Building utilities system, including HVAC, water, and electrical, internet, IT, etc. The Owner will operate the control devices as required for normal conduct of the work. The Design-Builder shall notify the Owner giving reasonable advance notice when such operation is required.

1.4 SECURITY REQUIREMENTS

Design-Builder personnel shall be required to obtain personnel identification badges. The Design-Builder shall submit, in triplicate, a list of his subcontractors and the work each is to perform. On this listing shall appear the names of the key personnel of the Design-Builder and subcontractors. The key personnel shall be responsible for identifying other Design-Builder and subcontractor personnel for the purpose of obtaining identification badges. Immediately after award, the Design-Builder shall submit a letter to the Owner with the following information for each employee: Company name, employee's name, Social Security number, height, and weight. Also, indicate the names of persons authorized to vouch for additional employees requiring badges.

a. The Owner’s Facilities Front Desk staff will issue an identification badge upon completion of part A of the activity pass application form. This outlines proper procedures and instructions to be followed when issuing activity badges and vehicles passes to Design-Builders. The following procedures may apply:

(1) Design-Builder shall submit to the Owner, an access list of all personnel who will be working on the contract job. All personnel are required to submit to a background check. We would issue a badge upon completion of a successful background check.

(2) The Owner requires a week notice (by Wednesday the week prior) to notify the specific personnel and timeframe that personnel need access to the Building. The Owner will review the request and will grant approval to the personnel entering the building. The Owner will confirm with the Design-Builder that all personnel are approved. The Owner will then send the COVID-19 Building Questionnaire that all personnel will have to review and self-attest the responses.

(3) The Design-Builder personnel will submit a COVID-19 Building Questionnaire, shall present a valid picture ID/State Issued ID/State Issued Driver’s License that

the Security Guard can compare against the access list which will be kept until the duration in the building, and sign in the sign in sheet.

(4) The Design-Builder personnel shall present a valid picture ID that the Owner can compare against the access list.

(5) Owner has access to an adjacent parking lot that can be used for a construction staging area. Owner would require 5 parking spaces and 1 ADA space made available during the construction period.

(6) Owner also, have red zone parking in front of the building for temporary parking to drop off and/or deliver equipment. Parking permits can be requested daily by our Front Desk and Security.

(7) Replacement of a lost or stolen pass will be granted after the applicant completes a signed statement outlining the circumstances. The applicant will be verified against a valid access list. Any lost badge will be required of a $20 replacement fee.

1.4.1. Areas Not Covered by Contract

Design-Builder personnel will not be permitted to enter Owner spaces and areas not covered by this contract except on prior approval of the site. Coordinate action with the Owner to obtain such entry approval.

1.4.2 Onsite Office

a. Owner will allow the Design-Builder to use an area of approximately 5,500 – 6,000 square feet of interior vacant space on the building's First Floor for its offices and approximately 3,000 square feet of outdoor space formerly used as a playground for light weight material storage . The Design-Builder shall coordinate with the Owner and submit his layout plan and schedule for approval prior to the usage of said areas.

b. Equipment markings. Equipment owned or rented by the company shall have the company name painted or stenciled on the equipment in a conspicuous location. Rented equipment is to be conspicuously marked with a tag showing who rented the equipment.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section--

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 REFERENCES

The following Articles and Public Contract Codes govern this Section:

Contract Article 5 entitled “Contract Time”

Contract Article 7 entitled “Procedure for Payment”

General Conditions Article 6 entitled “Payment”

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Schedule of values; G

1.3 SCHEDULE OF VALUES

1.3.1 Data Required

Unless required by the Owner upon execution of this Agreement, within ten (10) days of execution of the Agreement, Design-Builder shall submit for Owner’s review and approval a schedule of values for all of the Work. See 6.1 Schedule of Values in Article 6 entitled “Payment” in the General Conditions. The schedule of values shall include but not limited to (Construction Contract Bid Items listed in but not limited to Attachment G – Schedule A - Price Proposal Form- in the RFP 2021-CIP 01 and per Section 01110) as a report from the NAS Schedule, Section 01321. Provide a detailed breakdown of the contract price, for each of the various kinds of work, and extended prices therefore.

1.3.2 Schedule Instructions

Payments will not be made until the Schedule of Values has been submitted to and accepted by the Owner. The schedule of values shall identify and breakdown the cost for each item of the scope of work.

1.4 CONTRACT MODIFICATIONS

In accordance with General Conditions Article 9 entitled “Changes to the Contract Price and Time”

1.5 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.5.1 Content of Invoice

Requests for payment will be processed in accordance with the Contract Article 7 entitled "Procedure For Payment".

a. The Contractor's invoice certified by Design-Builder QC Manager, on the form furnished by the Owner for this purpose, showing in summary form, the basis for arriving at the amount of the invoice. Submit original electronically and copies, unless otherwise required by the Owner.

b. The Contract Performance Statement on the form furnished by the Owner for this purpose, showing in detail, the estimated cost, percentage of completion, and value of completed performance for each of the construction categories stated in this contract. Submit original electronically and the draft, unless otherwise required by the Owner.

c. Updated construction and equipment delivery schedules (electronically),unless otherwise required by the Owner. Updated network mathematical analysis (electronically), unless otherwise required by the Owner.

d. In conjunction with contract Article 5 entitled "Contract Time", Interim redline as-built of all the work completed as of the cutoff date for the invoice. The submittal of interim redline as-built is a condition precedent for payment of the invoice.

e. In conjunction with Contract clause 7.3 "Final Payment" in Article 7 entitled " Procedure For Payment" , and with Contract Article 5 entitled " Contract Time", Final invoice shall be accompanied by Final Release Form per provision 6.7.2 of the General Conditions. If the Design-Builder is incorporated, the release shall contain the corporate seal. An authorized representative of the corporation shall sign the release and the corporate secretary shall certify the release.

1.5.2 Payment Application of Invoices

a. All invoices shall be forwarded electronically.

b. Invoices not completed in accordance with contract requirements will be returned to the Contractor for correction of the deficiencies.

c. Final invoices not accompanied by Final Release Form will be considered incomplete and will be returned to the Contractor.

1.6 PAYMENTS TO THE DESIGN-BUILDER

Payments will be made on submission of itemized requests by the Design-Builder which comply with but not limited to the requirements of this section (unless otherwise noted in the Contract Documents), and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Design-Builder.

a. Basis for Owner's consideration to allow progress payment for material delivered on the site (but not installed) and for completed preparatory work: Materials that will not be paid for prior to installation include, but are not limited to, bulk quantities such as nails, fasteners, conduits, gypsum board, etc. In the request for progress payment, such items shall be specifically identified in the Design-Builder's estimates of work submitted for the Owner`s approval in accordance with paragraph entitled "Schedule of Values" above. At the time of invoicing, the amount billed shall be supported by documents establishing its value.

1.6.1 Obligation of Owner's Payments

The obligation of the Owner to make payments required under the provisions of this contract will, at the discretion of the Owner, be subject to reductions and/or suspensions permitted under the Contract Documents and the Public Contract Code:

a. Reasonable deductions due to defects in material or workmanship;

b. Claims which the Owner may have against the Design-Builder under or in connection with this contract;

c. Unless otherwise adjusted, repayment to the Contract upon demand for overpayments made to the Contractor; and

d. Failure to provide up-to-date drawings not current pursuant to General Conditions Article 2 entitled "Design-Builder's Services and Responsibilities."

1.6.2 Payment for Materials Offsite

Not Used

1.6.3 Payment for Materials OnSite

A partial payment at the Owner`s sole discretion may be made for materials delivered to the site but not yet incorporated into the construction. Materials on-site shall be listed as a separate item on the Contract Performance Statement. The value of the materials shall be supported by the Schedule of Values, verified supplier-invoiced and Design-Builder – purchased value and proof of payment for the acceptable materials delivered to the site, or stored subject to the control of the Design-Builder but identified as the property of the Owner. A separate list of all materials being invoiced shall be submitted with the invoice in the following format:

MATERIAL ON SITE LAST ITEM PERIOD	+	MATERIAL RECEIVED THIS PERIOD	-	MATERIAL CONSUMED THIS PERIOD	=	MATERIAL ON SITE

The Design-Builder must make any materials stored offsite secured and accessible to the Owner to verify invoiced value and shall deliver these materials to the Owner upon request.

1.7 EQUITABLE ADJUSTMENTS: WAIVER AND RELEASE OF CLAIMS

In conjunction with the General Conditions Article 10 entitled "Contract Adjustments and Disputes":

a. Whenever the Design-Builder submits a claim for equitable adjustment under any clause of this Contract which provides for equitable adjustment of the Contract, such claim shall include all types of adjustments in the total amounts to which the clause entitles the Design-Builder, including, but not limited to, adjustments arising out of delays or disruptions or both caused by such change.

b. Except as the parties may otherwise expressly agree, the Design-Builder shall be deemed to have waived (1) any adjustments to which it otherwise might be entitled under the clause where such claim fails to request such adjustments, and (2) any increase in the amount of equitable adjustments additional to those requested in its claim.

c. The Design-Builder agrees that, if required by the Owner, he will execute a release, in form and substance satisfactory to the Owner, as part of the supplemental agreement setting forth the aforesaid equitable adjustment. The Design-Builder further agrees that such release shall discharge the Owner , its officers, Consultants, agents and employees, from any further claims, including but not limited to, further claims arising out of delays or disruptions or both caused by the aforesaid change.

1.8 CHANGES ESTIMATES

In making all equitable adjustments under Article 9 of the General Conditions entitled "Changes to the Contract Price and Time" compensation for additions will be based upon estimated costs at the time the work is performed and credit for deductions will be based upon estimated costs at the time the Contract was made. In arriving at the amount of the change in price, if any, allowance may be made for profit overhead and general expenses, and other items approved by Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section--

SECTION 01 31 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

List of contact personnel; G

View location map; G

Progress and completion slides; G

Insurance; G

Personnel list; G

Vehicle list; G

Statement of Acknowledgement Form

1.3 NOT USED

1.4 NOT USED

1.5 NOT USED

1.6 DESIGN-BUILDER PERSONNEL REQUIREMENTS

1.6.1 Subcontractors and Personnel

Furnish a list of contact personnel of the Design-Builder and subcontractors including addresses and telephone numbers for use in the event of an emergency. As changes occur and additional information becomes available, correct and change the information contained in previous lists.

1.6.2 Identification Badges

Identification badges, if required, will be furnished without charge. Application for and use of badges will be as directed. Immediately report instances of lost or stolen badges to the Owner.

1.6.3 Contractor Personnel Requirements

Failure to obtain entry approval will not affect the contract price or time of completion.

1.6.3.1 Passes

Submit request for personnel and vehicle passes together. Include the Certificate of Insurance for Contractor and Subcontractor(s) and the Statement of Acknowledgement Form with the submittal. Passes will normally be issued within 10 days.

1.6.3.2 Control

Maintain strict accountability over passes. Immediately report to the source of issue, passes missing or lost and the circumstances. If the Design-Builder has another active contract or one commencing immediately, employees' names may be transferred from one contract to the other. Final payment will not be effected until employees are transferred to another contract or the records are cleared. Furnish a signed letter, countersigned by the source of issue, stating that passes have been turned in.

1.7 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site during working hours. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

1.8 PRECONSTRUCTION CONFERENCE

At the final design completion, but prior to commencement of any work at the site, meet with the Owner to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of values, shop drawings, and other submittals, scheduling programming, and prosecution of the work. Major subcontractors who will engage in the work shall also attend.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section—

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Submittal Register

Submittal register database and submittal management program shall be delivered to the Owner by the Contractor at the Pre-Construction Meeting. Register database will have the following fields completed, to the extent that will be required by the Owner during subsequent usage.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g., SD-04 Drawings) required in each specification section.

Column (e): Lists one principal paragraph in the specification section and/or contract documents where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

Column (f): Indicate approving authority for each submittal. A "G" indicates approval by Owner; a blank indicates approval by the Design-Builder QC manager.

1.2 DEFINITIONS

1.2.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval.

1.2.2 Types of Submittals

All submittals are classified as indicated in paragraph "Submittal Descriptions (SD)". Submittals also are grouped as follows:

a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by contractor or through contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate portion of work, but not prepared exclusively for this contract.

c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portion of work, illustrating portion of work or establishing standards for evaluating appearance of finished work or both.

d. Administrative submittals: Data presented for reviews and approval to ensure that administrative requirements of project are adequately met but not to ensure directly that work is in accordance with the design concept and in compliance with contract documents.

1.3 SUBMITTAL IDENTIFICATION (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

Certificates of insurance.
Surety bonds.
List of proposed subcontractors.
List of proposed products.
Construction Progress Schedule.
Submittal schedule.
Schedule of values.
Health and safety plan.
Work plan.
Quality control plan.
Environmental protection plan.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.

Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Design-Builder on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

As-built drawings.

As-built schedule

Special warranties.

Posted operating instructions.

Maintenance/Operating Manuals

Training plan.

1.3.1 Approving Authority

Person authorized to approve submittal.

1.3.2 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.4 SUBMITTALS

Submit the following in accordance with the requirements of this section.

SD-01 Preconstruction Submittals

Submittal register; G
Certificates of insurance.
Surety bonds.
Lists of proposed subcontractors
List of proposed products.
Construction Progress Schedule.
Submittal schedule.
Schedule of values.
Health and safety plan.
Work plan.
Quality control plan
Environmental protection plan.

1.5 USE OF SUBMITTAL REGISTER

Prepare and maintain submittal register as the work progresses. Use electronic submittal register program in the format approved by the Owner. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by the Owner; retain data which is output in columns (a), (g), (h), and (i) as approved.

1.5.1 Submittal Register

Submit submittal register as an electronic database. Submit with quality control plan and project schedule required by Section 01450A, "Quality Control" and Section 01321, "Network Analysis Schedules (NAS)." Do not change data in columns (c), (d), (e), and (f) provided at the preconstruction meeting. Verify that all submittals required for the project are listed and add missing submittals. Complete the following on the register database

Column (a) Activity Number: Activity number from the project schedule.

Column (g) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (h) Contractor Approval Date: Date contractor needs approval of submittal.

Column (i) Contractor Material: Date that contractor needs material delivered to contractor control.

1.5.2 Design-Builder Use of Submittal Register

Update the following fields in the submittal register program or equivalent fields in program utilized by Design-Builder.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.5.3 Approving Authority Use of Submittal Register

Update the following fields in the submittal register program or equivalent fields in program utilized by contractor.

Column (b).

Column (l) List date of submittal receipt.

Column (m) through (p).

Column (q) List date returned to contractor.

1.5.4 Contractor Action Code and Action Code

Entries used will be as follows (others may be prescribed by Transmittal Form):

NR - Not Received

AN - Accepted as noted

A - Accepted

RR - Rejected, Revise, and Resubmit

1.5.5 Copies Delivered to the Owner

Deliver one copy of submitted register updated by contractor to Owner with each invoice request. Deliver in electronic format, unless a paper copy is requested by Owner.

1.6 PROCEDURES FOR SUBMITTALS

1.6.1 Reviewing, Certifying, Approving Authority

Design-Builder QC organization shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is Design-Builder QC manager unless otherwise specified for specific submittal. At each "Submittal" paragraph in individual specification sections, a notation "G," following a submittal item, indicates Owner is approving authority for that submittal item.

1.6.2 Constraints

a. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

d. Acceptance of a separate material, product, or component does not imply acceptance of assembly in which item functions.

1.6.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow review period, beginning with receipt by reviewing authority that includes at least 5 working days for submittals for the design-Builder QC manager approval and 10 working days for submittals for Owner review. Period of review for submittals with Owner review begins when Owner receives submittal from QC organization. Period of review for each resubmittal is the same as for initial submittal.

c. For submittals requiring review by fire protection engineer, allow review period, beginning when Owner receives submittal from QC organization, of 20 working days for return of submittal to the contractor. Period of review for each resubmittal is the same as for initial submittal.

1.6.4 Variations

Variations from contract requirements require Owner approval pursuant to Contract Article 6 entitled “Contract Price” and General Conditions of Contract article 9 entitled “Changes to the Contract Price and Time” and will be considered where advantageous to Owner.

1.6.4.1 Considering Variations

Discussion with Owner prior to submission, will help ensure functional and quality requirements are met and minimize rejections and resubmittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

1.6.4.2 Proposing Variations

When proposing variation, deliver written request to the Owner, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Owner. If lower

cost is a benefit, also include an estimate of the cost-saving. In addition to the documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.6.4.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Design-Builder warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.6.4.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Owner of submittals with variations.

1.6.5 Design-Builder's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

b. Transmit submittals to QC organization in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to Owner, or delays to separate contractors.

c. Advise Owner of variation, as required by paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by reviewing authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by reviewing authority on previous submissions.

e. Not Used

f. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "accepted," or "accepted as noted", except to the extent that a portion of work must be accomplished as basis of submittal.

1.6.6 QC Organization Responsibilities

The responsibilities of the Design-Builder QC Organization, pursuant to the General Conditions Article 2 entitled “Design-Builder’s Services and Responsibilities,” include but are not limited to the following:

a. Note date on which submittal was received from Design-Builder on each submittal.

b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.

c. Review submittals for conformance with project design concepts and compliance with contract documents.

d. Act on submittals, determining appropriate action based on QC organization's review of submittal.

(1) When Design-Builder QC manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."

(2) When Owner is approving authority or when variation has been proposed, forward submittal to Owner with certifying statement or return submittal marked "not reviewed" or "revise and resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is Owner, QC organization will certify submittals forwarded to Owner with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with Contract Number _____, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Owner approval.

Certified by Design-Builder Submittal Reviewer _____ , Date _____
(Signature when applicable)

Certified by Design-Builder QC manager _____, Date _____"
(Signature)

(2) When approving authority is Design-Builder QC manager, the QC manager will use the following approval statement when returning submittals to contractor as "Approved" or "Approved as Noted."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with Contract Number _____, is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is _____ approved for use.

Certified by Design-Builder Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by Design-Builder QC manager _____, Date _____"
(Signature)

g. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved QC plan. The signatures shall be in original ink. Stamped signatures are not acceptable unless otherwise approved by Owner.

h. Update submittal register database as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by the Owner.

i. Retain a copy of approved submittals at project site, including contractor's copy of approved samples.

1.6.7 The Owner's Responsibilities

When approving authority is the Owner, the Owner will:

a. Note date on which submittal was received from QC manager, on each submittal for which the Owner is approving authority.

b. Review submittals for acceptance within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

c. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

1.6.8 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by contractor or for being incomplete, with appropriate action, coordination, or change.

b. Submittals marked "accepted" "accepted as submitted" authorize Design-Builder to proceed with work covered.

c. Submittals marked "accepted as noted" or "accepted except as noted; resubmission not required" authorize Design-Builder to proceed with work as noted provided contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "rejected" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.7 FORMAT OF SUBMITTALS

1.7.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to office of approving authority. Transmit submittals with transmittal form prescribed by Owner and standard for project. The transmittal form shall identify contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.7.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Section number of the specification section by which submittal is required.

d. Submittal description (SD) number of each component of submittal.

e. When a resubmission, add alphabetic suffix on submittal description, for example, SD-10A, to indicate resubmission.

f. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second-tier contractor associated with submittal.

g. Product identification and location in project.

1.7.3 Format for Product Data

a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page, and catalog item numbers for product data.

b. Indicate, by prominent notation, each product submitted; indicate specification section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project.

d. Provide product data in imperial dimensions. Where product data are included in preprinted catalogues with inch-pound units only, submit metric dimensions on separate sheet.

1.7.4 Format for Shop Drawings

a. Shop drawings shall not be less than 8 ½ x 11 in, nor more than 46.8 x 33.1 in.

b. Present 8 ½ x 11 in sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

1.7.5 Format of Samples

a. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 2 x 3 in: Built up to 8 ½ x 11 in

(3) Sample of Materials Exceeding 8 ½ x 11 in: Cut down to 8 ½ x 11 in and adequate to indicate color, texture, and material variations.

(4) Not used.

(5) Sample of Non-Solid Materials: 750 ml. Examples of non-solid materials are sand and paint.

(6) Color Selection Samples: 2 x 4 in

(7) Not Used

(8) Not Used

b. Not Used

c. Not Used

d. Not Used

e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.7.6 Format of Administrative Submittals

a. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Design-Builder's approval stamp to document, but to a separate sheet accompanying document.

b. Operation and Maintenance Manual Data: Submit in accordance with Section 017810, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

c. Provide all dimensions in administrative submittals in imperial. Where data are included in preprinted material with inch-pound units only, submit metric dimensions on separate sheet.

1.8 QUANTITY OF SUBMITTALS

1.8.1 Number of Copies of Product Data

a. Submit an electronic copy and as needed hard copies(if required) of submittals of product data requiring review and acceptance only by Design-Builder QC organization and an electronic copy and as needed hard copies(if required by Owner) of product data requiring review and acceptance by Owner. Submit two copies of submittals of product data for operation and maintenance manuals.

1.8.2 Number of Copies of Shop Drawings

Submit shop drawings in compliance with quantity requirements specified for product data.

1.8.3 Number of Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.8.4 Number of Copies of Administrative Submittals

a. Unless otherwise specified, submit administrative submittals compliance with quantity requirements specified for product data.

b. Submit administrative submittals required under "SD-10 Operation and Maintenance Data" to conform to Section 017810, "Operation and Maintenance Data."

1.9 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.9.1 Owner Approved

Owner approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Owner. Within the terms Specifications and Drawings for Construction, they are considered to be "shop drawings."

1.9.2 Information Only

All submittals not requiring Owner approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.10 APPROVED SUBMITTALS

The Owner's acceptance or approval of submittals shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Acceptance or Approval will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been accepted or approved by the Owner, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.11 REJECTED SUBMITTALS

The Design-Builder shall make all corrections required by the Owner and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. If the Design-Builder considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with Article 9 in the General Conditions entitled “Changes to the Contract Price and Tim shall be given promptly to the Owner.

1.12 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.13 GENERAL

The Contractor shall make submittals as required by the specifications. The Owner may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, all items shall be checked and approved by the Contractor's Quality Control (CQC) System Manager and each item shall be stamped, signed, and dated by the Design-Builder licensed Architect/Engineer (A/E) and/or CQC System Manager indicating action taken. Proposed deviations from the contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Owner acceptance or approval shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the work shall be picked up and disposed of in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.14 SUBMITTAL REGISTER

The Design-Builder shall submit a sample of the submittal register in the preconstruction for approval. The Design-Builder QC Organization shall prepare and maintain the Submittal Register for the life of this contract.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section—

SECTION 01 32 10

NETWORK ANALYSIS SCHEDULES (NAS)

PART 1 GENERAL

1.1 DESCRIPTION

Within (see 2.1.3 in the General Conditions Article 2 “Design-Builder’s Services and Responsibilities) days after award, provide a detailed design schedule, along with a milestone construction schedule. Submit the complete network analysis system (NAS) construction schedule with 100% design submittal. The NAS shall consist of the network analysis schedule (diagram), mathematical analysis, and associated reports. The scheduling of construction shall be the responsibility of the Design-Builder. Submission of progress and revision data will be used to measure work progress, aid to evaluate time extensions, and provide basis of all progress payments. The Critical Path Method (CPM) of network calculation shall be used to generate the project schedule and will utilize the Precedence Diagram technique to satisfy both time and cost applications. All progress payment amounts will be derived from and tied to the cost-loaded schedule activities.

The schedule shall include a Design and Construction Phasing Plan. Such Plan shall identify all potential interruptions to utilities and activity operations

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Standard Activity Coding Dictionary

Network Analysis Schedule; G

Accepted Network Analysis Schedule; G

Construction Phasing Plan

SD-07 Certificates

Monthly Network Analysis Updates; G

SD-11 Closeout Submittals

1.3 SCHEDULE ACCEPTANCE

Review comments made by the Owner on the Design-Builder's construction schedule will not relieve the Design-Builder from compliance with requirements of the Contract Documents. The Design-Builder is responsible for scheduling, sequencing, and prosecuting the Work to comply with the requirements of the Contract Documents. Owner acceptance extends only to the activities of the Design-Builder's schedule that the Owner has been assigned responsibility for and agrees it is responsible. The Owner will also review for contract imposed schedule constraints and conformance, and cost loading of the CPM activities. Comments offered on other parts of the schedule which the Design-Builder is assigned responsibility are offered as a courtesy and are not conditions of Owner acceptance; but are for the general conformance with established industry schedule concepts.

1.3.1 Schedule Acceptance Prior to Start of Work

The Accepted Network described in the paragraph entitled "Accepted Network Analysis Schedule" must be submitted and accepted by the Owner before the Design-Builder will be allowed to start work.(see 2.1.3 in the General Conditions Article 2)

1.3.2 Acceptance

a. When the Accepted Network Analysis Schedule is submitted and accepted by the Owner, it will be considered the "Baseline CPM Schedule". The Baseline CPM Schedule will then be used by the Design-Builder for planning, organizing, and directing the work; reporting progress; and requesting payment for work accomplished. The schedule will be updated monthly by the Design-Builder and submitted monthly with the progress pay request to reflect the current status of the work. The submittal and acceptance of the Accepted Network Analysis Schedule and accurate updated schedules accompanying the pay requests are both conditions precedent to processing pay requests. Only design milestone payments will be paid prior to acceptance of construction Baseline CPM schedule.

b. Submittal of the Network, and subsequent schedule updates, will be understood to be the Design-Builder's representation that the submitted schedule meets all of the requirements of the Contract Documents, accurately reflects the work accomplished, and that Work will be executed in the sequence indicated on the submitted schedule.

1.4 SOFTWARE

The scheduling software that will be utilized by the Owner on this project is Primavera Project Planner (P6) by Primavera Systems, Inc, unless otherwise approved by the Owner. If the Design-Builder chooses to use an equally capable program, the Design-Builder shall convert all data into Primavera Machine Readable Format (Excel, etc.) prior to submission of all schedule inputs, included but not limited to the initial schedule, monthly updates, and changes to the schedule. It is the responsibility of the Design-Builder to ensure all data elements and logic required by this specification are kept intact during the conversion to Primavera. If scheduling software other than Primavera is being used, provide a licensed copy of the Design-Builder's scheduling software and data if needed. The software will be the most current version available and will be compatible with all MS-Windows operating systems. The scheduling software package shall contain all user manuals normally provided by the software distributor. If the Design-Builder upgrades their software during the course of the contract, the upgrade shall also be provided to the Owner if required. The software will remain the property of the Owner.

1.4.1 Software Training (If requested by Owner)

If software other than Primavera is used by the Design-Builder, provide schedule software training for two Owner personnel, if required. A firm accredited by the scheduling software manufacturer, as their authorized trainer, shall conduct the training. The training shall last a minimum of 24 hours per individual. Provide course material the training firm typically distributes at their software classes. Provide all necessary materials and equipment to conduct the training. The Design-Builder shall provide training within 10 working days after notification to the Design-Builder, by the Owner. Unless agreed to by the Owner, the training site shall be at the Owner’s offices.

1.5 QUALIFICATIONS

The Design-Builder shall designate a Scheduler that will be responsible for the development, preparation, and maintenance of an accurate, computerized Network Analysis Schedule. The Scheduler shall have previously developed, created and maintained previous computerized schedules of similar size and complexity of this contract. A resume outlining the qualifications of the scheduler shall be submitted for acceptance to the Owner. If at a later date, the Owner considers the Design-Builder's Scheduler to be incompetent or objectionable, the Design-Builder will propose a new Scheduler, meeting the qualification requirements. Payments will not be processed until an acceptable Scheduler is provided.

1.6 NETWORK SYSTEM FORMAT

The system shall consist of time scaled logic diagrams accompanying mathematical analyses and specified reports.

1.6.1 Diagrams

Show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned. The basic concept of a network analysis diagram will be followed to show how the start of a given activity is dependent on the completion of preceding activities and how its completion restricts or restrains the start of following activities. Diagrams shall be organized by Work Phase and sorted by Early Start Date and will show a continuous flow from left to right with no logic (relationship lines) from right to left. With the exception of the Project Start and Project Completion milestone activities, no activities will be open-ended; each activity will have predecessor and successor ties. The diagram shall clearly show the activities of the critical path. No onsite construction activity shall have a duration in excess of 20 working days. Once an activity exists on the schedule it may not be deleted and must remain in the logic. No more than 20 percent of the activities may be critical or near critical. Critical will be defined as having zero days of Total Float. "Near critical" will be defined as having Total Float in the range of 1 to 14 days. Show the following information on the diagrams for each activity:

a. Activity/Event Number

b. Activity Description

c. Original Duration in work days

d. Actual Duration in Work Days

e. Early Start Date

f. Early Finish Date

g. Total Float (or Slack)

h. Responsibility Code

Provide network diagrams on ANSI E sheets. Updated diagrams shall show the date of the latest revision.

1.6.2 Quantity and Numbering of Activities

Numbering shall be assigned so that, in general, predecessor activity numbers are smaller numerically than the successor activity numbers. Skip numbering shall be used on the network to

allow insertion of additional activities for contract modifications and logic changes. Types of activities included in the schedule are specified below.

1.6.2.1 Procurement Activities

Tasks related to the procurement of material or equipment shall be included as separate activities in the project schedule. As a minimum, separate procurement activities shall be provided for every specification section. If the Design-Builder intends on using Just-In-Time (JIT) delivery methods, the schedule will show each JIT delivery with relationship tie to the Construction Activity specifically for the JIT delivery. Material and equipment for which payment will be requested in advance of installation shall be cost-loaded with the procurement costs. All activities within a procurement process/cycle will have a unique identifier in the activity code to show their relationships and will extend to the related construction activities (i.e., Work Category).

If the Owner's action on any submittal is "Rejected" or "Revise and Resubmit", a new series of Procurement Activities will be inserted into the schedule. Predecessor for the new submittal preparation activity will be the original acceptance activity and the successor of the new acceptance activity will be the fabrication/deliver activity for the equipment or material.

1.6.2.2 Owner Activities

Owner and other agency activities that could impact progress shall be clearly identified. Owner activities include, but are not limited to; Owner accepted submittal reviews, Owner conducted inspections/tests, utility outages, Notice(s) to Proceed and delivery of Owner Furnished Material/Equipment. Show activities indicating Owner furnished materials and equipment utilizing delivery dates; Owner activities will be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

1.6.2.3 Construction Activities

Construction activities shall include, but are not limited to: Tasks related to mobilization/demobilization; the installation of temporary or permanent work by tradesman; testing and inspections of installed work by technicians, inspectors or engineers; start-up and testing of equipment; commissioning of building and related systems; scheduling of specified manufacturer’s representatives; final clean-up; training to be provided; and administrative tasks necessary to start, proceed with, accomplish or finalize the contract. Design-Builder activities will be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

1.6.2.4 Anticipated Weather Delays

Schedule activity duration(s) shall be formulated with allowance for normal adverse weather conditions. Any activity duration which could be impacted by normally anticipated adverse weather (precipitation, high or low temperature, wind, etc.), due to the time period which the Design-Builder has scheduled the work, shall include an adjustment to include the anticipated weather delay. The Design-Builder shall anticipate delay by comparing the contractually imposed environmental restrictions in the Contract Documents to the National Oceanic and Atmospheric Association's (NOAA) historical monthly averages for the NOAA location closest to the project site. The number of anticipated adverse weather delays allocated to an activity will be reflected in the activity's calendar. A lost workday, due to weather conditions, is defined as a day in which the Design-Builder's workforce cannot work 50 percent or more of the day. The Design-Builder shall immediately notify the Owner when a lost day has occurred due to weather and will record on the Daily Reports, the occurrence of adverse weather and resultant impact to the normally scheduled

work. If the number of actual adverse weather delay days exceeds the number of days anticipated, the Owner will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days and issue a modification in accordance with the contract clauses.

1.6.2.5 Activity Properties

Schedule activities will have the following properties:

a. Standard Activity Coding Dictionary: The Design-Builder shall submit a coding scheme for Schedule Activity Numbers that shall be used throughout the project. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. Code length shall not exceed 10 characters. Once accepted, the coding scheme will be used for the duration of the project.

b. Activity Description: Each activity shall have a narrative description consisting of a Verb or work function (e.g., form, pour, excavate), an Object (e.g., slab, footing, underfloor plumbing), and Area (e.g., 3rd floor).

c. Work Phase: All activities shall be identified in the project schedule by the phase of work in which the activity occurs. Activities shall not be contained in more than one Work Phase.

d. Work Category: All Activities shall be identified in the project schedule according to the work category which best describes the activity. Examples of work categories are procurement, Owner, and construction activities that are all related to a single Definable Feature of Work. Activities shall not be contained in more than one Work Category.

e. Responsibility Code: All activities in the project schedule shall be identified with the party responsible to perform the task. Responsibility includes, but is not limited to; the prime Design-Builder, subcontracting firm, or Owner agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by a responsibility code. For example, a responsibility code value, "ELEC", may be identified as "Electrical Sub Design-Builder."

f. CSI Code: All activities in the project schedule shall be identified with its respective 6-digit Specification Section number. Activities shall not belong to more than one Section number. If an activity does not have an applicable CSI Code, (such as "Mobilize"), the code will be "000000".

g. Drawing Code: All activities in the project schedule shall be identified with its respective project drawing code. The drawing code is the Sheet Number on the primary project drawing, which indicates the work to be performed. Activities shall not belong to more than one Drawing Code. Examples of Drawing Codes are "C-10", "C.10" or "C10". The code system will allow organizing all activities by drawing code in alpha and numeric order. If an activity does not have an applicable Drawing Code (such as "Mobilize"), the code will be "000000".

h. Modification Code: The Modification Code shall identify activities that are modified or added by contract modification. Activities shall not belong to more than one Modification Code. The Owner will assign the modification number, which will be shown on the. Use a shortened version of the modification number for the code (e.g., A00010 = 010).

i. Request for Equitable Adjustment (REA) or Claim Code: Activities that are modified or added, as a result of a Design-Builder's REA or Claim shall be identified by a code generated by the Design-Builder. Activities shall not belong to more than one REA or Claim Code.

j. The Three Phases of Control (Preparatory, Initial, and Follow-up): For each Definable Feature of Work identified in the Design-Builder's Quality Control Plan, include an activity for the Preparatory Phase. The Initial Phase and Follow-up Phase will be represented by the Construction Activities in the schedule.

k. Project Milestone Dates: Dates shall be shown on the diagram for the start of the project, any contract required interim start and completion dates, contract completion date, and other significant milestones.

l. Scheduled Project Duration: The schedule duration shall extend from notice-to-proceed to the contract completion date.

m. Project Start Date Milestones: The schedule shall start no earlier than the contract award date and the project duration (Day 1) will start on the Notice-to-Proceed (NTP) date. The Design-Builder shall include as the first activity in the schedule, an activity named "Contract Award" and another activity on the NTP date named "Start Project". Both activities will be zero duration, with constrained start dates equal to the contract award and NTP dates.

n. Constraint of Last Activity Milestone: The Design-Builder shall include as the last activity in the project schedule, an activity named "End Project". The "End Project" activity shall be zero duration with a mandatory finish constraint equal to the contract completion date for the project. Calculation of project updates shall be such that if the finish of the last activity falls after the contract completion date, then the float calculation shall reflect negative float on the critical path.

o. Early Project Completion: In the event the Design-Builder's project schedule shows completion of the project prior to the contract completion date, the Design-Builder shall include an activity named "Design-Builder Early Completion". The activity shall be a zero duration milestone with an unconstrained date representing the Design-Builder's Early Completion date.

p. Substantial Completion: If the Design-Builder elects to include an activity for Substantial Completion, then it is agreed that Substantial Completion will be the point in time that the Owner considers the project is complete and ready for its intended use. The activity will be named "Substantial Completion". The activity shall be a zero duration milestone with an unconstrained date representing the Design-Builder's Substantial Completion date.

q. Phase Start Milestone: The Design-Builder shall include as the first activity for a project phase, an activity named "Start Phase X", where "X" identifies the phase of work. The "Start Phase X" activity shall be zero duration with an unconstrained start date equal to the date of the Phase NTP. This unconstrained start date is not a release from contractually required start dates, but is left unconstrained to allow the schedule logic to calculate without hindrance.

r. End Phase Milestone: The Design-Builder shall include as the last activity in a project phase, an activity named "End Phase X" where "X" identifies the phase of work. The "End Phase X" activity shall be zero duration with an unconstrained late finish date equal to the contract phase completion date. This unconstrained completion date is not a release from contractually required finish dates but is left unconstrained to allow the schedule logic to calculate without hindrance.

s. Early Phase Completion: If the Design-Builder expects to finish prior to the contract phase completion date, the milestone will show an early finish date equal to the Design-Builder's early finish date. The name of the activity will be "Early Phase Completion" and will be

zero duration with an unconstrained date representing the Design-Builder's early phase completion date.

t. Summary Activities: The Design-Builder shall include special activities that are a summary of a chain of activities. The start of the activity will be the start date of the first activity in the chain and the finish date will be the finish date of the last activity in the chain. Generalized work sequences, Categories of Work and all Phase of Work activity chains will be summarized.

u. Activity/Event Constraints: Date/time constraint(s), other than those required by the contract, will not be allowed unless accepted by the Owner.

v. Leads and Lags: Leads or lags will not be used when the creation of an activity will perform the same function (e.g., concrete cure time). Lag durations contained in the project schedule shall not have a negative value. The use of any lead or lag will be explained in the Narrative Report.

w. Default Progress Data Disallowed: Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in the CPM scheduling software system. Actual Start and Actual Finish dates on the CPM schedule shall match the dates provided from Design-Builder Quality Control and Production Reports. These reports will be the sole basis for updating the schedule. Work activities will be updated by actual work progression rather than being cash flow driven. The updating of the percent complete and the remaining duration of any activity shall be independent functions; program features that calculate one of these parameters from the other shall be disabled. Out-of-Sequence progress (if applicable) shall be handled through Retained Logic, not the Default Option of Progress Override. Actual labor and equipment hours used on activities will be derived from the daily reports.

1.6.3 Mathematical Analysis

The network diagram mathematical analysis shall include a tabulation of each activity shown on the detailed network diagrams. Provide the following information as a minimum for each activity:

a. Activity/Event number

b. Activity/Event description

c. Estimated duration of activities (by work days)

d. Earliest start date (by calendar date)

e. Earliest finish date (by calendar date)

f. Actual start date (by calendar date)

g. Actual finish date (by calendar date)

h. Latest start date (by calendar date)

i. Latest finish date (by calendar date)

j. Total float or slack

k. Material/Equipment costs will be assigned to their respective Procurement Activities (i.e., the delivery activity). Costs for installation of the material/equipment (labor, construction equipment, and temporary materials) will be assigned to their respective Construction Activities. The value of inspection/testing activities will not be less than 10 percent of the

total costs for Procurement and Construction Activities. Evenly disperse overhead and profit to each activity over the duration of the project.

l. Responsibility code (including prime Design-Builder, subcontractors, suppliers, Owner, or other party responsible for accomplishment of an activity.)

m. Area Code

n. Manpower required (crew size) - If required by Owner

o. Percentage of activity duration completed

p. Design-Builder's earnings based on accepted work-in-place.

The program or means used in making the mathematical computation shall be capable of compiling the total value of completed and partially completed activities. The program shall also be capable of accepting revised completion dates as modified by approved time extensions and recompilation of tabulation dates/costs and float accordingly. The total of all cost loaded activities; including costs for material and equipment delivered for installation on the project, and manpower and construction equipment loaded construction activities, shall total to 100 percent of the value of the contract.

1.6.4 Additional Requirements

In addition to the tabulation of activities, in the Paragraph entitled "Mathematical Analysis", include the following data (if requested by Owner):

a. Not Used.

b. Equipment loading schedule: Include a description of the major items of construction equipment planned for each construction activity on the project. The description shall include the year, make, model, and capacity. If no equipment is required for an activity, then the activity shall be identified as using zero equipment per day.

1.6.5 Required Reports (unless otherwise agreed with the Owner)

The following reports will be made available in the schedule submittals and in each updated schedule submission provided on disk by the Design-Builder:

a. By the preceding event number from lowest to highest and then in the order of the following activity number (Activity Identification Report) showing the current status of all activities.

b. By the amount of total float, from lowest to highest and then in order of [activity number] [early start date] (Total Float or Slack Report) showing all incomplete activities.

c. By latest allowable start dates and then in order of activity numbers (Late Start Report).

d. Earned Value Report listing all activities having a budget amount and cost. A compilation of total earnings on the project from the notice to proceed to the most recent monthly progress payment request and the difference between the previous request amount and the current payment request amount. Sort report first by resource and then by activity.

e. By earliest allowable start dates and then in order of activity number (Early Start Report).

f. By tasks scheduled to start and finish by the end of the next pay period (30-Day Look Ahead).

g. With each updated schedule submission, provide a computer generated Log Report using a recognized schedule comparison software listing all changes made between the previous schedule and current updated schedule. Identify the name of the previous schedule and name of the current schedule being compared. This report will as a minimum show changes for: Added & Deleted Activities, Original Durations, Remaining Durations, Activity Percent Complete, Total Float (or Slack), Free Float, Calendars, Descriptions, Constraints (added, deleted or changed), Actual Starts/Finishes, Added/Deleted Resources, Resource Quantities, Costs, Resource Percents, Added/Deleted Relations, Changed Relation Lags, Changed Driving Relations, and Changed Critical Status.

h. By the activity number from lowest to highest, showing preceding and succeeding activity numbers for each activity (Predecessor/Successor Report), and showing the current status of each activity.

i. Not Used.

j. Equipment usage report and histogram: With each update schedule, a planned early and planned late versus actual equipment resource histogram will be provided. This histogram shall be based upon and shall be in agreement with the equipment allocation accepted on the Accepted Network Analysis Schedule (planned) and the Monthly Network Update (actual). Included in the report will be a tabular report that will list equipment (by make and model) to the activities that were worked on during the construction period.

1.7 SUBMISSION AND ACCEPTANCE

1.7.1 Preliminary Meeting

Prior to preparing the schedule, the Owner, Design-Builder and major subcontractors shall participate in a preliminary meeting to discuss the proposed schedule and requirements of this section prior to submission of the network. The definition of a "major subcontractors" is one that exceeds 5 percent of the contract value.

1.7.2 Network Analysis Schedule

Submit the complete network system, consisting of the network mathematical analysis and network diagrams with the 100% Design Submittal. Submit electronically to the Owner a diagram described in the paragraph entitled "Diagrams", the required reports listed in the paragraph entitled "Required Reports", the analysis described in the paragraph entitled "Mathematical Analysis", and information required by the paragraph entitled "Additional Requirements". As part of this submittal, provide the Project Name format (and Project Group Name if used) that will be used by the Design-Builder to identify initial schedule submittals, updates, fragnets, changes, etc.

1.7.3 Review and Evaluation

After the Owner's review, the Design-Builder shall meet with the Owner to discuss the review and evaluation of the NAS submittal. Revisions necessary as a result of this review shall be resubmitted for acceptance within 3 calendar days after the meeting.

1.7.4 Accepted Network Analysis Schedule

Once review comments are resolved and the network has been accepted by the Owner, the Design-Builder shall within 3 calendar days furnish electronically:

a. The network diagrams.

b. The required reports listed in paragraph entitled "Required Reports".

c. The "Mathematical Analysis".

d. The Cash Flow Report indicating the cash flow based upon both the early and late start schedules.

e. Each major subcontractor's statement certifying their concurrence with the Design-Builder's Accepted Network Analysis Schedule. Each certifying statement will be made on the subcontractor's letterhead.

For major revisions, updates or changes to the network diagrams, once accepted by the Owner, the Design-Builder shall submit these same diagrams and reports.

1.7.5 Monthly Network Analysis Updates

At monthly intervals the Design-Builder, Owner representatives will meet to jointly update the project schedule and agree on percentage of payment for each activity progressed during the update period. The purpose of the meeting is to determine progress payment amounts for each activity, allow all parties to evaluate project status at the data date, provide a complete and accurate update of procurement and construction progress, create an historical record of the project and establish prediction of completion date(s) based upon current status. The Design-Builder is responsible to gather all supporting documentation propose the update data for the schedule and record the meeting minutes. All progress payment amounts will be derived from and tied to the cost-loaded schedule activities. Submit at monthly intervals a report of the actual construction progress by updating the required reports, the time scaled logic diagram, and mathematical analysis. Meeting to update the schedule and the submission of an error free, acceptable updated schedule to the Owner is a condition precedent to the processing of the Design-Builder's pay request. As a minimum, the following actions will be accomplished during the meeting:

a. Identify activities started and completed during the previous period and enter the Actual Start and Actual Finish dates.

b. Show estimated duration (in workdays) to complete each activity started but not completed (remaining duration).

c. Indicate percentage of cost payable for each activity.

d. Reflect changes in the network diagram. All changes (i.e., duration changes, logic changes, new logic, conformed change orders, new activities, changes due to Conformed Modifications, changes in work sequence, etc.) shall be recorded and a note added to the activity log field. The log shall include as a minimum, the date and reason for the change, and description of the change.

e. Submit electronically a Narrative Report describing: 1) Progress made in each area of the project; 2) Changes in the following; activities, original durations, logic interdependencies, milestones, planned sequence of operations, critical path, and resource and loading; 3) Pending items and status thereof, including permits, change orders, and time extensions; 4) Status of Contract Completion Date and interim milestones; 5) Current and anticipated delays (describe cause of the delay and corrective action(s)); and 6) Description of current and future schedule problem areas. Each entry in the narrative report will cite the respective Activity ID and Activity Description.

f. Submit electronically the required reports listed in paragraph entitled "Required Reports".

g. Submit electronically of the Update Meeting minutes.

1.7.6 As-Built Schedule

As a condition precedent to the release of retention, the last update of the schedule submitted shall be identified by the Design-Builder as the "As-Built Schedule". The As Built shall reflect the exact manner in which the project was actually constructed (including actual start and finish dates, activities, sequences, and logic) and shall be certified by the Design-Builder's Project Manager and Construction Scheduled as being a true reflection of the way the project was actually constructed. If more than one person filled the position(s) during the course of the project, each person will provide certification for the period of time they were responsible.

1.8 CONTRACT MODIFICATION

When a contract modification to the work is required, submit proposed revisions to the network with a fragnet and a cost proposal for each proposed change. All modifications shall be incorporated into the network analysis system as separately identifiable activities broken down and inserted appropriately on the first update following issuance of a directive to proceed with the change. Submit one copy of the Total Float Report, Log Report and a copy of the proposed Time Impact Analysis electronically, with the cost proposal. Unless the Owner requests otherwise, only conformed contract modification fragnets will be added into the subsequent monthly updates. All revisions to the current baseline schedule activities that are necessary to further refine the schedule so that the changed work activities can be logically tied to the schedule shall be made. Financial data shall not be incorporated into the schedule until the contract modification is signed by the Owner.

1.8.1 Time Impact Analysis:

Time Impact Analysis shall be used by the Owner in determining if a time extension or reduction to the contract milestone date(s) is justified. The Design-Builder shall provide a Time Impact Analysis to the Owner for any proposed contract change or as support for a Value Engineering Proposal, Claim or Request for Equitable Adjustment by the Design-Builder.

a. The Design-Builder shall submit a Time Impact Analysis (TIA) illustrating the influence of each change or delay on the Contract Completion Date or milestones. Unless the Owner requests an interim update to the schedule, the current monthly updated schedule accepted by the Owner shall be used to display the impacts of the change. Unless requested by the Owner, no other non-conformed changes will be incorporated into the schedule being used to justify the change impact.

b. Each TIA shall include a Fragmentary Network (fragnet) demonstrating how the Design-Builder proposes to incorporate the impact into the Project Schedule. A fragnet is defined as the sequence of new activities and/or activity revisions, logic relationships and resource changes that are proposed to be added to the existing schedule to demonstrate the influence of impacts to the schedule. The fragnet shall identify the predecessors to the new activities and demonstrate the impacts to successor activities. Include a narrative report describing the effects of new activities and relationships to interim and contract completion dates, with each TIA.

c. Following the Design-Builder's receipt of a contract modification on a Standard Form signed by the Owner; all changes in the fragnet used to determine impacts, shall be incorporated into the schedule. Changes will occur during the next monthly schedule update meeting.

1.8.2 No Reservation-Of-Rights

All direct costs, indirect costs, and time extensions will be negotiated and made full, equitable and final at the time of modification issuance.

1.9 CHANGES TO THE NETWORK ANALYSIS SCHEDULE

If changes in the method of operating and scheduling are desired, the Owner shall be notified in writing stating the reasons for the change. If the Owner considers these changes to be of a major nature, the Design-Builder may be required to revise and submit for acceptance, without additional cost to the Owner, the network diagrams and required sorts. A change may be considered of a major nature if the estimated time required or actually used for an activity or the network logic is varied from the original plan to a degree that there is a reasonable doubt as to the effect on the contract completion date(s) [or phase completion dates]. Changes that affect activities with adequate float time shall be considered a major change when their cumulative effect could extend the contract completion date.

1.10 FLOAT

Use of float suppression techniques, such as; preferential sequencing (arranging critical path through activities more susceptible to Owner caused delay), special lead/lag logic restraints, zero total or free float constraints, extended activity times, or imposing constraint dates other than as required by the contract, shall be cause for rejection of the project schedule or its updates. The use of Resource Leveling (or similar software features) used for the purpose of artificially adjusting activity durations to consume float and influence the critical path is expressly prohibited.

1.10.1 Definitions of Float or Slack

Free Float is the length of time the start of an activity can be delayed without delaying the start of a successor activity. Total Float is the length of time along a given network path that the actual start and finish of activity(s) can be delayed without delaying the project completion date. Project Float is the length of time between the Design-Builder's Early Completion (or Substantial Completion) and the Contract Completion Date.

1.10.2 Ownership of Float

Float available in the schedule, at any time shall not be considered for the exclusive use of either the Owner or the Design-Builder. During the course of contract execution, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. Efficiencies gained as a result of favorable weather within a calendar month, where the number of days of normally anticipated weather is less than expected, will also contribute to the reserve of float. A schedule showing work completing in less time than the Contract time, and accepted by the Owner, will be considered to have Project Float. Project Float will be a resource available to both the Owner and the Design-Builder. No time extensions will be granted nor delay damages paid unless a delay occurs which impacts the Project's critical path, consumes all available float or contingency time, and extends the work beyond the Contract Completion Date.

1.10.3 Negative Float

Negative float will not be a basis for requesting time extensions. Any extension of time will be addressed in accordance with the Paragraph "Time Extensions". Scheduled completion date(s) that extend beyond the contract [or phase] completion date(s) (evidenced by negative float) may be used in computations for assessment of payment withholdings. The use of this computation is not to be construed as a means of acceleration.

1.11 TIME EXTENSIONS

Extension of time for performance required under the clauses entitled " Changes to the Contract Price and Time," "Differing Site Conditions," "Default (Fixed-Price Construction)" or "Suspension of Work" will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total float or slack along the network paths involved at the time Notice to Proceed was issued for the change. The Design-Builder acknowledges and agrees that delays in activities which, according to the network analysis schedule, does not in fact actually affect any milestone completion dates or the contract completion date shown on the CPM network at the time of delay, will not be a basis for a contract extension. Submit time extension requests with a Time Impact Analysis and three copies of the Total Float (or Slack) Report, Narrative Report and Log Report.

1.12 MONTHLY COORDINATION MEETING

In conjunction with receipt of the Monthly Network Update submission, a coordination meeting will be held each month [on site] [in the Owner's conference room or virtually] to discuss the report. The Design-Builder shall make a presentation of the previously submitted and current Monthly Network Update to the Owner so as to provide an overview of the project's schedule and provide an opportunity to discuss items of coordination.

1.13 BIWEEKLY WORK SCHEDULE

To provide a more detailed day-to-day planning of upcoming work, the Design-Builder shall prepare and issue detailed work plans that coordinate with and supplement the above defined network analysis. The work plans shall be keyed to the CPM activity numbers and shall be submitted each week and shall show the projects activities that will occur during the following two-week interval. Additionally, the critical path activities are to be identified on the Biweekly Work Plan. The detail work plans are to be bar chart type schedules prepared by the Design-Builder in sufficient detail to define the work to be accomplished, the crews, construction tools and equipment to be used during the current and next two-week interval. The bar charts shall be formatted to allow reproduction on 8 1/2 by 11 sheets. Electronic copy of the bar chart schedules shall be delivered to the Owner not less than 3 work hours prior to the start of the weekly coordination meeting.

1.14 WEEKLY COORDINATION MEETING

In conjunction with the receipt of the Bi-Weekly Work Schedule, a coordination meeting will be held each week on site to discuss the work schedule. The Design-Builder shall make a presentation of the previously submitted and current Bi-Weekly Work Schedule to the Owner so as to provide an overview of the project's schedule and provide an opportunity to discuss items of coordination. Consideration of materials, crews, and equipment shall be addressed to ascertain their respective availability. The meeting shall identify actions necessary to provide adherence to the Bi-Weekly Work Schedule and the overall network for the project defined above. The Design-Builder will take meeting minutes. All meeting minute entries will be keyed to the schedule activity number(s) being addressed. Within one day of the meeting, the Design-Builder will provide a draft copy of

the meeting minutes to the Owner for review and comment. Final copies of the minutes containing the comments provided by the Owner, will be issued within 3 days of the meeting.

1.15 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minutes, Production and QC Daily Reports, material delivery tickets, photographs, etc.) shall reference the Schedule Activity Number(s) that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure, etc.) shall reference the Schedule Activity Number(s) that are being addressed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section—

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A880	(1995) Criteria for Use in Evaluation of Testing Laboratories and Organization for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

Los Angeles County Public Works Building & Safety Response Regarding COVID-19

Occupational Safety and Health Administration

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Quality Control (QC) plan; G

Submit a QC plan within 5 calendar days after receipt of Notice of Award.

The QC Plan shall include a preliminary submittal of the list of definable features of work that shall cover the first 90 days of construction.

Submit the completed list of definable features of work in conjunction with the Accepted Network Analysis Schedule.

Any acceptance by the Owner of the QC Plan shall be considered to be "accepted as noted, resubmittal required" and will be in effect only until the completed list of definable features of work is received and accepted. If the completed list of definable features of work and accepted network schedule is not received within the time indicated in the paragraph entitled "Accepted Network Analysis Schedule" of Section 013210 "Network Analysis Schedules," the QC Plan will become rejected and all work, except for the work authorized in the paragraph entitled "Preliminary Work Authorized Prior to acceptance," will stop.

1.3 INFORMATION FOR THE OWNER

The Design-Builder shall deliver the following reports to the Owner. The report forms will consist of the Design-Builder Production Report, Design-Builder Production Report (Continuation Sheet), Contractor Quality Control Report, Design-Builder Quality Control Report (Continuation Sheet), Preparatory Phase Checklist, Initial Phase Checklist, Rework Items List, and Testing Plan and Log. Referenced below may be in formats customarily used by the Contractor, Testing Laboratories, etc. and will contain the information required by this specification.

a. Design-Builder Quality Control Report; electronically, by 10:00 AM the next working day after each day that work is performed.

b. Design-Builder Production Report: electronically, by 10:00 AM the next working day after each day that work is performed, attached to the Contractor Quality Control Report.

c. Preparatory Phase Checklist: electronically, original attached to the original Design-Builder Quality Control Report.

d. Initial Phase Checklist: Original attached to the original Design-Builder Quality Control Report

e. QC specialist Reports: electronically, originals and 1 copy, by 10:00 AM the next working day after each day that work is performed, attached to the Design-Builder Quality Control Report.

f. Field Test Reports: electronically, within 2 working days after the test is performed, attached to the Design-Builder Quality Control Report.

g. Monthly Summary Report of Tests: electronically, attached to the Design-Builder Quality Control Report.

h. Testing Plan and Log, electronically, at the end of each month.

i. Rework Items List: electronically, by the last working day of the month.

j. QC Meeting Minutes: electronically, within 2 working days after the meeting.

k. QC Certifications: As required by the paragraph entitled "QC Certifications."

1.4 QC PROGRAM REQUIREMENTS

Establish and maintain a QC program as described in this section. The QC program consists of a QC Organization, a QC Plan, a QC Plan Meeting, a Coordination and Mutual Understanding Meeting, QC meetings, three phases of control, submittal review and acceptance , testing, completion inspections, and QC certifications and documentation necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with the requirements of this Contract. The QC program shall cover on-site and off-site work and shall be keyed to the work sequence. No work or testing may be performed unless the Design-Builder QC Manager is on the work site. The QC Manager shall report to an officer of the firm and shall not be subordinate to the Project Superintendent or the Project Manager. The QC Manager, Project Superintendent and Project Manager must work together effectively. Although the Quality Control Manager is the primary individual responsible for quality control, all three individuals will be held responsible for the quality of work on the job. The project superintendent will be held responsible for the quality of production.

1.4.1 Preliminary Work Authorized Prior to Acceptance

The only work that is authorized to proceed prior to the acceptance of the QC Plan is mobilization to establish field offices , temporary utilities, and surveying.

1.4.2 Acceptance

Acceptance of the QC Plan is required prior to the start of construction. The Owner reserves the right to require changes in the QC Plan and operations as necessary, including removal of personnel, to ensure the specified quality of work. The Owner reserves the right to interview any member of the QC organization at any time in order to verify the submitted qualifications. All QC organization personnel shall be subject to acceptance by the Owner. The Owner may require the removal of any individual for non-compliance with quality requirements specified in the contract.

1.4.3 Notification of Changes

Notify the Owner, in writing, of any proposed change, including changes in the QC organization personnel, a minimum of seven calendar days prior to a proposed change. Proposed changes shall be subject to acceptance by the Owner.

1.5 QC ORGANIZATION

1.5.1 QC Manager

1.5.1.1 Duties

Provide a QC Manager at the work site to implement and manage the QC program. The only duties and responsibilities of the QC Manager are to manage and implement the QC program on this contract. The QC Manager shall not be designated as the safety competent person. The QC Manager is required to attend the QC Plan Meeting, attend the Coordination and Mutual Understanding Meeting, conduct the QC meetings, perform the three phases of control, perform submittal review and acceptance, ensure testing is performed and provide QC certifications and documentation required in this contract. The QC Manager is responsible for managing and coordinating the three phases of control and documentation performed by the QC specialists, Testing Laboratory personnel and any other inspection and testing personnel required by this Contract.

1.5.1.2 Qualifications

An individual with a minimum of 10 years' experience as a superintendent, inspector, QC Manager, project manager, project engineer or construction manager on similar size and type construction contracts which included the major trades that are part of this Contract. The individual must be familiar with the requirements of -1 the Public works and OSHA, and have experience in the areas of safety compliance.

1.5.1.3 Construction Quality Management Training

In addition to the above experience and education requirements, the QC Manager shall have completed the course entitled "Construction Quality Management for Contractors." If the QC Manager does not have a current certification, they shall obtain the CQM course certification within 90 days of award.

1.5.2 Alternate QC Manager Duties and Qualifications

Designate an alternate for the QC Manager at the work site to serve in the event of the designated QC Manager's absence. The period of absence may not exceed two weeks at one time, and not

more than 30 workdays during a calendar year. The qualification requirements for the Alternate QC Manager shall be the same as for the QC manager.

1.5.3 QC Specialists Duties and Qualifications

Provide a separate QC specialist at the work site for each of the areas of responsibilities, specified below, who shall assist and report to the QC Manager and who may perform production related duties but must be allowed sufficient time to perform their assigned quality control duties. QC specialists are required to attend the Coordination and Mutual Understanding Meeting, QC meetings, and be physically present at the construction site to perform the three phases of control and prepare documentation for each definable feature of work in their area of responsibility. Submit qualifications of the QC Specialists for each discipline for approval of the Owner.

1.5.4 Submittal Reviewers Duties and Qualifications

Provide Submittal Reviewers, other than the QC Manager, qualified in the disciplines being reviewed, to review and certify that the submittals meet the requirements of this Contract prior to certification or approval by the QC Manager. Submit qualifications of the Submittal Reviewers for each discipline for approval of the Owner.

1.5.5 QC Assistant

Provide an Administrative Assistant at the work site until the work has been accepted. The primary duty shall be to assist the QC Manager in processing and maintaining files for submittals, preparing and publishing reports and meeting minutes. After primary duties are accomplished, other duties may be assigned provided the duties do not interfere with primary duties.

1.6 QUALITY CONTROL (QC) PLAN

1.6.1 Requirements

Provide, for acceptance by the Owner, a QC plan submitted electronically and (if required)in a 3-ring binder with pages numbered sequentially that covers both on-site and off-site work and includes the following:

a. A table of contents listing the major sections identified with tabs in the following order:

I. QC ORGANIZATION
II. NAMES AND QUALIFICATIONS
III. DUTIES, RESPONSIBILITY AND AUTHORITY OF QC PERSONNEL
IV. OUTSIDE ORGANIZATIONS
V. APPOINTMENT LETTERS
VI. SUBMITTAL PROCEDURES AND INITIAL SUBMITTAL REGISTER
VII. TESTING LABORATORY INFORMATION
VIII. TESTING PLAN AND LOG
IX. PROCEDURES TO COMPLETE REWORK ITEMS
X. DOCUMENTATION PROCEDURES
XI. LIST OF DEFINABLE FEATURES
XII. PROCEDURES FOR PERFORMING THE THREE PHASES OF CONTROL
XIII. PERSONNEL MATRIX
XIV. PROCEDURES FOR COMPLETION INSPECTION

b. A chart showing the QC organizational structure.

c. Names and qualifications, in resume format, for each person in the QC organization. Include the CQM course certifications for the QC Manager and Alternate QC Manager as required by the paragraphs entitled "Construction Quality Management Training" and "Alternate QC Manager Duties and Qualifications".

d. Duties, responsibilities and authorities of each person in the QC organization.

e. A listing of outside organizations such as, architectural and consulting engineering firms that will be employed by the Contractor and a description of the services these firms will provide.

f. Letters signed by an authorized personnel of the firm appointing the QC Manager and Alternate QC Manager and stating that they are responsible for implementing and managing the QC program as described in this contract. Include in this letter the responsibility of the QC Manager and Alternate QC Manager to implement and manage the three phases of quality control, and their authority to stop work which is not in compliance with the contract. The QC Manager shall issue letters of direction to all other QC specialists outlining their duties, authorities, and responsibilities. Copies of the letters shall be included in the QC plan.

g. Procedures for reviewing, approving and managing submittals. Provide the names of the persons in the QC organization authorized to review and certify submittals prior to acceptance. Provide the initial submittal of the Submittal Register as specified in section entitled "Submittal Procedures."

h. Testing laboratory information required by the paragraphs entitled "Accreditation Requirements" or "Construction Materials Testing Laboratory Requirements", as applicable.

i. A Testing Plan and Log that includes the tests required, referenced by the specification paragraph number requiring the test, the frequency, and the person responsible for each test.

j. Procedures to identify, record, track and complete rework items.

k. Documentation procedures, including proposed report formats.

l. List of definable features of work. A definable feature of work (DFOW) is a task which is separate and distinct from other tasks, has the same control requirements and work crews. The list shall be cross-referenced to the contractor's Construction Schedule and the specification sections. For projects requiring a Progress Chart, the list of definable features of work shall include but not be limited to all items of work on the schedule. For projects requiring a Network Analysis Schedule, the list of definable features of work shall include but not be limited to all critical path activities.

m. Procedures for Performing the Three Phases of Control. For each DFOW, provide the DFOW's Preparatory and Initial Phase Checklists. Each list shall include a breakdown of quality checks that will be used when performing the quality control functions, inspections, and tests required by the contract documents. The Preparatory and Initial Phases and meetings shall be conducted with a view towards obtaining quality construction by planning ahead and identifying potential problems for each definable feature of work.

n. A personnel matrix showing for each section of the specification who will review and approve submittals, who will perform and document the three phases of control, and who will perform and document the testing.

o. Procedures for Identifying and Documenting the Completion Inspection process. Include in these procedures the responsible party for punch out inspection, prefinal inspection, and final acceptance inspection.

1.7 QC PLAN MEETING

Prior to submission of the QC plan, meet with the Owner to discuss the QC plan requirements of this Contract. The purpose of this meeting is to develop a mutual understanding of the QC plan requirements prior to plan development and submission.

1.8 COORDINATION AND MUTUAL UNDERSTANDING MEETING

After submission of the QC Plan, and prior to the start of construction, meet with the Owner to present the QC program required by this Contract. The purpose of this meeting is to develop a mutual understanding of the QC details, including documentation, administration for on-site and off-site work, and the coordination of the Design-Builder's management, production and QC personnel. At the meeting, the Design-Builder`s will be required to explain in detail how three phases of control will be implemented for each definable feature of work. As a minimum, the Design-Builder's personnel required to attend shall include an authorized personnel of the firm, the project manager, project superintendent, QC Manager, Alternate QC Manager, QC specialists, Design-Builder A/E, and subcontractor representatives. Each subcontractor who will be assigned QC responsibilities shall have a principal of the firm at the meeting. Minutes of the meeting will be prepared by the Design-Builder's QC Manager and signed by the Design-Builder, the A/E and the Owner. A copy of the signed minutes shall be provided to all attendees by the Contractor. Repeat the coordination and mutual understanding meeting when a new QC Manager is appointed.

1.9 QC MEETINGS

After the start of construction, the QC Manager shall conduct weekly QC meetings at the work site with the project superintendent and QC specialists. The QC Manager shall prepare the minutes of the meeting and provide a copy to the Owner within 2 working days after the meeting. The Owner may attend these meetings. The QC Manager shall notify the Owner at least 48 hours in advance of each meeting. As a minimum, the following shall be accomplished at each meeting:

a. Review the minutes of the previous meeting;

b. Review the schedule and the status of work:

(1) Work or testing accomplished since last meeting

(2) Rework items identified since last meeting

(3) Rework items completed since last meeting;

c. Review the status of submittals:

(1) Submittals reviewed and accepted since last meeting

(2) Submittals required in the near future;

d. Review the work to be accomplished in the next 2 weeks and documentation required:

(1) Establish completion dates for rework items

(2) Update the schedule showing planned and actual dates of the preparatory, initial and follow-up phases, including testing and any other inspection required by this contract

(3) Discuss construction methods and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work

(4) Discuss status of off-site work or testing

(5) Documentation required;

(6) Discuss upcoming Activity Hazard Analyses (if found during construction):

e. Resolve QC and production problems:

(1) Assist in resolving Request for Information issues; and

f. Address items that may require revising the QC plan:

(1) Changes in QC organization personnel

(2) Changes in procedures.

g. Review health – COVID 19 and safety plan

1.10 THREE PHASES OF CONTROL

The Three Phases of Control shall adequately cover both on-site and off-site work and shall include the following for each definable feature of work.

1.10.1 Preparatory Phase

Notify the Owner at least 2 work days in advance of each preparatory phase. This phase shall include a meeting conducted by the QC Manager and attended by the QC specialists, the superintendent, and the foreman responsible for the definable feature. Document the results of the preparatory phase actions in the daily Contractor Quality Control Report and in the Preparatory Phase Checklist. Perform the following prior to beginning work on each definable feature of work:

a. Review each paragraph of the applicable specification sections;

b. Review the Contract drawings;

c. Verify that appropriate shop drawings and submittals for materials and equipment have been submitted and approved. Verify receipt of approved factory test results, when required;

d. Review the testing plan and ensure that provisions have been made to provide the required QC testing;

e. Examine the work area to ensure that the required preliminary work has been completed;

f. Examine the required materials, equipment and sample work to ensure that they are on hand and conform to the approved shop drawings and submitted data;

g. Discuss construction methods, construction tolerances, workmanship standards, and the approach that will be used to provide quality construction by planning ahead and identifying potential problems for each definable feature of work; and

h. Review the safety plan and appropriate activity hazard analysis to ensure that applicable safety requirements are met, and that required Material Safety Data Sheets (MSDS) are submitted.

1.10.2 Initial Phase

Notify the Owner at least 2 work days in advance of each initial phase. When construction crews are ready to start work on a definable feature of work, conduct the initial phase with the QC Specialists, the superintendent, and the foreman responsible for that definable feature of work. Observe the initial segment of the definable feature of work to ensure that the work complies with Contract requirements. Document the results of the initial phase in the daily Contractor Quality Control Report and in the Initial Phase Checklist. Repeat the initial phase for each new crew to work on-site, or when acceptable levels of specified quality are not being met. Perform the following for each definable feature of work:

a. Establish the quality of workmanship required;

b. Resolve conflicts;

c. Ensure that testing is performed by the approved laboratory, and

d. Check work procedures for compliance with the Safety Plan and the appropriate activity hazard analysis (if found during construction) to ensure that applicable safety requirements are met.

1.10.3 Follow-Up Phase

Perform the following for on-going work daily, or more frequently as necessary until the completion of each definable feature of work and document in the daily Design-Builder's Quality Control Report:

a. Ensure the work is in compliance with Contract requirements;

b. Maintain the quality of workmanship required;

c. Ensure that testing is performed by the approved laboratory;

d. Ensure that rework items are being corrected; and

e. Perform safety inspections.

1.10.4 Additional Preparatory and Initial Phases

Additional Preparatory and Initial Phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable QC organization, if there are changes in the on-site production supervision or work crew, if work on a definable feature is resumed after substantial period of inactivity, or if other problems develop.

1.10.5 Notification of Three Phases of Control for Off-Site Work

Notify the Owner at least two weeks prior to the start of the preparatory and initial phases.

1.11 SUBMITTAL REVIEW AND ACCEPTANCE

Procedures for submission, review and acceptance of submittals are described in section entitled "Submittal Procedures."

1.12 TESTING

Except as stated otherwise in the specification sections, perform sampling and testing required under this Contract.

1.12.1 Not Used

1.12.2 Construction Materials Testing Laboratory Requirements

Provide an independent construction materials testing laboratory accredited by an acceptable laboratory accreditation authority to perform sampling and tests required by this Contract. Testing laboratories that have obtained accreditation by an acceptable laboratory accreditation authority listed in the paragraph entitled "Laboratory Accreditation Authorities" submit to the Owner, a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation shall include the test methods required by the Contract. For testing laboratories that have not yet obtained accreditation by an acceptable laboratory accreditation authority listed in the paragraph entitled "Laboratory Accreditation Authorities" submit an acknowledgment letter from one of the laboratory accreditation authorities indicating that the application for accreditation has been received and the accreditation process has started, and submit to the Owner for acceptance, certified statements, signed by an official of the testing laboratory attesting that the proposed laboratory, meets or conforms to the ASTM standards listed below as appropriate to the testing field.

a. Laboratories engaged in testing of construction materials shall meet the requirements of ASTM E329.

b. Laboratories engaged in testing of concrete and concrete aggregates shall meet the requirements of ASTM C1077.

c. Not Used

d. Not Used

e. Laboratories engaged in inspection and testing of steel, stainless steel, and related alloys will be evaluated according to ASTM A880.

f. Not Used

g. Laboratories engaged in Hazardous Materials Testing shall meet the requirements of OSHA and EPA. (If required)

1.12.3 Laboratory Accreditation Authorities

Laboratory Accreditation Authorities are the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology and the American Association for Laboratory Accreditation (A2LA) program and the Washington Association of Building Officials (WABO) (Approval authority for WABO is limited to projects within Washington State), and as accepted by the Owner.

Furnish to the Owner, a copy of the Certificate of Accreditation and Scope of Accreditation. The scope of the laboratory's accreditation shall include the test methods required by the Contract.

1.12.4 Capability Check

The Owner retains the right to check laboratory equipment in the proposed laboratory and the laboratory technician's testing procedures, techniques, and other items pertinent to testing, for compliance with the standards set forth in this Contract.

1.12.5 Test Results

Cite applicable Contract requirements, tests or analytical procedures used. Provide actual results and include a statement that the item tested or analyzed conforms or fails to conform to specified requirements. If the item fails to conform, notify Owner immediately. Conspicuously stamp the cover sheet for each report in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements, whichever is applicable. Test results shall be signed by a testing laboratory representative authorized to sign certified test reports. Furnish the signed reports, certifications, and other documentation to the Owner via the QC Manager. Furnish a summary report of field tests at the end of each month. Attach a copy of the summary report to the last daily Design-Builder Quality Control Report of each month.

1.12.6 Test Reports and Monthly Summary Report of Tests

The QC Manager shall furnish the signed reports, certifications, and a summary report of field tests at the end of each month to the Owner. Attach a copy of the summary report to the last daily Design-Builder Quality Control Report of each month.

1.13 QC CERTIFICATIONS

1.13.1 Design-Builder Quality Control Report Certification

Each Design-Builder Quality Control Report shall contain the following statement: "On behalf of the Design-Builder, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge, except as noted in this report."

1.13.2 Invoice Certification

Furnish a certificate to the Owner with each payment request, signed by the QC Manager, attesting that as-built drawings are current and attesting that the work for which payment is requested, including stored material, is in compliance with contract requirements.

1.13.3 Completion Certification

Upon completion of work under this Contract, the Design-Builder QC Manager shall furnish a certificate to the Owner attesting that "the work has been completed, inspected, tested and is in compliance with the Contract."

1.14 COMPLETION INSPECTIONS

1.14.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Contract Article 5 entitled "Contract Time," or stated elsewhere in the specifications, the QC Manager shall conduct an inspection of the work and develop a "punch list" of items which do

not conform to the approved drawings and specifications. Include in the punch list any remaining items on the "Rework Items List" which were not corrected prior to the Punch-Out Inspection. The punch list shall include the estimated date by which the deficiencies will be corrected. A copy of the punch list shall be provided to the Owner. The Design-Builder QC Manager or its QC team shall make follow-on inspections to ascertain that all deficiencies have been corrected. Once this is accomplished the Design-Builder shall notify the Owner that the facility is ready for the Owner "Pre-Final Inspection."

1.14.2 Pre-Final Inspection

The Owner will perform this inspection to verify that the facility is complete and ready to be occupied. An Owner "Pre-Final Punch List" may be developed as a result of this inspection. The Design-Builder QC Manager shall ensure that all items on this list are corrected prior to notifying the Owner that a "Final" inspection with the customer can be scheduled. Any items noted on the "Pre-Final" inspection shall be corrected in timely manner and shall be accomplished before the contract completion date for the work or any particular increment thereof if the project is divided into increments by separate completion dates.

1.14.3 Final Acceptance Inspection

The Design-Builder QC Manager, the QC specialists, the superintendent or other primary Design-Builder management personnel, and the Owner's representative will be in attendance at this inspection. Additional Owner personnel may be in attendance. The final acceptance inspection will be formally scheduled by the Owner based upon results of the "Pre-Final" inspection. Notice shall be given to the Owner at least 14 days prior to the final inspection stating that all specific items previously identified to the Design-Builder as being unacceptable, along with all the remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Owner to bill the Design-Builder for the Owner's additional inspection cost in accordance with the Contract Clause entitled "Inspection of Construction."

1.15 DOCUMENTATION

Maintain current and complete records of on-site and off-site QC program operations and activities.

1.15.1 Contractor Production Report

Reports are required for each day that work is performed and shall be attached to the Design-Builder Quality Control Report prepared for the same day. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Contractor Production Reports are to be prepared, signed and dated by the project superintendent and shall contain the following information:

a. Date of report, report number, name of contractor, Contract number, title and location of Contract and superintendent present.

b. Weather conditions in the morning and in the afternoon including maximum and minimum temperatures.

c. Identify work performed by corresponding Schedule Activity No., PC#, Modification No., etc.

d. A list of Contractor and subcontractor personnel on the work site, their trades, employer, work location, description of work performed, hours worked by trade, daily total work hours on work site this date (incl hours on continuation sheets), and total work hours from start of construction.

e. A list of job safety actions taken and safety inspections conducted. Indicate that safety requirements have been met including the results on the following:

(1) Was a job safety meeting held this date? (If YES, attach a copy of the meeting minutes.)

(2) Were there any lost time accidents this date? (If YES, attach a copy of the completed OSHA report.)

(3) Was crane/man-lift/trenching/scaffold/high electrical/high work/hazmat work done? (If YES, attach a statement or checklist showing inspection performed.)

(4) Was hazardous material/waste released into the environment? (If YES, attach a description of incident and proposed action.)

f. Identify Schedule Activity No. related to safety action and list safety actions taken today and safety inspections conducted.

g. Identify Schedule Activity No., Submittal # and list equipment/material received each day that is incorporated into the job.

h. Not Used

i. Include a "remarks" section in this report which will contain pertinent information including directions received, problems encountered during construction, work progress and delays, conflicts or errors in the drawings or specifications, field changes, safety hazards encountered, instructions given and corrective actions taken, delays encountered and a record of visitors to the work site. For each remark given, identify the Schedule Activity No. that is associated with the remark.

1.15.1.1 Contractor Production Report (Continuation Sheet)

Additional space required to contain daily information on the Design-Builder Production Report will be placed on its Continuation Sheet(s). An unlimited number of Continuation Sheets may be added as necessary and attached to the Production Report.

1.15.2 Contractor Quality Control Report

Reports are required for each day that work is performed and for every seven consecutive calendar days of no-work and on the last day of a no-work period. Account for each calendar day throughout the life of the Contract. The reporting of work shall be identified by terminology consistent with the construction schedule. Design-Builder Quality Control Reports are to be prepared, signed and dated by the Design-Builder QC Manager and shall contain the following information:

a. Date of report, report number, Contract Number, and Contract Title.

b. Indicate if Preparatory Phase work was performed today (Yes/No checkboxes).

c. If Preparatory Phase work was performed today (including on-site and off-site work), identify its Schedule Activity No. and Definable Feature of Work. The Index # is a cross reference to the Preparatory Phase Checklist. An example of the Index # is: 0025-P01, where "0025" is the Design-Builder Quality Control Report Number, "P" indicates

Preparatory Phase, and "01" is the Preparatory Phase Checklist number(s) for this date. Each entry in this section must be accompanied with a corresponding Preparatory Phase Checklist.

d. Indicate if Initial Phase work was performed today (Yes/No checkboxes).

e. If Initial Phase work was performed today (including on-site and off-site work), identify its Schedule Activity No. and Definable Feature of Work. The Index # is a cross reference to the Initial Phase Checklist. An example of the Index # is: 0025-I01, where "0025" is the Design-Builder Quality Control Report Number, "I" indicates Initial Phase, and "01" is the Initial Phase Checklist number(s) for this date. Each entry in this section must be accompanied with a corresponding Initial Phase Checklist.

f. Results of the Follow-up Phase inspections held today (including on-site and off-site work), including Schedule Activity No., the location of the definable feature of work, Specification Sections, etc. Indicate in the report for this definable feature of work that the work complies with the Contract as approved in the Initial Phase, work complies with safety requirements, and that required testing has been performed and include a list of who performed the tests.

g. List the rework items identified, but not corrected by close of business; along with its associated Schedule Activity Number.

h. List the rework items corrected from the rework items list along with the corrective action taken and its associated Schedule Activity Number.

i. Include a "remarks" section in this report which will contain pertinent information including directions received, quality control problem areas, deviations from the QC plan, construction deficiencies encountered, QC meetings held, acknowledgement that as-built drawings have been updated, corrective direction given by the Design-Builder QC Organization and corrective action taken by the Design-Builder. For each remark given, identify the Schedule Activity No. that is associated with the remark.

j. Design-Builder Quality Control Report certification, signature and date.

1.15.2.1 Design-Builder Quality Control Report (Continuation Sheet)

Additional space required to contain daily information on the Design-Builder Quality Control Report will be placed on its Continuation Sheet(s). An unlimited number of Continuation Sheets may be added as necessary and attached to the Design-Builder Quality Control Report.

1.15.3 Preparatory Phase Checklist

Each Definable Feature of Work that is in the Preparatory Phase shall have this checklist filled out for it. The checklist shall be identified by terminology consistent with the construction schedule. Attach this checklist to the Contractor Quality Control Report of the same date.

a. Specification Section, date of report, and Contract number shall be filled out. Duplicate this information in the header of the second page of the report.

b. Definable Feature of Work, Schedule Activity No. and Index # entry and format will match entry in the Preparatory Phase section of the Contractor Quality Control Report. Duplicate this information in the header of the second page of the report.

c. Personnel Present: Indicate the number of hours of advance notice that was given to the Owner Representative and indicate (Yes/No checkboxes) whether or not the Owner Rep

was notified. Indicate the Names of Preparatory Phase Meeting attendees, their position and company/Owner they are with.

d. Submittals: Indicate if submittals have been accepted (Yes/No checkboxes), if no indicate what has not been submitted. Are materials on hand (Yes/No checkboxes) and if not, what items are missing. Check delivered material/equipment against accepted submittals and comment as required.

e. Material Storage: Indicate if materials/equipment is stored properly (Yes/No checkboxes) and if not, what action is/was taken.

f. Specifications: Review and comment on Specification Paragraphs that describe the material/equipment, procedure for accomplishing the work and clarify any differences.

g. Preliminary Work & Permits: Ensure preliminary work is in accordance with the contract documents and necessary permits are on file, if not, describe the action taken.

h. Testing: Identify who performs tests, the frequency, and where tests are to occur. Review the testing plan, report abnormalities, and if the test facilities have been approved.

i. Safety: Indicate if the activity hazard analysis has been approved (Yes/No checkboxes).

j. Meeting Comments: Note comments and remarks during the Preparatory Phase Meeting that was not addressed in previous sections of this checklist.

k. Other Items or Remarks: Note any other remarks or items that were a result of the Preparatory Phase.

l. QC Manager will sign and date the checklist.

1.15.4 Initial Phase Checklist

Each Definable Feature of Work that is in the Initial Phase shall have this checklist filled out for it. The checklist shall be identified by terminology consistent with the construction schedule. Attach this checklist to the Design-Builder Quality Control Report of the same date.

a. Specification Section, date of report, and Contract number shall be entered.

b. Definable Feature of Work, Schedule Activity No. and Index # entry and format will match entry in the Initial Phase section of the Design-Builder Quality Control Report.

c. Personnel Present: Indicate the number of hours of advance notice that was given to the Owner Representative and indicate (Yes/No checkboxes) whether or not the Owner Rep was notified. Indicate the Names of Initial Phase Meeting attendees, their position and company/Owner they are with.

d. Procedure Compliance: Comment on compliance with procedures identified at Preparatory Phase of Control and assurance that work is in accordance with plans, specifications and submittals.

e. Preliminary Work: Ensure preliminary work being placed is in compliance and if not, what action is/was taken.

f. Workmanship: Identify where initial work is located; if a sample panel is required (Yes/No checkboxes); is the initial work the sample (Yes/No checkboxes); and if Yes, describe the panel location and precautions taken to preserve the sample.

g. Resolution: Comment on any differences and the resolutions reached.

h. Check Safety: Comment on the safety review of the job conditions.

i. Other: Note any other remarks or items that were a result of the Initial Phase.

j. Design-Builder QC Manager will sign and date the checklist.

1.15.5 Quality Control Validation

Establish and maintain the following in a series of 3 ring binders. Binders shall be divided and tabbed as shown below. These binders shall be readily available to the Owner's Quality Assurance Team during all business hours.

a. All completed Preparatory and Initial Phase Checklists, arranged by specification section.

b. All milestone inspections , arranged by Activity/Event Number.

c. A current up-to-date copy of the Testing and Plan Log with supporting field test reports, arranged by specification section.

d. Copies of all contract modifications, arranged in numerical order. Also include documentation that modified work was accomplished.

e. A current up-to-date copy of the Rework Items List.

f. Maintain up-to-date copies of all punch lists issued by the QC Staff on the Design-Builder and Sub-Contractors and all punch lists issued by the Owner.

1.15.6 Reports from the QC Specialist(s)

Reports are required for each day that work is performed in their area of responsibility. QC specialist reports shall include the same documentation requirements as the Design-Builder Quality Control Report for their area of responsibility. QC specialist reports are to be prepared, signed and dated by the QC specialists and shall be attached to the Design-Builder Quality Control Report prepared for the same day.

1.15.7 Testing Plan and Log

As tests are performed, the Design-Builder QC Manager shall record on the "Testing Plan and Log" the date the test was conducted, the date the test results were forwarded to the Owner, remarks and acknowledgement that an accredited or Owner approved testing laboratory was used. Attach a copy of the updated "Testing Plan and Log" to the last daily Contractor Quality Control Report of each month.

1.15.8 Rework Items List

The Design-Builder QC Manager shall maintain a list of work that does not comply with the Contract, identifying what items need to be reworked, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. There is no requirement to report a rework item that is corrected the same day it is discovered. Attach a copy of the "Rework Items List" to the last daily Contractor Quality Control Report of each month. The Contractor shall be responsible for including on this list items needing rework including those identified by the Owner.

1.15.9 As-Built Drawings

The Design-Builder QC Manager is required to ensure the as-built drawings, required by Section 01770N "Closeout Procedures," are kept current on a daily basis and marked to show deviations which have been made from the Contract drawings. Ensure each deviation has been identified with the appropriate modifying documentation (e.g., PC No., Modification No., Request for Information No., etc.). The QC Manager or QC specialist assigned to an area of responsibility shall initial each deviation and each revision. Upon completion of work, the QC Manager shall furnish a certificate attesting to the accuracy of the as-built drawings prior to submission to the Owner.

1.15.10 Report Forms

The following forms, are acceptable for providing the information required by the paragraph entitled "Documentation." While use of these specific formats are not required, any other format used shall contain the same information:

a. Contractor Quality Control Report w/ continuation sheet(s).

b. Contractor Production Report w/ continuation sheet(s).

c. Preparatory Phase Checklist.

d. Initial Phase Checklist.

e. Testing Plan and Log.

f. Rework Items List.

1.16 NOTIFICATION ON NON-COMPLIANCE

The Owner will notify the Design-Builder of any detected non-compliance with the foregoing requirements. The Design-Builder shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Design-Builder at the work site, shall be deemed sufficient for the purpose of notification. If the Design-Builder fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Design-Builder.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section—

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70(1999) National Electrical Code

NFPA 241(1996) Safeguarding Construction, Alteration, and Demolition Operations

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Traffic control plan; G

Construction site plan; G

1.3 CONSTRUCTION SITE PLAN

With 100% Design Submittal and prior to construction submit a site plan showing the locations of temporary facilities including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes used for this contract. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

1.4 Not Used

1.5 TEMPORARY UTILITIES

Reasonable amounts of the utilities will be made available to the Design-Builder at the prevailing rates for electricity and potable water. Such costs related to the utility usage shall be computed at a base rate $0.75/sf per month. Owner shall present Design-Builder a quarterly billing for utility use.

1.6 Not Used

1.7 Not Used

1.8.2 Special Restrictions Regarding Access of Vehicles and Parking

1.8.2.1 Traffic Control Plan

If during the performance of work, it is necessary to modify vehicular traffic patterns at any locations, provide a Traffic Control Plan detailing the proposed controls to traffic movement for acceptance of the Owner. The plan shall be in accordance with State and local regulations. Make all notifications and obtain any permits required for modification to traffic movements outside project's jurisdiction. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic.

Submit the Traffic Control Plan with the 100% Construction Documents Submittal.

1.8.2.2 Interruption of Vehicular Traffic

Notify the Owner at least 15-days prior to the proposed traffic interruption at any location per the accepted Traffic Control Plan. Any deviation from the accepted plan must be accepted by the Owner.

1.9 STORAGE AREAS (Unless otherwise noted per the LA Union Station Covenants, Conditions & Restrictions (CC&Rs))

Design-Builder shall be responsible for security of his property. The General Conditions provision 2.8 in Article 2 entitled "Design-Builder's Responsibility for Project Safety" and the following apply:

1.9.1 Storage Size and Location

The open sites available for the office traffic and storage shall be confined to those indicated on the drawings and accepted by the Owner.

1.9.2 Storage in Existing Buildings

The Design-Builder shall be working around existing buildings; and, the storage of material will not be allowed in buildings, unless otherwise approved by the Owner. The Owner will allow the Design-Builder to use an area on the First floor for offices and light weight material storage. The Design-Builder shall coordinate with the Owner and submit a layout plan of said area for approval.

1.10 TEMPORARY SANITARY FACILITIES

Design-Builder may use the existing restrooms of the area allocated by the Owner (refer to subsection 1.4.2 in SECTION 01 14 00 entitled "Work Restrictions"). Owner shall require the Design-Builder to utilize Owner designated janitorial company to clean and maintain the onsite offices and storage areas. Such costs associated with the daily cleanup and maintenance shall be at the Design-Builder's sole cost and expense. The base rate for such services shall be at $0.75/sf per month. In the event that extra cleanup is needed or emergency cleanup, the actual cost shall be billed separately to Design-Builder. Owner shall present Design-Builder a monthly billing for janitorial expense.

1.11 TEMPORARY IMPROVEMENTS

Temporary improvements shall be in compliance with the Los Angeles City code and be installed after obtaining necessary permits from appropriate City Departments and other agencies.

1.11.1 Maintenance of Temporary Facilities

Paint in accordance with Owner's standards and maintain the temporary facilities. Failure to do so will be sufficient reason to require their removal.

1.111.1 ~~Trailer Sign~~

~~A sign shall be mounted on the trailer or storage building that shows the company name, phone number, and emergency phone number.~~

PART 2 PRODUCTS

2.1 Not Used.

PART 3 EXECUTION

3.1 TEMPORARY PHYSICAL CONTROLS

3.1.1 Not Used

3.1.1.1 Temporary Barricades

Design-Builder shall provide for barricading around all work areas including open excavation to prevent access by unauthorized persons.

3.1.1.2 Fencing

Enclose the Contractor lay-down area with a 2400 mm high chain link fence and gates with brown, UV light resistant, plastic fabric mesh netting (similar to tennis court or other screening). Remove the fence upon completion and acceptance of the work.

3.1.1.3 Signs

Place warning signs at the construction area perimeter It is required that all points of entry shall have signs designating the construction site as a hard hat area.

3.1.1.4 Traffic Work

Not Used.

3.2 TEMPORARY WIRING

Not Used.

3.3 Not Used.

3.4 Not Used.

--End of Section--

SECTION 01 52 50

SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.14	(1991) Construction and Demolition Operations - Requirements for Safety Belts, Harnesses, Lanyards and Lifelines for Construction and Demolition Use
ANSI Z359.1	(1992) Safety Requirements for Personal Fall Arrest Systems

ASME INTERNATIONAL (ASME)

ASME B30.5	(1994) Mobile Cranes
ASME B30.22	(1993) Articulating Boom Cranes

LA Unions Station – Metro : Covenants, Conditions & Restrictions (CC&Rs)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1995) Portable Fire Extinguishers
NFPA 70	(1999) National Electrical Code
NFPA 241	(1996) Safeguarding Construction, Alteration, and Demolition Operations

1.2 DEFINITIONS

a. Certified Industrial Hygienist. An industrial hygienist is an individual who is certified by the American Board of Industrial Hygiene.

b. Certified Safety Professional. A safety manager, safety specialist, or safety engineer that has passed the CSP exam administered by the Board of Certified Safety Professionals.

c. Competent Person. A competent person is one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

d. Not Used.

e. First Aid. First aid is any one-time treatment, and any follow-up visit for the purpose of observation, of minor scratches, cuts, burns, splinters, and so forth, which do not ordinarily require medical care, even though provided by a physician or registered professional personnel.

f. Not Used

g. Lost Workdays. The number of days (consecutive or not) after, but not including, the day of injury or illness during which the employee would have worked but could not do so; that is, could not perform all or part of his normal assignment during all or any part of the workday or shift; because of the occupational injury or illness.

h. Medical Treatment. Medical treatment includes treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

i. Multi-employer work site (MEWS). A multi-employer work site, as defined by OSHA, is one in which many employers occupy the same site. This Contract considers the Design-Builder to be the "controlling authority" for all work site safety and health of the subcontractors.

j. Operating Envelope. There is an "operating envelope" around any crane, and inside the envelope are the operator, riggers, rigging gear between the hook and the load, the load and the crane's supporting structure (ground, rail, etc.).

k. Qualified Person. One who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated his or her ability to solve or resolve problems related to the subject matter, the work or the project.

l. Recordable Occupational Injuries or Illnesses. Any occupational injuries or illnesses which result in:

(1) Fatalities, regardless of the time between the injury and death, or the length of the illness; or

(2) Lost Workday Cases, other than fatalities, that result in lost workdays, or

(3) Non-Fatal Cases without lost workdays which result in transfer to another job or termination of employment, or require medical treatment (other than first aid) or involve: loss of consciousness or restriction of work or motion. This category also includes any diagnosed occupational illnesses which are reported to the employer but are not classified as facilities or lost workday cases.

m. Safety Officer. The superintendent or other qualified or competent person who is responsible for the on-site safety required for the project. The Design-Builder quality control person cannot be the safety officer, even though the QC has safety inspection responsibilities as part of the QC duties.

n. Serious Accidents. Any work-related incident, which results in, a fatality, in-patient hospitalization of three or more employees, or property damage in excess of $200,000.

o. Significant Accident. Any contractor accident which involves falls of 1.2 m or more, electrical accidents, confined space accidents, diving accidents, equipment accidents, crane accident or fire accidents, which, result in property damage of $10,000 or more, but less than $200,000; or when fire department or emergency medical treatment (EMT) assistance is required.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-07 Certificates

Accident Prevention Plan (APP); G

Activity Hazard Analysis (AHA); G (If found during construction)

Health and Safety Plan (HASP); G

SD-11 Closeout Submittals

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Crane Reports

Crane Critical Lift Plan

Certificate of Compliance

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

a. Qualifications of Safety Officer:

(1) Ability to manage the on-site Design-Builder safety program through appropriate management controls.

(2) Ability to identify hazards and have the capability to expend resources necessary to abate the hazards.

(3) Must have worked on similar types of projects that are equal to or exceed the scope of the project assigned with the same responsibilities.

(4) Shall, as a minimum, have attended an OSHA training qualification class including at least 10 hours of classroom instruction.

b. Qualifications of Qualified Person, The qualified person shall be capable (by education and specialized training) of anticipating, recognizing, and evaluating employee exposure to hazardous substances or other unsafe conditions. This person shall be capable of specifying necessary control and protective action to ensure worker safety.

c. Qualification of Crane Operators. Crane operators shall be certified by an accredited crane operator testing organization, such as the National Commission for the Certification of Crane Operators (NCCCO)

1.4.2 Meetings

1.4.2.1 Preconstruction Conference

The safety officer shall attend the preconstruction conference.

1.4.2.2 Meeting on Work Procedures

a. Meet with Owner to discuss work procedures and safety precautions required. Ensure the participation of the Design-Builder's superintendent, the quality control.

b. Meet with Owner to discuss work procedures and safety precautions required by the HASP. Ensure the participation of the contractor's superintendent, the quality control.

1.4.2.3 Weekly Safety Meetings

Hold weekly at the project site. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the QC Contractor Quality Control daily report.

1.4.2.4 Work Phase Meetings

The appropriate AHA (if required) shall be reviewed and attendance documented by the Design-Builder at the preparatory, initial, and follow-up phases of quality control inspection.

1.4.2.5 New Employee Indoctrination

New employees will be informed of specific site hazards before they begin work. Documentation of this orientation shall be kept on file at the project site.

1.4.3 Certifications

1.4.3.1 Accident Prevention Plan (APP)

Submit the APP at least 5 calendar days prior to start of work at the job site. Make the APP site specific. Notice To Proceed will be given after Owner finds the APP acceptable.

1.4.3.2 Activity Hazard Analysis (AHA)

If required.

1.4.3.3 Not Used

1.4.4 Reports

1.4.4.1 Crane Reports

Submit crane inspection reports required as specified herein with Daily Reports of Inspections.

1.4.4.2 Not Used

1.4.4.3 Certificate of Compliance

The Design-Builder shall provide a Certificate of Compliance for each crane entering the property/LA Union Station-Metro under this contract. Certificate shall state that the crane and rigging gear meet applicable OSHA regulations (with the contractor citing which OSHA regulations are applicable) These certifications shall be posted on the crane.

1.5 ACCIDENT PREVENTION PLAN (APP)

Prepare the APP in accordance with the required and advisory provisions, some of which are listed below.

1.5.1 Contents of the Accident Prevention Plan

a. Name and safety related qualifications of safety officer (including training and any certifications).

b. Qualifications of competent and of qualified persons.

c. Identity of the individual who will complete exposure data (hours worked); accident investigations, reports and logs; and immediate notification of accidents to include subcontractors.

d. Emergency response plan.

e. Not Used

f. Hazardous Material Use. Provisions to deal with hazardous materials, pursuant to the General Conditions Article 4 entitled "Hazardous Conditions"

g. General Background Checks for all Design-Builder Employees and Subcontractors

h. Not Used

i. Alcohol and Drug Abuse Plan

(1) Describe plan for random checks and testing with pre-employment screening in accordance with the DFAR Clause subpart 252.223-7004, "Drug Free Work Force."

(2) Description of the on-site prevention program

j. Fall Protection and Prevention (FP&P) Plan. The plan shall be site specific and address all fall hazards in the work place. It shall address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 1.8 m. A qualified person shall prepare the plan. The plan shall include fall protection and prevention systems, equipment and methods employed, responsibilities, rescue and escape equipment and operations, training requirements, and monitoring methods.

k. Not Used

l. Lead Abatement Plan. The safety and health aspects of lead-based paint removal, prepared in accordance with Section 13283N, "Removal and Disposal of Lead Containing Paint".

m. Asbestos Abatement Plan. The safety and health aspects prepared in accordance with Section 13281N, "Engineering Control of Asbestos Containing Materials"

n. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02220N, "Site Demolition" and referenced sources. Include engineering survey as applicable.

o. Not Used

p. Training Records and Requirements. List of mandatory training and certifications which are applicable to this project (e.g., fall protection, crane operation, vehicle operator, forklift operators, personal protective equipment); list of requirements for periodic retraining/certification; outline requirements for supervisory and employee safety meetings.

q. Severe Weather Plan. Procedures of ceasing on-site operations during lightning or upon reaching maximum allowed wind velocities.

r. Emergency Lighting and Power Systems Plan (e.g., periodic testing of batteries for emergency lighting.)

1.5.2 Not Used

1.6 Not Used

1.7 HEALTH AND SAFETY PLAN (HASP)

Prepare as required

1.7.1 Qualified Personnel

Retain a Certified Industrial Hygienist (CIH) or a Certified Safety Professional (CSP) to prepare the HASP, conduct activity hazard analyses, and prepare detailed plan for demolition, removal, and disposal of materials.

1.7.2 Contents

In addition to the requirements of COE EM-385-1-1, Table 28-1, the HASP must include:

a. Location, size, and details of control areas.

b. Location and details of decontamination systems.

c. Interface of trades involved in the construction.

d. Sequencing of work.

e. Disposal plan.

f. Sampling protocols.

g. Testing labs.

h. Protective equipment.

i. Pollution control.

1.8 DRUG PREVENTION PROGRAM

Conduct a proactive drug and alcohol use prevention program for all workers, prime and subcontractor, on the site. Ensure that no employees either use illegal drugs or consume alcohol during work hours. Ensure there are no employees under the influence of drugs or alcohol during work hours. After accidents, collect blood, urine or saliva specimens and test injured employee's influence. A copy of the test shall be made available to the Owner upon request.

1.9 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

1.9.1 Scaffolds

Delineate the fall protection requirements necessary during the erection and dismantling operation of scaffolds used on the project in the Fall Protection and Prevention (FP&P) plan and activity hazard analysis for the phase of work.

1.9.2 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, Contractor shall provide training for each employee who might be exposed to fall hazards.

1.10 DUTIES OF THE SAFETY OFFICER

a. Ensure construction hazards are identified and corrected.

b. Maintain applicable safety reference material on the job site.

c. Maintain a log of safety inspections performed.

d. Attend the pre-construction conference as required.

e. Identify hazardous conditions and take corrective action. Failure to do so will result in a dismissal from the site, with a work stoppage pending approval of suitable replacement personnel.

1.11 DISPLAY OF SAFETY INFORMATION

Display the following information in clear view of the on-site construction personnel:

a. Map denoting the route to the nearest emergency care facility with emergency phone numbers.

b. Not Used

c. Not Used

d. A sign indicating the number of hours worked since last lost workday accident.

1.12 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturers' manuals.

1.13 Not Used

1.14 EMERGENCY MEDICAL TREATMENT

Design-Builder will arrange for their own emergency medical treatment. Owner has no responsibility to provide emergency medical treatment.

1.15 SITE CONDITIONS

1.15.1 The Design-Builder shall take into consideration that this Contract is within LA Union Station

1.16 REPORTS

1.16.1 Accident Reports

a. For recordable occupational injuries and illnesses, the Design-Builder shall conduct an accident investigation to establish the root cause(s) of the accident, and provide to the Owner within 5 calendar days of the accident.

1.16.2 Notification

Notify the Owner as soon as practical, but not later than four hours, of any accident meeting the definition of Recordable Occupational Injuries or Illnesses or Significant Accidents. Information shall include contractor name; contract title; type of contract; name of activity, installation or

location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; and brief description of accident (to include type of construction equipment used, PPE used, etc.).

1.16.3 Not Used

1.16.4 OSHA Citations and Violations

Provide the Owner with a copy of each OSHA citation, OSHA report and Design-Builder response. Correct violations and citations promptly and provide written corrective actions to the Owner.

1.16.5 Crane Notification

Notify the Owner at least 15 days prior to bringing any crane equipment on-site so that the Owner may discuss (if needed) or arrange for any additional quality assurance spot checks necessary by the Los Angeles County Metropolitan Transportation Authority.

1.17 HOT WORK

Prior to performing "Hot Work" (welding, etc.) or operating other flame-producing devices, the Design-Builder shall request a written permit from the Fire Division. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Design-Builder will provide at least two (@2) twenty (20) pound extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity.

a. Oil painting materials (paint, brushes, empty paint cans, etc.), and all flammable liquids shall be removed from the building at quitting time. All painting materials and flammable liquids shall be stored outside in a suitable metal locker or box and will require re-submittal with non-hazardous materials.

b. Accumulation of trays, paper, shavings, sawdust, boxes and other packing materials shall be removed from the building at the close of each workday and such material disposed of in the proper containers located away from the building.

c. The storage of combustible supplies shall be a safe distance from structures.

d. Area outside of building undergoing work shall be cleaned of trash, paper, or other discarded combustibles at the close of each workday.

e. All portable electric devices (saws, sanders, compressors, extension cord, lights, etc.) shall be disconnected at the close of each workday. When possible, the main electric switch in the building shall be deactivated.

f. When starting work in building or areas, Design-Builder shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE OWNER IMMEDIATELY.

PART 2 PRODUCTS

2.1 FALL PROTECTION ANCHORAGE

If required, Fall protection anchorage, conforming to ANSI Z359.1, will be left in place and so identified for continued customer use.

2.2 Not Used

PART 3 EXECUTION

3.1 CONSTRUCTION

Comply with, NFPA 241, the accident prevention plan, the activity hazard analysis and other related submittals and activity fire and safety regulations.

3.1.1 Not Used

3.1.2 Unforeseen Hazardous Material (Refer to Article 4 in the General Conditions entitled "Hazardous Conditions and Differing Site Conditions")

3.2 PRE-OUTAGE COORDINATION MEETING

When the Owner intends to occupy any area of the Building, the Design-Builder is required to apply for utility outages a minimum of 15 days in advance. As a minimum, the request should include the location of the outage, utilities being effected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved and prior to beginning work on the utility system requiring shut down, the Design-Builder shall attend a pre-outage coordination meeting with the Owner to review the scope of work and the lock out/tag out procedures for worker protection. No work will be performed on energized electrical equipment unless proven impassable. Working equipment "hot" must be considered the last option.

3.3 PERSONNEL PROTECTION

3.3.1 Hazardous Noise

Provide hazardous noise signs, and hearing protection, wherever equipment and work procedures produce sound-pressure levels greater than 85 dBA steady state or 140 dBA impulse, regardless of the duration of the exposure. Design-Builder is required to coordinate with the Owner and obtain approval before scheduling and executing high levels of dBA operations.

3.3.2 Fall Protection

Enforce use of the fall protection device designated for each specific work activity in the FP&P plan and/or AHA all times when an employee is on a surface 1.8 m or more above lower levels. Personal fall arrest systems are required when working from an articulating or extendible boom, scissor lifts, swing stages, or suspended platform. Fall protection must comply with ANSI A10.14.

3.3.2.1 Personal Fall Arrest Device

Personal fall arrest device equipment, systems, subsystems, and components shall meet ANSI Z359.1, "Safety Requirements for Personal Fall Arrest Systems". Only a full-body harness with a shock absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest device. Body belts may only be used as a positioning device system such as steel reinforcing assembly and in

conjunction with another fall arrest system. Harnesses shall have a fall arrest attachment, which is a connector, affixed to the body support (usually a D-ring) and specifically designated for attachment to the rest of the system. Only double locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber.

3.3.3 MCAS Requirements

All personnel who enter the construction site will wear mandatory personal protective equipment (PPE) at all times. All personnel shall also comply with PPE postings of shops both inside and outside the construction site. PPE shall be governed in all other areas by the nature of the work the employee is performing. They will also have personal hearing protection on their person at all times in designated noise hazardous areas or when performing noise hazardous tasks. Mandatory PPE includes:

a. Hard Hat

b. Safety Glasses

c. Safety Toed Shoes

3.4 SCAFFOLDING

Employees shall be provided with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Stair towers or ladders built into scaffold systems in accordance with OSHA are required for work platforms greater than 6 m in height. Design-Builder shall ensure that employees that are qualified perform scaffold erection. Do not use scaffold without the capability of supporting at least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection plan. Minimum platform size shall be based on the platform not being greater in height than three times the dimension of the smallest width dimension for rolling scaffold. Some Baker type scaffolding has been found not to meet these requirements. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Special care shall be given to ensure scaffold systems are not overloaded. Outrigger brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base.

3.5 EQUIPMENT

3.5.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturers printed instructions.

3.5.2 Weight Handling Equipment

a. Cranes must be equipped with:

(1) Load Indicating Devices (LIDs) and a Boom Angle or Radius Indicator,

(2) or Load-Moment Indicating Devices (LMIs).

(3) Anti-two-block prevention devices.

(4) Boom Hoist Hydraulic Relief Valve, Disconnect, or Shutoff (stops hoist when boom reaches a predetermined high angle).

(5) Boom Length Indicator (for telescoping booms).

(6) Device to prevent uncontrolled lowering of a telescoping hydraulic boom.

(7) Device to prevent uncontrolled retraction of a telescoping hydraulic boom.

b. The Design-Builder shall notify the Owner, in advance, of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated.

c. The Design-Builder shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in ASME B30.5). All testing shall be performed in accordance with the manufacturers recommended procedures.

d. The Design-Builder shall comply with ASME B30.22 for articulating boom cranes.

e. The presence of Owner's safety and health inspectors (if any) does not relieve the Design-Builder of an obligation to comply with all applicable safety regulations. The Owner will investigate all complaints of unsafe or unhealthful working conditions received in writing from Design-Builder employees, or any assigned personnel on site.

f. Each load shall be rigged/attached independently to the hook/master-link in such a fashion that the load cannot slide or otherwise become detached. Christmas-tree lifting (multiple rigged materials) is not allowed.

g. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of ASME B30.5 or ASME B30.22 as applicable.

h. Crane supported work platforms shall only be used in extreme conditions if the Design-Builder proves that using any other access to the work location would provide a greater hazard to the workers. Personnel shall not be lifted with a live hoist or friction crane.

i. A fire extinguisher having a minimum rating of 10BC and a minimum nominal capacity of 5lb of extinguishing agent shall be available at all operator stations or cabs of cranes. Portable fire extinguishers shall be inspected, maintained, and recharged as specified in NFPA 10, Standard for Portable Fire Extinguishers.

j. All employees shall be kept clear of loads about to be lifted and of suspended loads.

k. A weight handling equipment operator shall not leave his position at the controls while a load is suspended.

l. A Contractor Crane Operation Checklist shall be used by the CQC representative during oversight of contractor crane operations.

m. Only contractor crane operators who have met the requirements of local and state requirements shall be authorized to operate the crane.

n. Cribbing shall be utilized by the Design-Builder when performing lifts on outriggers.

o. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

p. A physical barricade must be positioned to prevent personnel from entering the tail swing area of the crane.

q. A substantial and durable rating chart containing legible letters and figures shall be provided with each crane and securely mounted onto the crane cab in a location allowing easy reading by the operator while seated in the control station.

r. Certification records which include the date of inspection, signature of the person performing the inspection along with the serial number or other identifier of the crane which was inspected. This record will always be available for review by Owner personnel.

s. Written reports listing the load test procedures utilized along with any repairs or alterations performed on the crane will be available for review by the contracting officer personnel.

t. Contractor shall certify that all of the crane operators have been trained not to bypass safety devices (e.g., anti-two block devices) during lifting operations.

3.6 Not Used

3.7 ELECTRICAL

3.7.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cable intended to be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the Owner for identification. The Owner will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cutting remotely. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers shall be permitted to enter. When work requires Design-Builder to work near energized circuits as defined by the NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. Insulating blankets, hearing protection, and switching suits may be required, depending on the specific job and as delineated in the Design-Builder AHA.

3.7.2 Portable Extension Cords

Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered.

3.8 Not Used

3.9 Not Used

3.10 HOUSEKEEPING

3.10.1 Clean-up

All debris in work areas shall be cleaned up daily or more frequently as necessary. Construction debris may be temporarily located in an approved location; however garbage accumulation must be removed each day.

3.10.2 Dust Control

In addition to the dust control measures required elsewhere in the contract documents dry cutting of brick or masonry shall be prohibited. Wet cutting must address control of water runoff.

3.11 ACCIDENT SCENE PRESERVATION

For serious accidents, and accidents involving weight handling equipment, ensure the accident site is secured and evidence is protected remaining undisturbed until released by the Owner.

3.12 FIELD QUALITY CONTROL

3.12.1 Inspections

Include safety inspection as a part of the daily Quality Control inspections required in Section 014500, "Quality Control".

3.13 FLAMMABLE AND COMBUSTIBLE LIQUID HANDLING AND STORAGE

3.13.1 Safety Gas Containers

Handling of flammable and combustible liquids shall be in safety containers with flame arresters, with not more than 19 L capacity, having a spring-closing lid and spout cover and designed to safely relieve internal pressures under fire exposures. Flammable and combustible Liquids shall be stored in separate NFPA approved storage cabinets 15 m away from any sources of ignition with suitable NO SMOKING OR OPEN FLAME signs posted in all such areas.

--End of Section--

SECTION 01 57 50

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
40 CFR 112	Oil Pollution Prevention
40 CFR 122.26	EPA National Pollutant Discharge Elimination System Permit Regulations
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 260	Hazardous Waste Management Systems: General (If found during construction)
40 CFR 261	Identification and Listing of Hazardous Waste (If found during construction)
40 CFR 263	Transporters of Hazardous Waste (If found during construction)
40 CFR 264	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities(If found during construction)
40 CFR 265	Interim Status Standard for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities(If found during construction)
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administrated Permit Programs: The Hazardous Waste Permit Program
40 CFR 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Universal Waste Management
40 CFR 279	Used Oil Regulations
40 CFR 280	Owners and Operators of Underground Storage Tanks
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 355	Emergency Planning and Notification
40 CFR 716	Health and Safety Data Reporting
49 CFR 173	Shipments and Packaging

49 CFR 178	Packaging

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846	(1996) Evaluating Solid Waste (Physical/Chemical Methods)
RCRA	California Resource Conservation and Recovery Act

1.2 DEFINITIONS

1.2.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.2.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material (except hazardous waste as defined in paragraph entitled "Hazardous Waste" or hazardous debris as defined in paragraph entitled "Hazardous Debris"), including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges; regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

c. Inert construction and demolition debris: Broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may not be re-enforced with or contain ferrous wire, rods, accessories and weldments.

d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as re-enforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

g. Recyclable: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint

contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

1.2.3 Debris

Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 60 mm particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g., cobbles and boulders). A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

1.2.4 Hazardous Debris

As defined in paragraph entitled "Debris" of this section, debris containing listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.2.5 Chemical Wastes

This includes salts, acids, alkalis, herbicides, pesticides, and organic chemicals.

1.2.6 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.2.7 Hazardous Waste

Hazardous waste as defined in 40 CFR 261 or as defined by applicable State and local regulations.

1.2.8 Oily Waste

Petroleum products and bituminous materials.

1.2.9 Regulated Waste

Those solid waste that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.2.10 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
halon-1211
halon-1301
halon-2402
carbon tetrachloride

chlorofluorocarbon-212 (CFC-212) methyl chloroform

1.2.11 Hazardous Materials

Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261. Throughout this specification, hazardous material includes hazardous chemicals.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-01 Preconstruction Submittals

Environmental protection plan; G

Storage Inventory Form; G

Dirt and dust control plan; G

SD-06 Test Reports

Laboratory analysis

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Preconstruction survey

Solid waste disposal permit

Waste determination documentation

Disposal documentation for hazardous and regulated waste

Design-Builder 40 CFR employee training records

Regulatory notification

Solid waste disposal report

Design-Builder Hazardous Material Inventory Log; G

1.4 DIRT AND DUST CONTROL PLAN

Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the sub Design-Builder and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

1.5 LABORATORY ANALYSIS

Submit a copy of a laboratory analysis of solid waste and debris with the potential of becoming classified as a hazardous waste (i.e., abrasive/sand blasting debris, etc.).

1.6 REPORTS

1.6.1 Preconstruction Survey

Perform a preconstruction survey of the project site with the Owner, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.6.2 Solid Waste Disposal Permit

Submit one copy of a State and local permit or license showing such agencies' approval of the disposal plan before transporting wastes off Owner`s property.

1.6.3 Waste Determination Documentation

The Design-Builder shall complete a Waste Determination form (provided at the pre-construction conference) for all Design-Builder derived wastes to be generated. The waste determination must be based upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). All support documentation must be attached to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

1.6.4 Disposal Documentation for Hazardous and Regulated Waste

Submit a copy of the applicable EPA and State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities.

1.6.5 Design-Builder 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. The Design-Builder shall ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with Federal, State and local regulatory requirements. The Design-Builder shall provide a Position Description for each employee, by sub Design-Builder, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. Submit these training records to the Owner at the conclusion of the project, unless otherwise directed.

1.6.6 Regulatory Notification

The Design-Builder is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. The Design-Builder shall forward copies to the Owner prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.6.7 Not Used

1.6.8 Solid Waste Disposal Report

Monthly the Design-Builder shall submit a solid waste disposal report to the Owner. For each waste, the report shall state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste. The Design-Builder shall include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Design-Builder may submit a statement indicating the disposal location for the solid waste which is signed by an authorized of the Design-Builder firm authorized to legally obligate or bind the firm. The sales documentation or Design-Builder certification shall include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Design-Builder for his own use, the Design-Builder shall submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received shall not be reported to the Owner unless required by other provisions or specifications of this Contract or public law.

1.7 Not Used

1.8 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Environmental Brief: Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes that may be generated during the contract.

1.8.1 Not Used

1.8.2 Licenses and Permits

For all permits, whether or not required by the permit, the Design-Builder is responsible to perform quality control inspections of the work in progress, and to submit notifications and certifications to the applicable regulatory agency, via the Owner, that the work conforms to the contract and permit requirements. The inspections and certifications shall be provided through the services of a Professional Engineer, registered in the State of California. As a part of the quality control plan, which is required to be submitted for approval by the quality control section, provide a sub item containing the name, P.E. registration number, address, and telephone number of the professional engineer(s) who will be performing the inspections and certifications for each permit listed above.

1.8.3 Design-Builder Liabilities for Environmental Protection

The Design-Builder is advised that this project is subject to Federal, State, and local regulatory agency inspections to review compliance with environmental laws and regulations. The Design-Builder shall fully cooperate with any representative from any Federal, State, or local regulatory agency who may visit the job site and shall provide immediate notification to the Owner, who shall accompany them on any subsequent site inspections. The Design-Builder shall complete, maintain, and make available to the Owner or regulatory agency personnel all documentation relating to environmental compliance under applicable Federal, State, and local laws and regulations. The Design-Builder shall immediately notify the Owner if a Notice of Violation (NOV) is issued to the Design-Builder.

The Design-Builder shall be responsible for all damages to persons or property resulting from Design-Builder fault or negligence as well as for the payment of any civil fines or penalties which may be assessed by any Federal, State, or local regulatory agency as a result of the Design-Builder's or any sub Design-Builder's violation of any applicable Federal, State or local environmental law or regulation. Should a Notice of Violation (NOV), Notice of Noncompliance (NON), Notice of Deficiency (NOD), or similar regulatory agency notice be issued to the Owner as facility owner/operator on account of the actions or inactions of the Design-Builder or one of its sub Design-Builders in the performance of work under this contract, the Design-Builder shall fully cooperate with the Owner in defending against regulatory assessment of any civil fines or penalties arising out of such actions or inactions.

1.9 Not Used

1.10 Not Used

1.10.1 Not Used

1.11 UNFORESEEN HAZARDOUS OR REGULATED MATERIAL

All known hazardous or regulated materials are indicated in the contract documents. If material that is not indicated in the contract documents is encountered that may be dangerous to human health upon disturbance during construction operations, stop that portion of work and notify the Owner immediately. Intent is to identify materials such as PCB, lead paint, mercury, petroleum products, and friable and nonfriable asbestos. (Refer to Article 4 in the General Conditions entitled “Hazardous Conditions and Differing Site Conditions”)

1.12 DESIGN-BUILDER HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Design-Builder Hazardous Material Inventory Log" which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS) to the Owner at the start and at the end of construction (30 days from final acceptance), and update during the life of the contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 Not Used

3.1.2.2 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.1.2.3 Not Used

3.4 CONTROL AND DISPOSAL OF SOLID WASTES

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the Owner and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Owner property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

3.4.1 Dumpsters

Equip dumpsters with a secure cover and paint the standard base color. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week. or as needed to keep the site free of debris and trash. If necessary, provide 208 liter trash containers painted the darker base color to collect debris in the construction site area. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 CONTROL AND DISPOSAL OF HAZARDOUS WASTES

3.5.1 Hazardous Waste/Debris Management

The Design-Builder shall identify all construction activities which will generate hazardous waste/debris. The Design-Builder must provide a documented waste determination for all resultant waste streams. Hazardous waste/debris shall be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268. Hazardous waste shall also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. No hazardous waste shall be brought onto Owner and Metro property. Provide to the Owner a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the Owner immediately.

3.5.1.1 Attach a waste determination form. Allow ten working days for processing this request.

3.5.1.2 Not Used

3.5.1.3 Asbestos Certification(If found during construction)

a. Asbestos containing material: Items, components, or materials which are specified to be worked on under this contract may involve asbestos. Other materials especially thermal insulation, in the general work area may contain asbestos. All thermal insulation, in all work areas should be considered to be asbestos unless positively identified by conspicuous tags or previous laboratory analysis certifying asbestos free. The Design-Builder shall not remove or perform work on any such materials without the prior approval of the Owner. The Design-Builder shall not engage in any activity, which would remove or damage such materials of cause the generation of fibers from such materials. The Design-Builder shall immediately stop all work which would generate further damage to the material, evacuate the potential asbestos exposed area, and notify the Owner for resolution of the situation prior to resuming normal work activities in the affected area.

3.5.1.4 Hazardous Waste Disposal (If found during construction)

Control of stored waste, packaging, sampling, analysis, and disposal shall be determined by the details in the contract. The requirements for jobs in the following paragraphs shall be used as the guidelines for disposal of any hazardous waste generated.

(a) Responsibilities for Design-Builder's Disposal

Any generation of WHM/HW requiring Design-Builder disposal of solid waste or liquid.

a. The Design-Builder agrees to provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services shall include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).

b. Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.

c. Control and turn in all hazardous waste requiring disposal in accordance with Base's Environmental Management Division requirements.

d. Obtaining a representative sample of the material generated for each job done to provide waste stream determination.

e. Analyzing for each sample taken and providing analytical results to the Owner. Provide two copies of the results.

f. Determine the DOT proper shipping names for all waste (each container requiring disposal) and shall demonstrate how this determination is developed and supported by the sampling and analysis requirements contained herein to the Contracting Officer for Code 106's review.

Interim Waste Generation Site for Design-Builder Disposal of WHM/HW

The Design-Builder shall request approval of the Owner for an area suitable for packaging WHN/HW requiring disposal. The Design-Builder shall comply with the requirements of the Base's Environmental Management Division. The area will be barricaded and a sign identifying as follows:

Signage- "DANGER - UNAUTHORIZED PERSONNEL KEEP OUT"

With additional custody sign indicating:

(1) Site # xxxxx
(2) Controlled by xxxxxx
Call Mr./Ms. xxxxxx____ at xxxxxx

Barricade Type: Yellow and black three 75 mm plastic tape. Corner barricades shall be provided by the Owner.

Design-Builder Disposal Turn-In Requirements

For any waste hazardous materials or hazardous waste generated which requires the Design-Builder to dispose of, the following conditions must be complied with:

a. Call the Owner designated representative and provide the following information:

(1) Your name and company
(2) Service/contract number
(3) Telephone number where you can be reached
(4) Material requiring disposal
(5) Location of material
(6) Volume of material in each container

3.5.2 Pollution Prevention/Hazardous Waste Minimization

The Design-Builder shall actively pursue minimizing the use of hazardous materials and the generation of hazardous waste while on-base. The Hazardous Waste Management Section of the Environmental Protection Plan shall include the Design-Builder's procedures for pollution prevention/ hazardous waste minimization. For preparing this part of the plan, the Design-Builder may consult the activity Environmental Office for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material. If no written plan exists, the Design-Builder may obtain information by contacting the Owner. The Design-Builder shall describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.5.3 Hazardous Material Control

The Design-Builder shall include hazardous material control procedures in the Safety Plan. The procedures shall address and ensure the proper handling of hazardous materials, including the appropriate transportation requirements. The Design-Builder shall submit a MSDS and estimated quantities to be used for each hazardous material to the Owner prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum

products. At the end of the project, the Design-Builder shall provide the Owner with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. The Design-Builder shall also ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. The Design-Builder shall ensure that all containers of hazardous materials have NFPA labels or their equivalent. Copies of the MSDS for hazardous materials shall be kept on site at all times and provided to the Owner at the end of the project. The Design-Builder shall certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.5.4 Petroleum Products

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. All used oil generated on site shall be managed in accordance with 40 CFR 279. The Design-Builder shall determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. In addition, used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Design-Builder's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste. All hazardous waste will be managed in accordance with the paragraph entitled Hazardous Waste/Debris Management of this section and shall be managed in accordance with the approved Environmental Protection Plan.

3.5.5 Releases/Spills of Oil and Hazardous Substances

Take precautions to prevent releases/spills of oil and hazardous substances. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the Base or Activity Fire Department, the activity's Command Duty Officer, and the Owner. The Design-Builder is responsible for verbal and written notifications as required by the federal 40 CFR 355, State, and local regulations. Spill response shall be in accordance with 40 CFR 300 and applicable State and local regulations. Contain and clean up these spills without cost to the Owner. If Owner assistance is requested or required, the Design-Builder shall reimburse the Owner for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

3.6 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning non-particulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.7 Not Used

3.7.1 Not Used

3.7.2 Not Used

3.8 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. B

--End of Section--

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 013300, "Submittal Procedures."

SD-10 Operation and Maintenance Data

Equipment/product warranty list

Submit Data Package 5 in accordance with Section 017810, "Operation and Maintenance Data."

SD-11 Closeout Submittals

As-built drawings; G

Record of materials; G

Utility as-built drawings; G

Equipment/product warranty tag; G

Valves identification plan; G

Monthly project waste summary report; G

Hazardous material reporting; G

1.2 As-Built Records and Drawings

Submit within ten working days after each system is in place, but no later than five working days before final inspection.

1.3 Monthly Project Waste Summary Report (If required)

1.3.1 Hazardous Material Reporting (If found during construction)

Submit hazardous material reporting information which includes actual quantities of hazardous materials stored and used during the project as specified in EFA Northwest regional Section 01525N, "Safety Requirements".

1.4 Not used

1.5 PROJECT RECORD DOCUMENTS

1.5.1 As-Built Drawings

1.5.2 Valves Identification Plan (If required)

Furnish as-built valves identification plan with a certification that the unique identification number for all the valves match the tags attached to the valves.

1.5.3 As-Built Record of Materials

Furnish a record of materials.

Where several manufacturers' brands, types, or classes of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces depicted on the contract drawing. Furnish the record of materials used in the following format:

MATERIALS DESIGNATION	SPECIFICATION	MANUFACTURER (MANUFACTURER'S DESIGNATION)	MATERIALS USED	WHERE USED
_____	_____	_____	_____	_____

1.6 EQUIPMENT/PRODUCT WARRANTIES

1.6.1 Equipment/Product Warranty List

Furnish to the Owner a bound and indexed notebook containing written warranties for equipment/products furnished under the contract, and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefor, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Owner prior to final acceptance of the facility.

1.6.2 Equipment Warranty Tags and Guarantor's Local Representative

Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Owner. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the following information:

EQUIPMENT/PRODUCT WARRANTY TAG

Type of Equipment/Product _____
Warranty Period _____ From _____ To _____
Contract No. _____
Inspector's Signature _____ Date Accepted _____

Construction Contractor:
Name: _____
Address: _____
Telephone: _____

Warranty Contact: _____
Name: _____

Address: _____
Telephone: _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

1.7 CLEANUP

Clean all construction caused debris from the construction site. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site.

a. Replace trees, shrubs and vegetation

1.7.1 Extraordinary Cleanup Requirements

The cleanup requirements apply: reseed grass areas and replace trees, shrubs and flowers as required.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section--

SECTION 01 78 10

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data/Manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 013300, "Submittal Procedures."

1.1.1 Quantity

Submit two sets and one electronic copy of the O&M information for each system, and its components, assemblies, subassemblies, attachments, and accessories.

1.1.2 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.3 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." For each product, system, or component piece of equipment requiring submission of O&M Data, submit the Data Package specified in the individual technical section.

1.1.4 Delivery

Submit O&M Data Manuals to the Owner for review and acceptance; submit data specified for a given item within 15 calendar days after the item is delivered to the contract site.

a. In the event the Design-Builder fails to deliver O&M Data/Manuals within the time limits set forth above, the Owner may withhold from progress payments 50 percent of the price of the item with which such O&M Data/Manuals are associated.

1.1.5 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Design-Builder if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Owner for final acceptance of submitted data, shall be submitted by the Design-Builder within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.5 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.

1.2.1.6 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications;

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

c. A lubrication schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or

inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.

1.2.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.6 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies. Parts data may cover more than one model or series of equipment, components, assemblies,

subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

1.2.6.1 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.6.2 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.2.4.4 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.4.5 Design-Builder Information

Provide a list that includes the name, address, and telephone number of the Design-Builder and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M Data Packages specified in individual technical sections. The required information for each O&M Data Package is as follows:

1.3.1 Data Package

a. Safety precautions
b. Operator prestart
c. Environmental conditions
d. Preventive maintenance plan and schedule
e. Troubleshooting guides and diagnostic techniques
f. Wiring and control diagrams
g. Maintenance and repair procedures
h. Spare parts and supply list
i. Testing equipment and special tools
j. Warranty information
k. Contractor information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

--End of Section--

SECTION 02 41 19
MINOR DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the Work specified in this Section.

B. This section includes the following:

1. Remove designated building equipment and fixtures.
2. Remove designated partitions and components.
3. Cap and identify utilities.
4. Temporary partitions to allow building occupancy.

C. Structural notes indicated on the drawings regarding “Demolition for Remodeling” shall be considered part of this specification.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. 2019 California Building Codes (CBC).

B. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 QUALIFICATIONS

A. Demolition Contractor shall have a minimum of five (5) years of documented experience in the field of demolition.

1.4 SUBMITTALS

A. Prepare and submit shop drawings detailing demolition and removal procedures and schedules.

B. Prepare and submit record documents of all items demolished or removed.

1.5 EXISTING CONDITIONS

A. Conduct demolition to minimize interference with adjacent building areas. Maintain protected egress and access at all times.

B. Provide, erect, and maintain temporary barriers and security devices.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 PREPARATION

A. Erect and maintain weatherproof closures for exterior openings.

B. Erect and maintain temporary partitions to prevent spread of dust, fumes, noise, and smoke to provide for Owner occupancy.

C. Protect existing items which are not indicated to be altered.

D. Disconnect, remove, and cap designated utility services within demolition areas.

E. Mark location of disconnected utilities. Identify and indicate capping locations on Project Record Documents.

3.2 EXECUTION

A. Demolish specified items in an orderly and careful manner.

B. Except where noted otherwise, immediately remove demolished materials from site.

C. Remove materials to be re-installed or retained in manner to prevent damage.

D. Relics, antiques, and similar objects remain the property of the Owner. Notify Architect/Engineer prior to removal and obtain acceptance regarding method of removal. Relics and antiques may include:

1. _____.

E. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect items clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.

F. Remove, store, and protect for re-installation the following materials and equipment:

1. _____.

G. Remove the following material and equipment to be retained by Owner. Deliver to location agreed upon.

1. _____.

H. Remove and promptly dispose of contaminated, vermin infested, or dangerous materials encountered, except asbestos. If asbestos is encountered, the Contractor shall immediately notify the Owner.

I. Do not burn or bury materials on site.

J. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All items required for executing and completing the cast-in-place concrete work and related work shown on the drawings or specified herein. Work shall include installation of items furnished in other sections of these specifications.

B. Concrete paving, walks, curbs are specified in Division 3.

C. Structural notes indicated on the drawings regarding cast-in-place concrete shall be considered a part of this specification.

1.2 RELATED WORK

A. Pertinent Sections of Division 01.

1.3 REFERENCES

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.

2. ACI 301 - Specifications for Structural Concrete.

3. ACI 304R - Guide to Measuring, Mixing, Transporting, and Placing Concrete.

4. ACI 308R - Guide to External Curing of Concrete.

5. ACI 318 - Building Code Requirements for Structural Concrete.

6. ACI 347R - Guide to Formwork for Concrete.

7. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

8. ASTM C33 - Standard Specification for Concrete Aggregates.

9. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

11. ASTM C150 - Standard Specification for Portland Cement.

12. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.

13. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

14. California Building Standards Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2 (including all supplements).

15. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

1.4 SAMPLING AND TESTING REQUIREMENTS

A. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the requirements of the Contract Documents.

B. Use of testing services will not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

C. Take samples of fresh concrete at the job site for each mix design placed each day. Sampling and testing shall be done after the final addition and proper mixing of any water or admixtures that are added on site.

1. Personnel and testing equipment shall meet the requirements of ASTM E329.

2. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

3. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or 5,000 sq. ft. of surface area, whichever is less or fraction thereof of each concrete mixture placed each day.

a. On a given project, if the total volume of concrete is such that the frequency of testing required above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.

4. A strength test shall be the average of the strengths of two 6x12 inch or three 4x8 inch cylinders made from the same sample of concrete and tested at 28 days.

D. For each sample of fresh concrete, perform the following duties:

1. Measure and record slump in accordance with ASTM C143.

2. Measure and record temperature in accordance with ASTM C1064.

a. Provide one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.

3. Measure and record air content by volume in accordance with either ASTM C231 or ASTM C173.

a. Wet cure specimens for a period of seven (7) days (including the period of time the specimens are in the mold). Wet cure may be achieved through storage in a moist cabinet or room in accordance with ASTM C511, or through storage in lime-saturated water.

b. Slump of concrete for testing shall match job requirements and need not be limited to the restrictions as stated in ASTM C157.

c. Report results in accordance with ASTM C157 at 0, 7, 14 and 28 days of drying.

4. Mold three 6x12 inch or four 4x8 inch cylinders (laboratory cylinders) in accordance with ASTM C31 to be laboratory-cured. Protect from moisture loss and maintain at 60°F to 80°F for 24 to 48 hours before moving. Deliver cylinders to testing laboratory for curing and testing.

5. Mold one cylinder (field cylinder) in accordance with ASTM C31 to be field-cured. Field cylinder shall be placed as near as possible to the in-place concrete from which it was taken, protected, and cured in the same manner. Deliver field-cured cylinder to testing laboratory, and measure and record compressive strength in accordance with ASTM C39. Field cylinder shall be used to determine if concrete footings, walls, or piers have reached the required compressive strength for steel erection to begin.

E. Measure and record compressive strength in accordance with ASTM C39 for laboratory cylinders. Test one laboratory cylinder at 7 days and all other cylinders at 28 days. Acceptance is based on the average of the two 6x12 inch or three 4x8 inch laboratory cured 28-day tests. Notify Architect in the event strength levels do not meet the acceptance requirements of ACI 318.

1. Any additional cylinders molded for Contractor to have a compressive strength test done before seven days shall be at the Contractor's expense.

F. Prepare and submit test reports to the Architect. Reports shall be completed and furnished within 48 hours of testing. Refer to description in Submittals.

G. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

H. Should the strength of any grade of concrete for any portion of work, as indicated by molded test cylinders, fall below the minimum 28-day compressive strength specified on the drawings, upon approval of the Structural Engineer, the concrete supplier shall adjust the concrete mix for remaining portion of construction so that the resulting concrete meets the minimum strength requirements.

1.5 SUBMITTALS

A. Concrete Materials: Submit information on concrete materials as listed below.

1. Cementitious materials: Submit type, class, producer name, and certification not more than 90 days old of compliance with applicable ASTM standard.

2. Aggregates: Submit type, pit or quarry location, producer name, gradations, specific gravity, water content, and certification not more than 90 days old.

3. Admixtures: Submit product data sheet. Product data shall include: dosages and performance data, brand names, producers, chloride ion concentrations, and certifications of compliance with applicable ASTM standard. Certifications shall not be more than 90 days old.

4. Water: Submit name of source.

B. Product Data: Prepare and submit product and performance data for materials and accessories, including patching compounds, joint systems, curing compounds, finish materials, and other concrete related items.

C. Testing Agency Qualifications: When requested, the proposed testing agencies shall submit data on qualifications for acceptance.

D. Concrete Mix Design:

1. Concrete mix design submittals shall be submitted to the Structural Engineer for review and approval at least 14 days prior to placing concrete.

2. Mix design shall be certified by a registered Civil Engineer licensed in California.

3. Obtain Structural Engineer approval for each mix design prior to use, including new mix designs required to be prepared should there be a change in materials being used.

4. Submit concrete mixture proportions and characteristics for each concrete mix. Include standard deviation analysis or trial batch data with mix design. Submit historical field test data to demonstrate the average compressive strength for approval. Concrete mix proportions, materials, and handling methods for field test data or trial batches shall be the same as used for the work. Include the following information for each mix design:

   a. Water/cementitious materials ratio.

   b. Slump per ASTM C143

   c. Air content per ASTM C231 or ASTM C173

   d. Unit weight of concrete per ASTM C138

   e. Compressive strength at 28 days per ASTM C39

   f. Shrinkage (length change) as measured in accordance with ASTM C157 with the modifications included in Section 1.3.

5. If trial batches are used, submit representative samples of each proposed ingredient to independent testing laboratory for use in preparation of mix design.

6. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Indicate amounts of mix water to be withheld for later addition at Project site.

7. Provide a record copy of the final mix designs and test results to the testing agency prior to commencement of the concrete work.

E. Slab-on-Grade Joint Layout: Submit drawings for proposed slab-on-grade control joint and construction joint layout for approval.

F. Test Reports: Submit laboratory test reports for concrete materials, mix design, compressive strength, slump, air content, and temperature. Each report shall indicate date of sampling, date of test, mix design, and location of concrete in structure.

G. Certificates: Submit written certification regarding the design mix from the ready-mix supplier and the admixture manufacturer stating all concrete and admixtures do not contain chloride ions in excess of concentrations specified herein.

H. Record Documents: Accurately record actual locations of embedded utilities and components that are concealed from view.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Cementitious materials: Store cementitious materials in dry weather tight buildings, bins, or silos that exclude contaminants.

B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates so as to drain freely.

C. Do not allow machinery to run over lightweight aggregates.

D. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and temperature changes, which would adversely affect their performance. Handle chemical admixtures in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: Portland cement shall conform to ASTM C150, Type I Normal, and be a standard brand of Portland cement. Use one brand of cement throughout project, unless approved in writing by the Engineer. Cement, which conforms to ASTM C150 Type II, may be used if it also meets the requirements of ASTM C150 Type I. Cement used in concrete shall be of the same brand and type as the cement used in the concrete represented by the submitted field test data or used in the trial mixtures. Maintain consistent cement color throughout project unless directed otherwise by architectural requirements.

1. Total replacement of Portland cement by supplementary cementitious materials in design mixture shall not exceed 50% (by weight).

B. Coarse Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide coarse aggregate from a single source for exposed concrete.

C. Fine Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide fine aggregate from a single source for exposed concrete.

D. Do not use aggregates containing deleterious substances that could cause spalling on any exterior exposed surface. These include, but are not limited to the following:

1. Organic impurities.

2. Ferrous metals.

3. Soluble salts.

4. Coal, lignite, or other lightweight materials.

5. Soft particles.

6. Clay lumps and friable particles.

7. Cherts of less than 2.40 specific gravity.

E. Water: Mixing water for concrete shall meet the requirements of ASTM C94. Water shall be clean and free from injurious amounts of acids, alkalis, organic materials, chloride ions and oils deleterious to concrete or reinforcing steel.

2.2 MISCELLANEOUS MATERIALS

A. Patching Mortar: Non-shrink, non-slump, non-metallic, quick setting.

1. Acceptable manufacturers and products:

a. Euclid Chemical Company - Eucospeed.

b. BASF Corporation - MasterEmaco N 424.

c. Adhesive Technologies. - Hard Rok Vertipatch.

d. W.R. Meadows - Speed Crete (Red Line).

e. Dayton Superior - Re-Crete 20 minute.

f. SpecChem - Precast Patch.

B. Cement Grout: Mix 1 part Portland cement, 2-1/2 to 3 parts fine aggregate, and enough water for required consistency. Depending on use, consistency may range from mortar consistency to a mixture that will flow under its own weight. Do not mix more than the amount that can be used within 30 minutes. Retempering is not permitted. Use for leveling, preparing setting pads, beds, construction joints (with liquid bonding admixture) and similar uses. Do not use for grouting under bearing plates or structural members in place.

C. Dry-Pack: Mix 1 part Portland cement, 2 parts fine aggregate, and enough water to hydrate cement and provide a mixture that can be molded with the hands into a stable ball (a stiff mix). Do not mix more than the amount that can be used within 30 minutes.

D. Expansion Joint Material: Preformed, resilient, non-extruding asphalt-impregnated fiber conforming to ASTM D1751. Thickness of expansion joint material shall be 1/2" unless noted otherwise on the drawings.

E. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.

2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.3 STRENGTH AND PROPERTIES

A. Concrete Mix Designs: Refer to the drawings for specified compressive strength.

B. No other admixtures shall be used unless approved by Structural Engineer.

C. Workability: Concrete shall have a workability such that it will fill the forms without voids, honeycombs, or rock pockets with proper vibration without permitting materials to separate or excess water to collect on the surface.

D. Concrete Temperatures: Minimum concrete temperature of fresh concrete varies in relation to average air temperature over a 24-hour period as follows:

1.	Air temperature below 0°F	Concrete temperature 70°F min.
2.	Air temperature 0°F to 30°F	Concrete temperature 65°F min.
3.	Air temperature 30°F to 50°F	Concrete temperature 50°F min.
4.	Air temperature above 50°F	No minimum temperature

5. The maximum temperature of concrete at the time of delivery shall be 90°F. When concrete temperature exceeds 90°F, concrete supplier shall attempt to reduce temperature by shading aggregates and cement and cooling mix water. When these methods fail to reduce the concrete temperature below 90°F, supplier shall use ice in the water to reduce the concrete temperature. Use set retarding admixtures only when approved in the mix design.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

C. Do not place concrete until data on materials and mix designs have been approved, Architect has been notified, and all other affected trades have coordinated their work.

D. Remove snow, ice, frost, water, mud, and other foreign material from surfaces, reinforcing bars and embedded items against which concrete will be placed.

E. Prepare previously placed concrete by cleaning with sandblasting, steel brush, or water blast to expose aggregate to minimum 1/4" amplitude.

3.2 SLABS

A. Slab on Grade:

1. Refer to drawings for required sub-grade preparation beneath slabs on grade.

2. Subgrade shall be moist with no free water and no muddy or soft spots.

3. Saw cut control joints: Cut with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Control joints shall be located along column lines, with intermediate joints spaced at a maximum distance indicated on the drawings, unless noted otherwise. Control joints shall be continuous, not staggered or offset. Slab panels shall have a maximum length to width ratio of 1.5 to 1. Provide additional control joints at all reentrant or isolated corners formed in the slab on grade. Refer to the drawings for typical control joint detailing.

4. Provide isolation joints along foundation walls. Form isolation joints with 1/2" expansion joint material. Extend isolation joint material full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

5. Verify completion of all under slab work with mechanical and electrical trades before placing slabs.

6. Slope slabs as indicated on the drawings and to provide positive drainage. Slope slab keeping bottom level and varying top. Maintain minimum thickness of concrete as indicated on the drawings. Refer to floor finishes for tolerances.

B. Embedded Items:

1. The outside diameter of embedded conduit or pipe shall not exceed one-third of the slab thickness in structural slabs, including at crossovers, and shall be placed between the top and bottom reinforcing with a minimum 3" clear cover. Conduit or pipe running parallel to each other shall be spaced at least 8" apart and no more than 2 runs stacked vertically in the slab. Conduit or pipe shall not be embedded in any supported slab less than 6" thick. No embedded conduit or pipe is allowed in any concrete slab-on-steel deck.

3.3 CONSTRUCTION JOINTS

A. Slabs: Where slab pour is to receive a subsequent topping or additional concrete, expose aggregate in top surface by brooming in two directions at right angles to each other.

3.4 CONCRETE PLACEMENT

A. Place concrete as continuously as possible until placement is complete. Do not place against concrete that has attained initial set, except at authorized joints. If, for any reason, concrete pour is delayed for more than 45 minutes, bulkhead off pour at last acceptable construction joint. Immediately remove excess concrete and clean forms.

B. Do not begin to place concrete during periods of rain, sleet, or snow unless adequate protection is provided.

C. No concrete shall be cast onto or against sub-grades containing free water, frost, ice, or snow. If earth at bottom of forms has dried out, rewet so the soil is moist, but free of standing water and mud.

D. Do not place concrete until all reinforcement is in place, forms have been thoroughly cleaned and approval has been given.

E. Do not accept concrete delivered to the job site more than 90 minutes after initial mixing.

F. Concrete from its point of release to mixers, hoppers, or conveyances, shall not be permitted to drop more than 5 feet (10 feet for concrete containing high range water reducers). Deposit concrete directly into conveyances and directly from conveyances to final points of deposit. Sufficient transportation equipment in good working order shall be on hand before work begins. All conveying equipment must be clean and kept clean during concreting operations. Take every possible precaution to prevent segregation or loss of ingredients.

G. Regulate rate of placement so concrete surface is kept level throughout; a minimum being permitted to flow from one area to another. Use tremie heads spaced at approximately 10-foot intervals for placing concrete in walls. Control rate of placement consistent with form design.

H. Deposit concrete in one continuous operation until section being placed has been completed. For slab thicknesses greater than 12 inches, prevent excessive segregation of aggregate and high temperatures in accordance with ACI 304 and ACI 308. Place concrete in wall forms in layers not greater than 12 inches in depth, each layer being compacted by internal vibration before succeeding layer is placed.

I. Place concrete as near as possible to its final position to prevent segregation or loss of materials.

J. Place concrete during daylight hours, unless permitted otherwise by the Structural Engineer.

K. Exercise care in placing concrete over waterproof membranes, rigid insulation, and/or protection boards to avoid damaging those materials. Report damage immediately, and do not proceed until damage is repaired.

L. Remove loose debris from hardened surfaces of previous pours by sandblasting surfaces and expose clean coarse aggregate firmly embedded in cement matrix.

M. Protect existing concrete work to be exposed to view and other finished materials from damage and staining resulting from concreting operations. Handle concrete carefully to avoid dripping and spillage. Remove spilled concrete from existing surfaces immediately. Covering sills, ledges, and other surfaces with protective coverings may be necessary to protect the work.

N. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor rods for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.5 CONCRETE SLAB FINISHES AND TOLERANCES

A. Fine Broom Finish:

1. Screed concrete to an even plane, float, then power trowel the surface. Provide fine hair broom finish perpendicular to slope, free of loose particles, ridges, projections, voids, and concrete droppings.

2. Provide fine broom finish as indicated on the drawings and at the following locations:

a. Raised curbs and walkway areas.

B. Broom Finish:

1. Screed concrete to an even plane and then float. Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a coarse broom across the surface.

2. Provide as indicated on the drawings and at the following locations:

a. ADA ramp slabs.

b. Exterior walkway slabs.

C. Slab Drainage: Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear the cost of corrections to provide positive drainage.

D. Special Tolerances for Concrete Slabs: No abrupt change in vertical elevation of 1/4" or more is acceptable at the interface between slabs and within areas where pedestrian traffic is expected.

3.6 CONCRETE CURING

A. Freshly placed concrete shall be protected from premature drying and excessively hot temperatures.

B. Concrete other than high-early strength shall be maintained above 50°F and in a moist condition for at least the first 7 days after placement, except when special curing is used. Special curing procedures shall not be used without written permission from the Structural Engineer.

C. Formed surfaces shall be cured by leaving the formwork in place during the curing period.

D. Protect concrete from excessive changes in temperature during the curing period and at the termination of the curing process. Changes in the temperature of the concrete shall be as uniform as possible and shall not exceed 5°F in any one hour or 50°F in any 24-hour period.

E. Protect concrete from injury from the elements until full strength is developed. Protect from mechanical injury.

3.7 SLAB CURING

A. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Use one of the methods described below.

B. Moisture-Retaining-Cover Curing for Concrete Floors Not Exposed in Final Condition: Cover concrete surface with waterproof sheet material as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be placed flat on the concrete surface, avoiding wrinkles. Sprinkle concrete with water as necessary during application of covering. Place in widest practicable width, with sides and ends lapped at least 12 inches, and seal with waterproof tape or adhesive. Verify the concrete is continuously wet under the sheets; otherwise, add water through soaker hoses under the sheets. Weight down covering to prevent displacement. Immediately repair any holes or tears during the curing period using polyethylene sheet and waterproof tape. Curing process shall be maintained for a minimum of 7 days.

C. Independent Testing Agency Inspector shall each perform their prescribed inspection, sampling, and testing services as described in Part 1 of this specification section.

3.8 REPAIR OF DEFECTIVE AREAS

A. All repair of defective areas shall be made, with prior approval of Architect and Structural Engineer as to method and procedure, in accordance with Section 5 of ACI 301, except specified bonding compound must be used. Cosmetic repairs of minor defects in exposed concrete surfaces shall be in a manner acceptable to the Architect. Defective areas shall be deemed when:

1. Tests on core or prism specimens fail to show specified strengths.

2. Not formed as indicated or detailed.

3. Not plumb or level where so indicated or required to receive subsequent work.

4. Not true to intended grades and levels.

5. Cut, filled, or resurfaced, unless under direction of the Structural Engineer.

6. Debris is embedded therein.

7. Not fully in conformance with provisions of the drawings.

8. Damaged by hot or cold weather conditions.

9. Mixing time exceeds 90 minutes from ready-mix plant to the time of deposit.

B. All structural repairs shall be made, with prior approval of the Architect/Engineer, as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.

3.9 CLEANING

A. Clean exposed concrete to remove laitance, efflorescence, and stains.

END OF SECTION

SECTION 04 22 00
REINFORCED UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply and installation of all reinforced concrete unit masonry work (concrete unit masonry, mortar, grout, reinforcement, anchors, and ties) and accessories as shown on the drawings and herein specified.

B. Products installed but not furnished under this section:

1. Masonry.

C. Structural notes indicated on the drawings regarding reinforced unit masonry shall be considered part of this specification.

1.2 RELATED WORK

A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCES

A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

2. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.

3. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

4. ASTM C270 - Standard Specification for Mortar for Unit Masonry.

5. ASTM C387 - Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.

6. ASTM C476 - Standard Specification for Grout for Masonry.

7. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.

8. TMS 402/602 - Building Code Requirements and Specifications for Masonry Structures.

9. UL - Underwriters Laboratories.

1.4 QUALITY ASSURANCE

A. Installation Company: Company shall have not less than five (5) years of documented experience in the construction of masonry projects of similar scope and complexity.

B. For the actual cutting and placing of concrete masonry units, use only skilled masons who are thoroughly experienced with the material and methods specified and thoroughly familiar with the design requirements. Workers shall have not less than three (3) years of documented experience in the construction of masonry walls.

C. Fire Resistance: Whenever a fire-resistant classification is indicated for unit masonry construction, provide concrete block units as tested and listed for the particular fire-resistant construction.

D. Perform the work in accordance with Chapter 21 of the California Building Code.

E. The governing building department reserves the right to take samples and make material tests prior to or during construction, without expense to the Contractor. Materials found to be defective shall be removed and replaced.

F. Certificates:

1. Submit a letter of certification from the manufacturer of the concrete masonry units certifying all concrete masonry units delivered to the worksite are in strict conformance with the provisions of this specification.

2. Submit concrete unit masonry compressive strength test results demonstrating the units meet the specified strength. Test must be conducted by a qualified independent testing agency.

G. Submit mortar mix design and test results as follows:

1. Mix designs shall indicate type and proportions of ingredients in compliance with the proportion requirements of ASTM C270.

2. For mix designs not in accordance with the proportion requirements of ASTM C270, the mortar test history must be performed in accordance with ASTM C780 to verify performance with property requirements of ASTM C270. Tests must meet the type of mortar specified on the drawings. Tests must be done by a qualified independent testing agency.

H. Submit grout mix designs and test results as follows:

1. Mix designs shall indicate type and proportions of the ingredients in compliance with the proportion requirements of ASTM C476.

2. For mix designs not in accordance with the proportion requirements of ASTM C476, the grout test history must be performed in accordance with ASTM C1019 to verify performance with property requirements of ASTM C476. Tests must meet the type of grout specified on the drawings. Test must be done by a qualified independent testing agency.

a. Perform one test prior to construction and perform at least one test during construction for each 5000 square feet of wall.

1.5 DELIVERY, STORAGE, AND HANDLING

A. All masonry units shall be delivered to the worksite and stacked on pallets to allow the circulation of air through all units. Cover with a waterproof covering anchored to prevent displacement during high winds.

B. Masonry accessories, including reinforcing steel, shall be stored clear of the ground to prevent deterioration or damage due to moisture, temperature changes, contaminants, and corrosion.

C. Deliver all materials in sufficient quantity and time to maintain approved construction schedule.

D. Deliver all packaged materials in manufacturer's original containers, with labels and markings intact and legible.

E. Immediately remove all damaged materials or containers from site and replace with new items.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Masonry Units: ASTM C90, Grade N-1 as follows:

1. Weight: Normal weight or lightweight.

2. Compressive Strength: As indicated on the drawings.

3. Nominal Size: As indicated on the drawings.

4. Actual Size: 3/8" less than nominal size.

5. Aggregates:

a. Normal Weight: ASTM C33.

b. Lightweight: ASTM C331.

6. Provide special units for 90° corners, lintels jambs, sash, control joints, headers, bond beams, and other special conditions conforming to ASTM C90.

7. All exposed unit masonry shall be free of chips, cracks, and other imperfections.

B. Mortar and Grout:

1. Compressive Strength: As indicated on the drawings.

2. Mortar type for masonry construction shall be as designated in the General Notes of the drawings, conforming to ASTM C270, and grout shall conform to ASTM C476.

3. Portland Cement: ASTM C150, Type I, non-staining, no air entraining, natural color cement.

4. Blended Cement: ASTM C595.

5. Masonry Cement: ASTM C91.

6. Mortar Aggregate: ASTM C144, standard masonry type sand per California Building Code.

7. Hydrated Lime: ASTM C207.

8. Quicklime: ASTM C5, non-hydraulic type.

9. Premix Mortar: ASTM C387, using [gray][white] cement, normal strength.

10. Grout Aggregate: ASTM C404 Pea gravel with not more than 5% passing the No. 8 sieve and 100% passing the 3/8-inch sieve per the California Building Code.

11. Grout Fine Aggregate: Sand.

12. Water: Clean and potable.

13. Do not use calcium chloride in mortar or grout.

C. Joint Reinforcement:

1. Provide joint reinforcement formed from galvanized carbon-steel wire in accordance with ASTM A641, Class 1 for interior walls; and ASTM A153, Class B-2, for exterior walls.

2. Provide welded wire units prefabricated with 9 gauge deformed continuous side rods and 9 gauge plain cross rods into straight lengths of not less than 10 feet with matching corner and tee units. Unit widths to be 1-1/2 to 2 inches less than the wall thickness.

3. For multi-wythe concrete masonry walls, provide truss type reinforcement with a third side rod extending out into the other wythe.

D. Ties and Anchors:

1. Rigid wall anchors shall be fabricated of 1/4 inch thick mild steel, 1 inch wide by 24 inches long, with ends turned up.

2. Wall ties shall be corrugated 7/8 inch wide by 7 inches long, minimum 16 gauge galvanized steel.

3. Structural steel column anchor ties shall be adjustable weld-on 1/4 inch diameter steel rods and minimum 3/16 inch galvanized triangular shaped tie.

4. For anchorage to concrete, use dovetail sheet metal anchor sections and triangular shaped 16 gauge wire tie sections sized to extend within 1 inch of masonry face.

E. Reinforcement:

1. Use deformed billet bars with unprotected finish conforming to ASTM A615, 60 ksi yield strength.

F. Control and Expansion Joints:

1. Control joint material for unit masonry shall consist of cross-shaped extruded polyvinyl gaskets sized to match wall thickness.

2. Expansion or joint filler material, unless otherwise indicated, shall be 1/2 inch thick asphalt impregnated cellular board.

3. Compressible filler shall be pre-molded filler strips complying with ASTM D1056, Type 2, Class A, Grade 1; compressible up to 35 percent of width and thickness indicated.

4. Bond breaker strips shall be asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).

G. Masonry cleaners shall be non-acidic and not harmful to masonry workers or adjacent materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive work.

1. Verify foundations are constructed with tolerances conforming to the requirements of ACI 117.

2. Verify reinforcing dowels are positioned in accordance with the drawings.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify built-in items are in proper location and ready for roughing into masonry work.

D. Beginning of installation means Installer accepts existing conditions.

3.2 PREPARATION

A. Layout walls in advance for accurate spacing of bond patterns, with uniform joint widths and to properly locate openings, expansion joints, and offsets.

B. Direct and coordinate placement of metal anchors supplied to other Sections.

C. The Contractor is responsible to design, provide, and install bracing that will ensure stability of masonry during construction. Maintain in place until building structure provides permanent bracing.

D. Remove laitance, loose aggregate, and anything else that would prevent mortar from bonding to the foundation.

E. Clean all reinforcement by removing mud, oil, or other materials that will adversely affect or reduce bond at the time mortar or grout is placed.

3.3 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement. Grouted cells shall be in vertical alignment.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Lay concrete masonry units in bond to match existing at all patch and infill locations.

D. Unless noted otherwise, provide masonry control joints at 30'-0" on center maximum.

E. Unless noted otherwise, build non-bearing interior partitions walls full height to underside of structure.

3.4 PLACING AND BONDING

A. Unless noted otherwise, construct masonry in running bond pattern.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Bed and Head Joints:

1. Unless otherwise required, construct 3/8 inch thick bed and head joints.

2. At foundation, construct bed joint of the starting course a thickness not less than 1/4 inch, and not more than 3/4 inch.

3. Unless otherwise noted, tool joint with a round jointer when the mortar is thumbprint hard.

4. Remove masonry protrusions extending 1/2 inch or more into cells or cavities to be grouted.

5. Where masonry rests on concrete, the concrete shall be sandblasted or bushed.

D. Collar Joints:

1. Unless otherwise required, solidly fill collar joints less than 3/4 inch wide with mortar as the job progresses.

E. Place hollow units as follows:

1. With face shells of bed joints fully mortared.

2. With webs fully mortared in:

a. All courses of piers, columns, and pilasters.

b. In the starting course on foundations.

c. When necessary to confine grout or loose fill.

d. When otherwise required.

3. With head joints mortared, a minimum distance from each face equal to the face shell thickness of the unit.

4. Vertical cells to be grouted are aligned and openings are unobstructed.

F. Place solid units as follows:

1. Unless otherwise required, solidly fill bed and head joints with mortar.

2. Do not fill head joints by grouting with mortar.

3. Construct head by shoving mortar tight against the adjoining unit.

4. Do not deeply furrow bed joints.

G. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

H. Remove excess mortar as work progresses.

I. Interlock intersections and external corners.

J. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

K. Perform job site cutting of masonry units with proper tools to provide straight, clean, undamaged edges. Prevent broken masonry unit corners or edges.

L. Isolate masonry partitions from vertical structural framing members with a control joint.

M. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler and pin top of wall with prefabricated partition anchors that allow vertical movement.

3.5 HORIZONTAL REINFORCEMENT AND ANCHORS

A. Install horizontal joint reinforcement as follows:

1. Interior non-load bearing walls - 24 inches on center vertically.

2. Exterior walls and interior load bearing walls - 16 inches on center vertically.

3. Parapet walls - 8 inches on center vertically unless noted otherwise.

4. Foundation walls - 8 inches on center vertically unless noted otherwise.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches. Extend minimum 16 inches each side of openings.

E. Place joint reinforcement so longitudinal wires are embedded in mortar with a minimum cover of 1/2 inch when not exposed to weather or earth, and 5/8 inch when exposed to weather or earth.

F. Anchor masonry to structural members where masonry abuts or faces such members.

G. Wall Ties:

1. Embed the ends of wall ties in mortar joints. Embed wall tie ends at least 1/2" into the outer face shell of hollow units. Embed wire wall ties at least 1-1/2" into the mortar bed of solid masonry units or solid grouted hollow units.

2. Do not bend wall ties after embedded in grout or mortar.

3. Unless otherwise required, install adjustable ties in accordance with the following requirements.

a. One tie for each 1.77 square feet of wall area.

b. Do not exceed 16 inches horizontal or vertical spacing.

c. The maximum misalignment of bed joints from one wythe to the other is 1-1/4".

d. The maximum clearance between connecting parts of the ties is 1/16".

e. When pintle legs are used, provide ties with at least two legs made of wire size W2.8.

f. Install wire ties perpendicular to a vertical line on the face of the wythe from which they protrude. Where one-piece ties or joint reinforcement is used, the bed joints of adjacent wythes shall align.

g. Unless otherwise required, provide additional unit ties around all openings larger than 16 inches in either dimension. Space ties around the perimeter of an opening at a maximum of 3 feet on center. Place ties within 12 inches of an opening.

3.6 VERTICAL REINFORCEMENT

A. Support and secure reinforcing bars from displacement beyond the tolerances allowed by construction loads or by placement of grout or mortar. Maintain position within 1/2 inch of masonry unit or formed surface, but not less than 1/4 inch (only when fine grout is used).

B. Dowels in footings shall be set to align with cores containing reinforcing steel.

C. Place and consolidate grout fill without displacing reinforcing. Completely embed reinforcing bars in grout.

D. All cells containing reinforcing in concrete blocks shall be filled solid with grout.

E. Do not bend reinforcement after it is embedded in grout or mortar.

F. Reinforce masonry unit cores and cavities with vertical reinforcement bars and grout as indicated on the drawings. Place reinforcement and ties in grout spaces prior to grouting.

G. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters.

H. Place steel in walls and flexural elements within 1/2 inch of required location.

I. Place vertical bars within 2 inches of the required location along the length of the wall.

3.7 CONCRETE UNIT MASONRY

A. Lay masonry units with core cells vertically aligned and clear of mortar dropping, debris, loose aggregates, and any material deleterious to masonry grout.

B. Do not place grout until height of masonry to be grouted has attained sufficient strength to resist grout pressure.

C. Do not wet concrete masonry units before laying.

D. Grout spaces less than two inches in width with fine grout using low lift grouting techniques. Grout spaces two inches or greater in width with course grout using high lift or low lift grouting techniques.

E. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.

F. Grouting:

1. Place grout in lifts not to exceed five feet. Consolidate grout at time of placement.

a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.

b. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

c. When the grout pour height exceeds 5 feet 4 inches, provide cleanout opening no less than 3 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit. Opening should be of sufficient size to permit removal of debris.

d. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.

e. Limit grout lift to 60 inches and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.8 GROUTING REINFORCED CONCRETE BLOCK WALLS

A. Provide reinforcing bars at indicated spacing and grout bars and voids solid with grout having a 28-day compressive strength as listed in the General Notes of the drawings.

3.9 GROUTING BLOCK CELLS BELOW LINTELS AND BEAMS

A. For lintel spans greater than 5'-0": Grout block cells 24 inches beneath the lintel and 24 inches each side of lintel.

3.10 LINTELS AND BOND BEAMS

A. Steel Lintels: Install steel lintels supplied from Division 5 of this specification. Provide a minimum of [8]<Insert> inches of end bearing on each side of opening unless noted otherwise. All exterior exposed steel lintels shall be hot-dip galvanized in accordance with ASTM A123.

B. Bond Beams:

1. Use specially shaped lintel units at hollow masonry unit walls, with reinforcing bars as shown and filled with concrete grout.

2. Provide minimum [8][16] inches of end bearing at each side of opening.

3. Provide reinforced concrete block lintels over openings less than 3'-0" wide which are not scheduled.

4. Place and consolidate concrete without disturbing the reinforcing.

5. Allow lintels to reach 100 percent of their design strength before removing temporary supports.

6. Do not place vertical control joints above bond beams or within [16 inches]<Insert> each side of bond beam.

3.11 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control and expansion joints except above wall openings.

B. Provide vertical expansion, control, and isolation joints as indicated on the drawings. If joints are not indicated, then provide control joints at a maximum spacing of 30'-0".

C. Install all built-in masonry accessory items as work progresses.

D. Exposed joints to be tooled slightly concave and concealed joints to be struck flush. Use a 3/4-inch diameter round tool for making 1/2-inch joints.

1. Bed Joints: Not less than 3/8-inch and not more than 2-inch thick.

2. Head Joints: To match bed joints.

E. Rake out mortar where sealants are shown or required.

3.12 BUILT-IN WORK AND EMBEDDED ITEMS

A. As work progresses, build in metal door and glazed frames, fabricated metal lintels, anchor bolts, plates, and other items furnished by other Sections.

B. Place pipes and conduits passing horizontally through masonry beams or masonry walls in steel sleeves or cored holes.

C. Install pipes and conduits passing horizontally through non-bearing masonry partitions.

D. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories.

E. Do not embed aluminum conduits, pipes, and accessories in masonry, grout, or mortar, unless effectively coated or covered to prevent aluminum-cement chemical reaction or electrolytic action between aluminum and steel.

F. Build in items plumb and level.

G. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

H. Do not build in organic materials subject to deterioration.

3.13 PREFABRICATED CONCRETE AND MASONRY ITEMS

A. Erect prefabricated concrete and masonry items in accordance with the requirements.

3.14 TOLERANCES

A. Comply with tolerances in the MSJC Specification and the following:

1. Maximum variation from alignment of columns and pilasters: 1/4 inch.

2. Maximum variation from unit to adjacent unit: 1/32 inch.

3. Maximum variation from plane of wall: 1/4 inch in 10 feet and 3/8 inch in 20 feet or more.

4. Maximum variation from plumb: 1/4 inch per story non-cumulative.

5. Maximum variation from level coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.

6. Maximum variation of bed joint thickness: 1/8 inch.

3.15 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and structural members. Coordinate with other Sections of work to provide correct size, shape, and location.

B. Obtain the Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.16 CLEANING

A. Remove excess mortar and mortar smears.

B. Replace defective mortar.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

E. Clean exposed masonry surfaces of all stains, efflorescence, mortar or grout droppings, and debris.

F. Where new masonry wall surfaces remain stained or defaced by mortar or any other foreign matter to a degree not acceptable to the Owner, clean surfaces by a light sandblasting at no added cost. Avoid damaging masonry surfaces and joints during sandblasting operations.

3.17 PROTECTION OF FINISHED WORK

A. Without damaging completed work, provide protective boards at exposed external corners that may be damaged by construction activities.

B. Water Repellent Coating:

1. Apply sufficient coats of the approved material to achieve a consistent and uniform appearance, free from runs and sags, and with a uniformly resistive surface that will prevent penetration of water through the walls for the required period of warranty.

2. Twenty days after completion of the portion of the Work, and as a condition of its acceptance, demonstrate by running a water test showing it will successfully repel water.

a. Notify the Engineer at least 72 hours in advance and conduct the test in the Engineer's presence.

b. By means of an outrigger or similar acceptable equipment, place the nozzle of a 3/4" garden hose at a point approximately 10 feet away from the top of the wall, aiming the nozzle at a slight downward angle to direct the full stream of water onto the wall.

c. Run the water onto the wall at full available force for not less than 4 hours.

d. Upon completion of the 4-hour period, inspect the interior surfaces of the wall for evidence of moisture penetration.

3. If evidence of moisture penetration is discovered, apply an additional coat of the water repellent material to the exterior surface in areas directed by the Engineer, repeating the application and the testing, at no additional cost to the Owner, until no evidence of moisture penetration is found.

END OF SECTION

SECTION 06 61 19
SOLID SURFACING FABRICATIONS

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz countertops.

2. Setting materials and accessories.

B. Related Sections:

1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. A108.5 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex Portland Cement Mortar.

2. A118.4 – Latex-Portland Cement Mortar.

B. ASTM International (ASTM:

1. C97 – Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone.

2. C99 – Standard Test Method for Modulus of Rupture of Dimension Stone.

3. C170 – Standard Test Method for Compressive Strength of Dimension Stone.

4. C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

5. C880 – Standard Test Method for Flexural Strength of Dimension Stone.

6. C1028 – Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

7. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. Shop Drawings: Include countertop layout, dimensions, materials, finishes, cutouts, and attachments.

B. Samples:

1. 3 x 3 inch quartz samples in specified color.

1.4 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Minimum 2 years documented experience in work of this Section.

1.5 WARRANTY

A. A. Provide manufacturer's 10 year warranty against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on products by Cosentino USA, Inc.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Quartz Sheet:

1. Product: Silestone.

2. Composition: Quartz aggregate, resin, and color pigments formed into flat slabs.

3. Anti-microbial protection: Microban by Microban International, Inc., integral to sheet.

4. Color: To be selected from manufacturer's full color range.

5. Thickness: To be selected from manufacturer's full material range. Minimum ¾" thick.

6. Physical characteristics:

a. Static coefficient of friction: 1.02 dry, 0.51 wet, tested to ASTM C1028.

b. Water absorption: Maximum 0.03 percent, tested to ASTM C97.

c. Compressive strength: Minimum 29,000 psi, tested to ASTM C170.

d. Bond strength: Minimum 210 psi, tested to ASTM C482.

e. Modulus of rupture: Minimum 6300 psi, tested to ASTM C99.

f. Flexural strength: Minimum 5800 psi, tested to ASTM C880.

g. Breaking strength: Minimum 480 lbf, tested to ASTM C648.

h. Stain resistance: Not affected by 10 percent hydrochloric acid or 10 percent KOH, tested to ASTM C650.

i. Thermal shock resistance: Pass 5 cycles, tested to ASTM C484.

j. Abrasive index: 65-Ha = 25, tested to ASTM C241.

k. Thermal expansion: 1.670 x 10-5 in/in/deg F, tested to ASTM C531.

l. Deicing resistance: Rating of 0, tested to ASTM C672/C672M.

m. Freeze/thaw resistance: 0 tiles at 15 cycles, tested to ASTM C1026.

n. Flame spread rating: Class 1, tested to ASTM E84.

2.3 ACCESSORIES

A. Adhesive: Type recommended by quartz manufacturer.

B. Joint Sealer:

1. Latisil Tile and Stone Sealant by Laticrete International, Inc.

2.4 FABRICATION

A. Cut quartz panels accurately to required shapes and dimensions.

B. Radius exposed edges.

C. Fabricate with hairline joints.

D. Cut holes for sinks, faucets, and toilet accessories.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive countertops; remove loose and foreign matter than could interfere with adhesion.

3.2 INSTALLATION

A. Install countertops in accordance with manufacturer’s instructions and approved Shop Drawings.

B. Adhere countertops to supports with continuous beads of adhesive.

C. Set in thin set mortar bed in accordance with ANSI A 108.5.

D. Set plumb and level. Align adjacent pieces in same plane.

E. Install with hairline joints.

F. Fill joints between countertops and adjacent construction with joint sealer; finish smooth and flush.

3.3 INSTALLATION TOLERANCES

A. Maximum variation from level and plumb: 1/8 inch in 10 feet, noncumulative.

B. Maximum variation in plane between adjacent pieces at joint: Plus or minus 1/16 inch.

3.4 CLEANING

A. Clean countertops in accordance with manufacturer’s instructions.

3.5 PROTECTION

A. Protect installed countertops with nonstaining sheet coverings.

END OF SECTION

SECTION 07 54 23
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Adhered TPO membrane roofing system.

B. Cover board.

C. Roof insulation.

1.2 RELATED SECTIONS

1.3 REFERENCES

A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:

1. ASTM D 1079 “Standard Terminology Relating to Roofing and Waterproofing.”

2. Glossary of NRCA’s “The NRCA Roofing and Waterproofing Manual.”

3. Roof Consultants Institute “Glossary of Building Envelope Terms.”

B. Sheet Metal Terminology and Techniques: SMACNA “Architectural Sheet Metal Manual.”

1.4 DESIGN CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Installer shall comply with current code requirements based on authority having jurisdiction.

D. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

E. California Title 24/CRRC-1: Roofing system shall comply with the requirements of Title 24 and shall be tested by CRRC-1.

F. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

1.5 SUBMITTALS

A. Product Data: Manufacturer’s data sheets for each product to be provided.

B. Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:

1. Base flashings and membrane terminations.

2. Tapered insulation, including slopes.

3. Crickets, saddles, and tapered edge strips, including slopes.

4. Insulation fastening and adhesive patterns.

C. Verification Samples: Provide for each product specified.

D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

E. Maintenance Data: Refer to Johns Manville’s latest published documents on www.JM.com.

F. Guarantees: Provide manufacturer’s current guarantee specimen.

G. Prior to beginning the work of this section, roofing sub-contractor shall provide a copy of the final System Assembly Letter issued by Johns Manville Roofing Systems indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified JM contractor in accordance with our application requirements, inspected and approved by a JM Technical Representative.

H. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by Johns Manville Roofing Systems indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.

B. Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

D. Test Reports:

1. Roof drain and leader test or submit plumber’s verification.

2. Roof deck fastener pullout test.

E. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.9 GUARANTEE

A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.

1. Single-source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover board, walkway products, manufacturer’s expansion joints, manufacturer’s edge metal products, and other single-source components of roofing system marketed by the manufacturer.

2. Guarantee Period: 20 years from date of Substantial Completion.

B. Installer’s Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period:

1. Guarantee Period: Two years from date of Substantial Completion.

C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.

1. Installer is responsible for coordinating with building owner’s representative to verify compliance.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE - TPO

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced. Basis of design: JM TPO

1. Membrane Thickness: 60 mils, nominal

2. Exposed Face Color: White

2.2 AUXILIARY ROOFING MATERIALS – SINGLE PLY

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's internally reinforced or scrim reinforced, smooth backed membrane with same thickness and color as sheet membrane. Basis of design: JM TPO

C. Bonding Adhesive: Manufacturer's standard solvent-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings. Basis of design: JM All Season Sprayable Bonding Adhesive

D. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Basis of design: JM Termination Systems

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Basis of design: High Load Fasteners and Plates

F. Miscellaneous Accessories: Provide pourable sealers, primers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, cover strips, and other accessories required for full installation. Basis of design: JM TPO Pourable Sealer A & B, JM TPO Pipe Boots, JM TPO Universal Corners, JM TPO Edge Sealant, JM TPO T-Joint Patch, JM TPO Membrane Cleaner, JM TPO Membrane Primer, JM TPO Membrane Primer (Low VOC), JM TPO Sealing Mastic, JM TPO Cover Tape, JM TPO Detail Membrane, JM TPO Peel & Stick 10" RPS, JM TPO Peel & Stick 6" RTS, JM TPO-Coated Metal, JM TPO Curb Flashing and JM Single Ply Caulk

2.3 COVER BOARD

A. High-Density Polyisocyanurate: ASTM C 1289, Type II, Class 4, Grade 1, High-density Polyisocyanurate technology bonded in-line to inorganic coated glass facers with greater than 80 lbs of compressive strength. Basis of design: ProtectoR HD

1. Thickness: 1/2 inch

2. R-value: 2.5

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of design: ENRGY 3

1. Provide insulation package with minimum R Value: R-30.

2. Provide insulation package in multiple layers.

3. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.

a. Determined in accordance with CAN/ULC S770 at 75ºF (24ºC)

2.5 TAPERED INSULATION

A. Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated. Basis of design: Tapered ENRGY 3

2.6 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of design: Diamondback Pre-Cut Cricket, Diamondback Pre-Cut Miter, or Tapered Fesco Edge Strip

C. Urethane Adhesive: Manufacturer’s two component polyurethane adhesive formulated to adhere insulation to substrate. Basis of design: JM Two-Part Urethane Insulation Adhesive (UIA)

D. Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

2.7 EDGE METAL COMPONENTS

A. Expansion Joints: Provide factory fabricated weatherproof, exterior covers for expansion joint openings consisting of flexible rubber membrane, supported by a closed cell foam to form flexible bellows, with two metal flanges, adhesively and mechanically combined to the bellows by a bifurcation process. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Expand-O-Flash Expand-O-Gard

B. Coping System: Manufacturer’s factory fabricated coping consisting of a base piece and a snap-on cap. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Lock Coping

C. Fascia System: Manufacturer’s factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Tite Fascia Presto-Tite Edge One Fascia

D. Metal Edge System: Manufacturer’s factory fabricated metal edge system used to terminate the roof at the perimeter of the structure. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Weld Drip Edge JM TPO-Coated Metal

E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.

1. General:

a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.

b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

2. Concrete Decks:

a. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

b. Verify that concrete substrate is visibly dry and free of moisture.

3. Ensure general rigidity and proper slope for drainage.

4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units more than 1/16 inch out of plane relative to adjoining deck.

B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner’s Representative and shall be corrected prior to installation of roofing system.

3.2 PREPARATION

A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. If applicable, prime surface of deck with asphalt primer at a rate recommended by roofing manufacturer and allow primer to dry.

D. Proceed with each step of installation only after unsatisfactory conditions have been corrected.

3.3 RE-ROOF PREPARATION

A. Remove all roofing membrane, surfacing, coverboards, insulation, fasteners, asphalt, pitch, adhesives, etc.

1. Remove an area no larger than can be re-roofed in one day.

B. Tear out all base flashings, counter flashings, pitch pans, pipe flashings, vents and like components necessary for application of new membrane.

C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.

1. Install decking to match existing as directed by Owner's Representative.

D. Raise (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:

1. Modify curbs as required to provide a minimum 8" base flashing height measured from the surface of the new membrane to the top of the flashing membrane.

2. Secure of flashing and install new metal counterflashing prior to re-installation of unit.

3. Perimeter nailers shall be elevated to match elevation of new roof insulation.

E. Immediately remove all debris from roof surface. Demolished roof system may not be stored on the roof surface.

3.4 INSULATION INSTALLATION

A. Coordinate installation of roof system components so insulation and cover board are not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer’s written instructions. Fill gaps exceeding 1/4 inch with like material.

E. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

H. Adhered Insulation: Adhere each layer of insulation to substrate as follows:

1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer’s instruction.

2. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

3.5 COVER BOARD INSTALLATION

A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.

C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer’s written instructions. Fill gaps exceeding 1/4 inch with cover board.

1. Cut and fit cover board within 1/4 inch of nailers, projections, and penetrations.

D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.

1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Cover Board: Adhere cover board to substrate as follows:

1. Install in a two-part urethane adhesive according to roofing system manufacturer’s instruction.

2. Install to resist uplift pressure at corners, perimeter, and field of roof.

3.6 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

C. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.

1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.7 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.

1. Unroll roofing membrane and allow to relax before installing.

2. Install sheet in accordance with roofing system manufacturer’s written instructions.

B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Solvent Based Bonding Adhesive for smooth backed membranes: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

D. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing membrane with side laps shingled with roof slope, where possible.

F. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.

a. Remove and repair any unsatisfactory sections before proceeding with installation.

3. Repair tears, voids, and incorrectly lapped seams in roofing membrane that do not meet requirements.

G. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

H. Install roofing membrane and auxiliary materials to tie into existing roofing.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates per membrane roofing system manufacturer's written instructions.

B. Apply solvent-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Apply single ply liquid applied flashing system per manufacturer’s written instructions.

D. Flash penetrations and field-formed inside and outside corners per manufacturer’s installation instructions.

E. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical representative to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 84 13
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 723 - Surface Burning Characteristics of Building Materials
B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
D. Intertek / Warnock Hersey - Directory of Listed Products
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
G. The Building Officials and Code Administrators National Building Code
H. 2019 California Building Code
I. NFPA 5000 – Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.

3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

F. Submit VOC rating of firestopping material in g/L (less water) with documentation that it meets the limits set forth in SCAQMD Rule 1168.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.

2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:

a. Floor penetrations located outside wall cavities.
b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq.ft. (0.0254 cu. m/s x sq. m) at both ambient temperature and 400°F (204°C) for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.

2. Hilti, Inc.

3. RectorSeal Corporation, Metacaulk.

4. Tremco; Sealant/Weatherproofing Division.

5. Johns-Manville.

6. Specified Technologies Inc. (S.T.I.)

7. Spec Seal Firestop Products

8. AD Firebarrier Protection Systems

9. Wiremold/Legrand: FlameStopper

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
   F Rating = Floor/Wall Rating
   T Rating = Floor/Wall Rating
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
   F Rating = Wall Rating
   T Rating = 0
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999

Penetrating Item	UL System No.
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Walls) = 0 or Wall Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the engineer and manufacturer's factory representative. The engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 07 92 00
JOINT SEALERS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and backing.

1.2 REFERENCES

A. ANSI/ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

B. ANSI/ASTM D1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).

C. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, solvent Release Type.

D. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

E. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

F. SWI (Sealing and Waterproofers Institute) - Sealant and Caulking Guide Specification.

1.3 SUBMITTALS

A. Submit product data under provisions of the General Conditions.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three (3) years documented experience.

B. Applicator: Company specializing in applying the work of this Section with minimum three (3) years documented experience and approved by sealant manufacturer.

C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate work under provisions of the General Conditions.

B. Coordinate the work of this Section with all Sections referencing this Section.

1.7 WARRANTY

A. Provide three-year warranty under provisions of the General Conditions.

B. Warranty: Include coverage of installed sealants and accessories which fail to achieve airtight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 SEALANTS

A. Polyurethane Sealant: Single component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type; color as selected.

Elongation Capability	25 percent
Service Temperature Range	-40 to 180ºF
Shore A Hardness Range	20 to 35

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ANSI/ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work and field measurements are as shown on the drawings and recommended by the manufacturer.

B. Beginning of installation means installer accepts existing surfaces.

3.2 PREPARATION

A. Clean and prime joints in accordance with manufacturer's instructions.

B. Remove loose materials and foreign matter which might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Perform preparation in accordance with manufacturer’s recommendations.

E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install sealant in accordance with manufacturer's instructions.

B. Measure joint dimensions and size materials to achieve required width/depth ratios.

C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.

D. Install bond breaker where joint backing is not used.

E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

G. Tool joints as recommended by manufacturer.

3.4 CLEANING AND REPAIRING

A. Clean work under provisions of the General Conditions.

B. Clean adjacent soiled surfaces.

C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 PROTECTION OF FINISHED WORK

A. Protect finished installation.

B. Protect sealants until cured.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hardware for wood and hollow steel doors.

1.2 REFERENCES

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. ANSI/NFPA 80 - Fire Doors and Windows.

C. AWI - Architectural Woodwork Institute.

D. BHMA - Builders' Hardware Manufacturers Association.

E. DHI - Door and Hardware Institute.

F. NAAMM - National Association of Architectural Metal Manufacturers.

G. NFPA 101 - Life Safety Code.

H. SDI - Steel Door Institute.

1.3 COORDINATION

A. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal reinforcement for door hardware.

1.4 QUALITY ASSURANCE

A. Manufacturers: Companies specializing in manufacturing door hardware with minimum three years’ experience.

B. Hardware Supplier: Company specializing in supplying commercial institutional door hardware with three years experience approved by manufacturer.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable California Building Codes for requirements applicable to fire rated doors and frames.

B. Conform to the applicable sections of Chapter 5 of NFPA 101.

1.6 CERTIFICATIONS

A. Architectural Hardware Consultant shall inspect complete installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified herein.

B. Provide two copies of certifications to Architect/Engineer.

1.7 SUBMITTALS

A. Submit schedule, shop drawings, and product data under provisions of Division 1.

B. Indicate locations and mounting heights of each type of hardware.

C. Provide product data on specified hardware.

D. Submit manufacturer's parts lists, templates, and installation instructions under provisions of Division 1.

E. Submit manufacturer's certificate under provisions of Division 1 that fire rated hardware meets or exceeds specified requirements.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1.

B. Store and protect products under provisions of Division 1.

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

D. Protect hardware from theft by cataloging and storing in secure area.

1.10 WARRANTY

A. Provide five year warranty under provisions of Division 1.

1.11 MAINTENANCE MATERIALS

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Norton / ASSA ABLOY.
B. Adams Rite
C. Substitutions: Under provisions of Division 1.

2.2 ACCEPTABLE MANUFACTURERS

A. Automatic Door Operator: Norton 6300 Series Low Energy Operator

B. Electric Latch: Adams Rite Heavy Duty Electric Strike

C. Automatic Wave-to-Open Switch: Norton Wave-To-Open Switch 700

D. Substitutions: Under provisions of Division 1.

2.3 FINISHES

A. Finishes to match existing building standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

B. Verify that power supply is available to power operated devices.

C. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use the templates provided by hardware item manufacturer.

C. Conform to ANSI A117.1 for positioning requirements for the handicapped.

3.3 SCHEDULE

END OF SECTION

SECTION 09 90 00
PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the Work specified in this Section.

B. This section includes Surface preparation and surface finish schedule as shown on the Drawings and herein specified.

C. Architectural notes indicated on the drawings regarding painting shall be considered part of this specification.

1.2 QUALITY ASSURANCE

A. codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.

1. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

2. ASTM D2016 - Test Method for Moisture Content of Wood.

B. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with five (5) years' experience.

C. Applicator: Company specializing in commercial painting and finishing with three (3) years documented experience and approved by product manufacturer.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in original sealed containers with clearly marked labels.

B. Store and protect products in an enclosed area, in a manner to prevent deterioration or damage due to moisture, temperature changes and contaminants.

C. Deliver products to site in manner that will avoid any further damage or deterioration. Inspect to verify acceptance.

D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

E. Store paint materials at minimum ambient temperature of 45ºF and a maximum of 90ºF in well ventilated area, unless required otherwise by manufacturer's instructions.

F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45ºF for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is above 50 percent, unless required otherwise by manufacturer's instructions.

C. Minimum Application Temperatures for Latex Paints: 45ºF for interiors; 50ºF for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Varnish Finishes: 65ºF for interior or exterior, unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 foot-candles measured mid-height at substrate surface.

1.5 EXTRA STOCK

A. Provide a one (1) gallon container of each color and surface texture to the Owner.

B. Label each container with color, texture, and room locations, in addition to the manufacturer's label.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PAINT

A. Dunn Edwards
B. Pittsburgh.
C. Glidden.
D. Iowa.
E. Sherwin Williams.
F. Substitutions: Under provisions of the General Conditions.

2.2 ACCEPTABLE MANUFACTURERS - PRIMER SEALERS

A. Dunn Edwards
B. Pittsburgh.
C. Glidden.
D. Iowa.
E. Sherwin Williams.
F. Substitutions: Under provisions of the General Conditions.

2.3 MATERIALS

A. Coatings: Ready mixed. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

B. Coatings: Good flow and brushing properties; capable of drying or curing free of streaks or sags.

C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.4 FINISHES

A. Refer to schedule at end of Section for surface finish schedule.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Beginning of installation means acceptance of existing surfaces.

3.2 PREPARATION

A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.

B. Correct minor defects and clean surfaces which affect work of this Section.

C. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

D. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high-pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

F. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

G. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

3.3 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

B. Repair damage to other surfaces caused by work of this Section.

C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

D. Remove empty paint containers from site.

3.4 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand lightly between coats to achieve required finish.

F. Allow applied coat to dry before next coat is applied.

3.5 CLEANING

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

END OF SECTION

SECTION 21 05 00
BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 21 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. CCR California Code of Regulation
B. CBC California Building Code
C. CFC California Fire Code
D. CEC California Electric Code
E. CMC California Mechanical Code
F. CPC California Plumbing Code
G. California Title 24 - Building Energy Efficiency Standards
H. SCAQMD Southern California Air Quality Management Division

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Scope of Work:

1. Fire Protection Work shall include, but is not necessarily limited to:

a. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.
b. Extend existing wet pipe sprinkler system for areas noted on the drawings.
c. Furnish and install a complete dry pipe sprinkler system for areas noted on the drawings.
d. Furnish and install a complete fire valve.
e. Furnish and install all items listed on the Fire Protection Material List.
f. Furnish all hydraulic calculations and working sprinkler drawings.
g. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 21 05 50.
h. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

2. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

   a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.4 OWNER FURNISHED PRODUCTS

A. The Owner will supply the following items for installation and/or connection by this Contractor:

B. The following items shall be relocated, installed and/or connected by this Contractor:

C. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.

D. This Contractor shall make all mechanical system connections shown on the drawings or as required for fully functional units.

E. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

B. Schedule overtime for the following work:

1. Itemize all work and list associated hours and pay scale for each item.

1.6 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

   a. Plumbing Contractor.
   b. Heating Contractor.
   c. Air Conditioning and Ventilating Contractor.
   d. Temperature Control Contractor.
   e. Fire Protection Contractor.
   f. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements, California Code of Regulation Title 24, Article E725.

5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

    a. Light fixtures.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical busduct.
    d. Sheet metal.
    e. Electrical cable trays, including access space.
    f. Sprinkler piping and other piping.
    g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

2. Temperature Control Subcontractor's Responsibility:

    a. Wiring of all devices needed to make the Temperature Control System functional.

    b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.

    c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

3. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

1.7 Coordination Drawings

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

    a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.

a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.

3. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

    a. Scale of drawings:

        1) General plans: 1/4 Inch = 1 '-0" (minimum).
        2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
        3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
        4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).
        5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, re-routings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.8 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the Los Angeles, California of 2019 CFC Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.

5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. Make application for and pay for fire protection water service connection.

F. Examination of Drawings:

1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.

    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.9 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
21 05 00	Owner Training Agenda
21 05 03	Fire Seal Systems
21 05 13	Motors
21 05 29	Hangers and Supports
21 05 48	Vibration Isolation Equipment
21 05 50	Seismic Restraint Systems
21 05 53	Mechanical Identification
21 13 00	Sprinkler Systems
21 13 00	Fire Protection Equipment
21 23 00	Fire Suppression Systems
21 22 00	Clean Agent Fire Suppression Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Division of work (e.g., plumbing, heating, ventilating, etc.)
e. Description of items submitted and relevant specification number
f. Notations of deviations from the contract documents
g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

a. Date
b. Project title and number
c. Architect/Engineer
d. Contractor and subcontractors' names and addresses
e. Supplier and manufacturer's names and addresses
f. Division of work (e.g., plumbing, heating, ventilating, etc.)
g. Description of item submitted (using project nomenclature) and relevant specification number
h. Notations of deviations from the contract documents
i. Other pertinent data
j. Provide space for Contractor's review stamps

3. Composition:

a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.

2) Addenda items have been incorporated.

3) Catalog numbers and options match those specified.

4) Performance data matches that specified.

5) Electrical characteristics and loads match those specified.

6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.

7) Dimensions and service clearances are suitable for the intended location.

8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.

9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

   b. The Contractor shall clearly indicate the size, finish, material, etc.

   c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

   d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.

14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

    a. Submittal file name: 21 XX XX.description.YYYYMMDD
    b. Transmittal file name: 21 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. The Contractor shall submit ten (10) paper copies of each shop drawing.

3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.10 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.

2. Submit in Excel format.

3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

    a. Material: Delivered cost of product with taxes paid.

    b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.

2. Change of subcontractor or supplier occurs.

3. Change of product or equipment occurs.

1.11 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.12 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Fire Seal Systems

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.13 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.14 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.15 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.16 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.17 CONTINGENCY

A. The Fire Protection Contractor shall include in the Base Bid a contingency of one percent (1%) to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.18 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

1.19 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in division 1 and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies.

The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website (https://call811.com/) or by calling 811.

2. The Contractor shall do all excavating, filling, backfilling and compacting associated with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workers.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Provide all necessary sand and/or CA6 for backfilling.

3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.

4. Dispose of the excess excavated earth as directed.

5. Backfill materials (native soil material, sand and/or CA6) shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris, or earth with a high void content.

6. Backfill all trenches and excavations immediately after installing pipes or removal of forms, unless other protection is provided.

7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

8. Lay all piping on a compacted bed of CA6 at least 3 inches deep. Backfill around pipes with CA6, 6 inch layers, and compact each layer.

9. Use native soil material (if approved), sand, or CA6 for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand or CA6 backfill to 6 inches above the top of the pipe.

10. Place all backfill above the sand/CA6 in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and under slab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:

a. Pipe wall penetrations are sealed.

b. Pipe identification is installed.

c. Branch piping in the location of sprinklers shall be dropped to the ceiling.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.

3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Inspection report by the State Fire Marshal of the fire protection system.

5. Start-up reports on all equipment requiring a factory installation inspection or start-up.

6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div21.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div21.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, five (5) paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example, 1 of 2, 2 of 2. No other form of binding is acceptable.

3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copy of final approved test and balance reports.

5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.

7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.

9. Capacities and utility consumption of equipment.

10. Detailed parts list with lists of suppliers.

11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.

15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

D. The instructions shall include:

1. Explanation of all system flow diagrams.

2. Maintenance of equipment.

3. Start-up procedures for all major equipment.

4. Explanation of seasonal system changes.

5. Description of emergency system operation.

E. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.

F. Minimum hours of instruction for each item shall be:

1. Sprinkler System(s) - < 2 hours.

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the fire protection and control systems.

2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

A. The fire protection systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. The following paragraphs supplement Division 1 requirements.

B. Maintain at the job site a separate and complete set of fire protection drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

D. Before completion of the project, a set of reproducible fire protection drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on re-producible shall be clear and permanent.

E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

F. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.9 PAINTING

A. This Contractor shall paint the following items:

1. All piping in mechanical room

2. Piping exposed in kitchen

B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.

D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer the color preference and furnish this color.

F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.

H. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:

1. painted. Finish with two coats of Alkyd base enamel paint.

2. Color of paint shall be as follows:

a. All piping in mechanical room:

1) Fire Protection: Red pipe/white letters

b. Piping exposed in kitchen:

1) All Piping: White

3.10 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.11 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

2. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

3.12 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

a. Minimizing the amount of dust generated.

b. Reducing solvent fumes and VOC emissions.

c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.

2. Request that the Owner designate an IAQ representative.

3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.

4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.

5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.

6. Request copies of and follow all of the Owner's IAQ and infection control policies.

7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.

8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.

9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.

2. All pumps operating and balanced.

3. Fire protection system operational.

4. Pipes labeled.

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 21 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials.
B. UL 723 - Surface Burning Characteristics of Building Materials
C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
F. Intertek / Warnock Hersey - Directory of Listed Products
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
I. The Building Officials and Code Administrators National Building Code
J. 1994 1997 Uniform Building Code
K. 2000 2003 2006 2009 2012 2015 International Building Code
L. NFPA 5000 – Building Construction Safety Code
M. CBC California Building Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Section 21 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

    a. Floor penetrations located outside wall cavities.
    b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
    c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
    d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq. ft at both ambient temperature and 400°F for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168

2. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Dow Corning Corp.
10. Fire Trak Corp.

11. International Protective Coating Corp.

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
F Rating = Floor/Wall Rating
T Rating = Floor/Wall Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
F Rating = Wall Rating
T Rating = 0
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999

Penetrating Item	UL System No.
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Walls) = 0 or Wall Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the engineer and manufacturer's factory representative. The engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 22 05 05
PLUMBING DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanical demolition.
B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.

B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.

C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.

D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.

E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.

F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.

G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

C. Existing Plumbing System: Maintain service to all plumbing fixtures until new piping is installed. Obtain permission from Owner at least 48 hours before shutting down system for any reason. Make changeover to new piping with minimum outage. Do not disconnect any roof drainage piping until new piping is in place and operational.

D. Existing Medical Gas System: Maintain existing system in service until new system is complete and ready for service. Modify existing system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before system modification. Minimize outage duration. Certify system same day as new connections are made.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Demolish and extend existing plumbing work under provisions of Division 2 and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned piping to source of supply and/or main lines.

D. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.

E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

H. Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 2 feet from main to prevent “dead legs”.

I. Temporarily cap all openings to the sanitary and vent system to prevent odor from entering the work area and building.

3.4 CUTTING AND PATCHING

A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 22 05 29 for additional requirements.

B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.

D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.

E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.

F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.

G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.

C. PLUMBING ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

3.6 SPECIAL REQUIREMENTS

A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.

B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

C. All medical gas piping scheduled for removal, relocation, extension, and/or revision will require re-certification by an independent agency acceptable to the Owner and NFPA-99 requirements. All testing shall conform to NFPA-99.

END OF SECTION

SECTION 21 05 13
MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
D. ANSI/NEMA MG 1 - Motors and Generators.
E. ANSI/NFPA 70 - National Electrical Code.
F. Energy Independence and Security Act of 2007.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 21 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.

B. Submit shop drawings for all three phase motors.

C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.

D. Submit shaft grounding device for all motors as required.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer’s recommendations for equipment and motor.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. Design motors for continuous operation in 40ºC environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

C. Explosion-Proof Motors: UL listed and labeled for the hazard classification shown on the drawing, with over-temperature protection.

D. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.

E. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

F. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.

G. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.

H. Each contractor shall set all motors furnished by him.

I. All motors shall have a minimum service factor of 1.15.

J. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.

K. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.

L. Aluminum end housings are not permitted on motors 15 HP or larger.

M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

A. All motors, unless exempted by EPAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
HP	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

B. Motor nameplate shall be noted with the above ratings.

2.3 MOTORS ON VARIABLE FREQUENCY DRIVES

A. All motors driven by VFDs shall be premium efficiency type.

B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, “Performance Standards Applying to All Machines,” Part 31 “Definite-Purpose Inverter-Fed Polyphase Motors.

D. All 480-volt motors controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive end of the motor shaft. Motor shafts 2” and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.

2. The following critical motors shall also be equipped with shaft grounding kits:

a. _____.

2.4 MOTORS FOR WET OR CORROSIVE DUTY

A. Where noted for wet and/or corrosive duty, motors shall be designed for severe duty with cast-iron frame, epoxy finish, stainless steel nameplate, polymer shaft seal, corrosion resistant fasteners and fan, moisture resistant windings, and non-wicking leads.

2.5 MOTORS FOR HAZARDOUS DUTY

A. Where noted for hazardous duty, motors shall be designed for the class, group, and T code listed for the application. Frame sizes 143T and larger shall have normally closed winding thermostats to keep surface temperatures below the nameplate T code under all conditions.

2.6 MOTOR DRIVEN EQUIPMENT

A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.

B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

2.7 SHEAVES

A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

B. When replacing sheaves, use sheaves of at least the originally supplied sizes.

C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

END OF SECTION

SECTION 21 05 29
FIRE SUPPRESSION SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 QUALITY ASSURANCE

A. Support Sprinkler Piping in conformance with NFPA 13.
B. Support Standpipes in conformance with NFPA 14.

1.3 REFERENCES

A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
D. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
E. NFPA 13 - Standard for the Installation of Sprinkler Systems.
F. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 21 05 00.

1.5 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 21 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers supporting steel, copper, and CPVC piping shall conform to the following:

Pipe Size	Rod Size
4" and smaller	3/8”
5”, 6", 8”	1/2”
10" and12"	5/8”

B. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

C. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

1.

2.3 PIPE HANGERS AND SUPPORTS

A. General:

1. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58, 69, 89, and 127 (where applicable).

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed takeoff locations.

Acceptable Products:

Anvil -	Fig. CT121
Cooper/B-Line -	Fig. B3373CT
Erico -	Model 510
Nibco/Tolco -	Fig. 82

2. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

3. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

C. Hangers and Clamps:

1. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

2. Unless otherwise indicated, hangers shall be as follows:

   a. Clevis Type:
      Service: Bare Metal Pipe
      Rigid Plastic Pipe

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	Fig. CT65
Cooper/B-Line	Fig. 3100	Fig. B3104CT
Erico	Model 400	Model 402
Nibco/Tolco	Fig. 1	Fig. 81

   b. Adjustable Swivel Ring Type:
      Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	Fig. CT69
Cooper/B-Line	Fig. B3170NF	Fig. B170CT
Erico	Model FCN	
Nibco/Tolco	Fig. 200	Fig. 202

3. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4” in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer’s installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

4. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

5. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

6. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

   a. Clamp Type:
      Service: Bare Metal Pipe
      Rigid Plastic Pipe

      1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

      2) Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps:

1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists.):

Acceptable Products:	
Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300
Nibco/Tolco	68

2) Scissor Type Beam Clamps (for use with bar-joists and wide flange):

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

b. Concrete:

1) Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

2) Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

3) Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

4) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 21 05 50 for additional requirements for concrete bases in seismic applications.

2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6” x 6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

5. Equipment requiring bases is as follows:

a. Air Compressor
b. Day Tank
c. Fire Pump
d. Tank

C. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum 302 stainless steel 316 stainless steel PVC coated powder coated zinc trivalent chromium finish.

7. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load), Miro Industries 1.5, 3-R, 4-R or 5-R (to match pipe).

D. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

E. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 ROOF PENETRATIONS

A. Seal pipes penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

2.7 PIPE SLEEVES AND LINTELS

A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve or thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.

5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40ºF to 250ºF
T	Fire Seals (1 hour)	Silicone	-67ºF to 400ºF
FS	Fire Seals (3 hours)	Silicone	-67ºF to 400ºF
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.8 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

2.9 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

4. Supports shall extend directly to building structure. Do not support piping from duct hangers. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3'spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

   a. The hanger is attached within 6" from a web/chord joint.

   b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of hangers shall in no case exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel (All steel pipe unless otherwise noted):	
	1-1/4" & under	12'-0"
	1-1/2" & larger	15'-0"
2.	Steel (Schedule 40 lightweight alternative):	
	3" & under	12'-0"
3.	Hard Drawn Copper:	
	1" & under	8'-0"
	1-1/4" to 1-1/2"	10'-0"
	2" to 3"	12'-0"
	3-1/2" & larger	15'-0"
4.	CPVC	
	3/4"	5'-6"
	1"	6'-0"
	1-1/4"	6'-6"

Pipe Material	Maximum Spacing
1-1/2"	7'-0"
2"	8'-0"
2-1/2"	9'-0"
3"	10'-0"

I. Installation of hangers shall conform to MSS SP-58, 69, 89, and applicable NFPA standards.

END OF SECTION

SECTION 21 05 50
SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.

2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.

3. These requirements are beyond those listed in Section 21 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.

2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

D. Installer: Company specializing in performing the work of this Section.

E. Suppliers: Following is a partial list of manufacturer/supplier contact information for seismic restraints:

1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
2. Unistrut Corporation http://www.unistrut.us/
3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
4. Mason Industries, Inc. www.mason-ind.com.
5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
6. Tolco (909) 737-5599, www.tolco.com
7. ISAT 877.523.6060, www.isatsb.com
8. Vibro-Acoustics (416) 291-7371 , https://virs.vibro-acoustics.com/

1.3 REFERENCES

A. International Building Code, 2000 2003 2006 2009 2012 2015.
B. California Building Code (CBC)

C. California Division of State Architect (DSA) Interpretation of Regulations
D. ASHRAE - A Practical Guide to Seismic Restraint.
E. Technical Manual 5-809-10, NAVFAC P-355, Air Force Manual 88-3, Chapter 13.
F. ASCE 7-02, Chapter 9.
G. ASCE 7-05, Chapter 13.
H. ASCE 7-10, Chapter 13.
I. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
J. NFPA 13 - Installation of Sprinkler Systems.
K. NFPA 14 - Standpipe and Hose Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 21 05 00.

B. Submittal to Code Official:

1. Contractor shall submit copies of the seismic shop drawings to the governing code authority for approval.

C. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Professional Structural Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.

2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.

3. Manufacturer’s Certifications: Professional Structural Engineer licensed in the state where the project is located shall review and approve manufacturer’s certifications of compliance.

4. System Supports/Restraints - Submit for each condition requiring seismic bracing:

a. Calculations for each seismic brace and detail utilized on the project.

b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.

c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.

d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Equipment - Submit for each piece of equipment supplied:

a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.

b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.

c. Engineering calculations and details for equipment anchorage and support structure.

D. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

1.5 TESTING AND INSPECTION

A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the International California Building Code.

B. The Owner Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.

C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.

D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.7 DESIGN REQUIREMENTS

A. This project is subject to the seismic bracing requirements of the International Building Code, 2000 2003 2006 2009 2012 2015 edition.

B. The following criteria are applicable to this project:

1. Seismic Use Group: I II III

[* * * * * O R * * * * *]

2. Occupancy Category: I II III IV

[* * * * * OR * * * * *]

3. Risk Category: I II III IV

4. Seismic Factor: I_E = 1.0 1.25 1.5

5. Seismic Design Category: A B C D E F

6. Component Amplification Factors (a_p) and Component Response Modification Factors (R_p) shall be taken from Table 1621.3 in IBC 2000 9.6.3.2 in ASCE 7-02 13.6-1 in ASCE 7-05 13.5-1 in ASCE 7-10 for the individual equipment or system being restrained.

7. Component Importance Factors (I_p) shall be taken from Section 1621.1.6 in IBC 2000 9.6.1.5 in ASCE 7-02 13.1.3 in ASCE 7-05 13.1.3 in ASCE 7-10 for the individual equipment or system being restrained.

8. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.

C. Forces shall be calculated with the above requirements and Equation 16-67, 68, & 69 in section 1621.1.4 of IBC 2000, unless exempted by 1621.1.1 9.6.1.3-1, -2, and -3 of ASCE 7-02, unless exempted by 9.6.1 13.3-1, -2, and -3 of ASCE 7-05, unless exempted by 13.1.413.3-1, -2, and -3 of ASCE 7-10, unless exempted by 13.1.4Equipment shall meet International California Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

D. All seismic anchorage and bracing shall comply with the St. Louis County Rules & Regulations on Anchorage & Sway Bracing - Mechanical, Electrical & Plumbing (MEP) System Components.

E. All seismic anchorage and bracing shall comply with FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.

1.8 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

1.9 WARRANTY

A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions

1. Stay in Place:

a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2. Remain Operational:

a. Requirements for “Stay in Place” listed above shall be met.

b. The following systems and associated equipment are intended not to fail externally or internally and are intended to remain operational.

1) Fire Protection
2) Plumbing
3) Medical Gas
4) Heating
5) Cooling
6) Humidification
7) Air Handling
8) Exhaust
9) Dust Collection

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; refer to submittal requirements.

2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer’s submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.

3. 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.

4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.

5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.

6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.

D. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.3 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.

B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:

1. Air Compressors
2. Pumps
3. Tanks
4. Fire Protection Equipment
5. Fire Pumps

2.4 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.6 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 1011, GR 33.

2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.

3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.

4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

[***OR*****]**

C. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.

1. Arrange units for attachment to the braced component at one end and to the structure at the other end.

2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.

D. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.

B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.

C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.

D. All seismic restraint systems shall be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.

E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.

F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.

H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.

I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.

J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.

K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.

L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.

M. Do not install cables over sharp corners.

N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.

O. Provide reinforced clevis bolts when required.

P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.

Q. Post-Installed anchors shall be provided to meet seismic requirements.

R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.

S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.

T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.

U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.

V. Brace all terminal units with water coils as required by the building code and provide flexible connection to the coil if bracing is required.

W. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.

X. Do not brace a system to two different structures such as a wall and a ceiling.

Y. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

Z. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.

AA. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.

BB. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

SECTION 21 05 53
FIRE SUPPRESSION IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 21.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
B. ASTM B-1, B-3, and B-8 for copper conductors.
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kv Cables.
D. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 21 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4” minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer’s recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide one Plexiglas framed valve directory listing all valves, with respective tag numbers, uses and locations. Mount directory in location chosen by the Architect/Engineer.

[***OR*****]**

8. Provide one 36" x 24" minimum Plexiglas framed piping schematic showing valve locations with respective tag numbers. Mount directory in location chosen by the Architect/Engineer.

[***OR*****]**

9. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.

2. Tracer wire shall be taped directly to plastic water or drain pipe.

3. Tracer wire shall not be fastened directly or indirectly to gas piping.

4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.

5. Tape shall be Polyken “930-35”, Protecto-Wrap “310”, or approved equal.

6. Tracer wire shall be continuous between boxes and shall be tested for continuity.

7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**

8. The tracer wire shall daylight to grade through a 2” PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
FIRE PROTECTION WATER	White	Red
SPRINKLER WATER	White	Red
Tracer Wire - Water Pipe Lines	---	Blue
Tracer Wire - All other buried types	---	Green

B. All piping downstream of the fire protection backflow preventer, upstream of sprinkler zone valves, standpipe piping, and combination sprinkler standpipe piping shall be labeled Fire Protection Water. All piping downstream of sprinkler zone valves shall be labeled Sprinkler Water.

END OF SECTION

SECTION 21 13 00
FIRE PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, Fittings, Valves, and Connections for Fire Protection System.
B. Wet-Pipe Sprinkler System.
C. Dry-Pipe Sprinkler System.
D. Standpipe System.

1.2 QUALITY ASSURANCE

A. Welding Materials and Procedures: Conform to ASME Code AWS D1.1-Structural Welding Code – Steel.

B. Equipment and Components: Bear UL/FM label or marking.

C. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body. Pressure rating shall match specified pipe system pressure rating. Remanufactured valves are not acceptable.

D. Specialist Firm: Company specializing in sprinkler systems with minimum three years' experience.

E. Sprinkler design drawings submitted by the Contractor shall be prepared by a NICET Water-Based Fire Protection Systems Layout Level III or Level IV designer or PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.

F. Sprinkler design drawings submitted by the C16 Contractor shall be prepared by a PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.

G. Fire sprinkler system pipefitters responsible for installing, altering, or repairing water-based fire protection systems will require certification by the California State Fire Marshal's office.

1.3 REFERENCES

A. ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
B. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings, Class 150 and 300.
C. ANSI/ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
D. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
E. ANSI/ASME B16.9 - Factory-made Wrought Steel Butt-Welding Fittings.
F. ANSI/ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
G. ANSI/ASME B16.25 - Butt-Welding Ends.
H. ANSI/ASME B36.10 - Welded and Seamless Wrought Steel Pipe.
I. ANSI/ASME Section 9 - Welding and Brazing Qualifications.
J. ANSI/ASTM A47 - Malleable Iron Castings.
K. ANSI/ASTM A135 - Electric-Resistance-Welded Steel Pipe.
L. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings.
M. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast.
N. ASME - Boiler and Pressure Vessel Code - Section IX, Welding and Brazing Requirements.

O. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.
P. AWS A5.8 - Brazing Filler Metal.
Q. AWS B2.2 - Standard for Brazing Procedure and Performance Qualification.
R. AWS D10.9 - Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
S. BOCA National Building Code.
T. FM Global - FM Global Approval Guide.
U. FM Global Datasheet 2-0 - Installation Guidelines for Automatic Sprinklers
V. FM Global Datasheet 3-26 - Fire Protection Water Demand for Nonstorage Sprinklered Properties
W. FM Global Datasheet 4-4N - Standpipe and Hose Systems
X. FM Global Datasheet 8-9 - Storage of Class 1, 2, 3, 4, and Plastic Commodities
Y. IBC - International Building Code.
Z. MSS SP-73 - Brazing Joints for Wrought and Cast Copper Alloy Solder Joint and Pressure Fittings.
AA. NFPA 101 - Life Safety Code,
BB. NFPA 13 – Standard for the Installation of Sprinkler Systems.
CC. NFPA 13D - Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes.
DD. NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.
EE. NFPA 14 – Standard for the Installation of Standpipe and Hose Systems.
FF. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
GG. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
HH. UBC - Uniform Building Code.
II. UL - Underwriter’s Laboratory Fire Protection Equipment Directory.
JJ. CBC California Building Code
KK. CFC California Fire Code

1.4 SUBMITTALS

A. Submit shop drawings per Section 21 05 00. Indicate pipe materials, joining methods, supports, floor and wall penetration seals, sprinklers, equipment data and ratings, and hydraulic calculations.

B. Submit detailed pipe and sprinkler layout and other calculations and forms as described in NFPA 13.

C. Submit detailed working drawings and obtain review of them in the following order:

1. Engineer/Architect.
2. State Fire Marshal/Authority Having Jurisdiction
3. Owner’s Insurance Company
4. Architect/Engineer
5. Local Fire Department
6. Owner’s Insurance Company
7. Architect/Engineer

D. Begin construction after all approvals are received.

E. Working drawings shall include piping and sprinkler layout, sprinkler types and ratings, sections and elevations at critical points. Show coordination with lighting, ductwork, and diffusers, and indicate basic flow and hydraulic design information, including main location and date that the test was taken.

F. Submit dry-pipe calculations including water delivery time and air supply refill defined in NFPA 13. Water delivery time and air supply shall meet the requirements set forth in NFPA 13.

G. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

H. Provide the Owner with one copy of NFPA 25. *Standard for the Inspection Testing and Maintenance of Water-based Fire Protection Systems.*

1.5 EXTRA STOCK

A. Provide metal storage cabinet, wrenches for each sprinkler type, and extra sprinklers per NFPA 13 and applicable building code.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store valves and sprinklers in shipping containers, with labels in place.

B. Provide temporary protective coating on iron and steel valves.

C. Maintain temporary end caps and closures in place until installation.

1.7 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core drilled by the Fire Protection Contractor.

1.8 SYSTEM DESCRIPTION

A. Contractor shall design and install the following water-based fire protection systems for the areas noted on the contract documents:

1. Wet pipe sprinkler system(s)
2. Dry pipe sprinkler system(s)
3. Pre-action sprinkler system(s)
4. Standpipe system(s)

B. Sprinkler systems shall be designed and installed according to the following standard(s):

1. NFPA 13 – Standard for the Installation of Sprinkler Systems

[* * * * * OR * * * * *]

2. FM Global Datasheets 2-0 - Installation Guideline for Automatic Sprinklers

3. FM Global Datasheet 3-26 – Fire Protection Water Demand for Nonstorage Sprinklered Properties

C. Standpipe system shall be designed and installed according to the following standard(s):

1. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

[* * * * * OR * * * * *]

2. FM Global Datasheet 4-4N – Standpipe and Hose Systems

D. System design and installation shall include all requirements by the Authority Having Jurisdiction, local and state building codes, and Owner's insurance company in addition to the previously listed design standard(s). Those requirements shall take precedence over the contract documents in the case of discrepancies.

E. Systems shall be hydraulically calculated in accordance with the applicable design standard(s). Contractor is responsible for final pipe sizing based on results from hydraulic calculations. Pipe sizing shown on drawings for service entrance and main risers is preliminary and for coordination purposes only.

F. The water supply source for this project is the following:

1. Public Private waterworks system with fire pump.

a. Refer to Section 21 30 00 for fire pump performance requirements.

b. The system design shall be based on water supply information provided on the contract drawings. Supply shall be presumed to be at the point of connection to existing water supply infrastructure unless noted otherwise. The Fire Protection Contractor is responsible to verify this information and conduct all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 6 12 18 months.

[* * * * * OR * * * * *]

c. System design shall be based on the following water supply information. Supply shall be presumed to be at the point of connection to existing water supply infrastructure unless noted otherwise. The Fire Protection Contractor is responsible to verify this information and conduct all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 6 12 18 months.

1) Date of Test:
2) Test Conducted By:
3) Static Pressure: XX psig
4) Residual Pressure: XX psig
5) Flow at Residual Pressure: XX GPM

d. System design shall provide a safety factor when comparing available water supply pressure versus system design pressure at design flow rate (including hose streams). The safety factor shall be the following:

1) 5 psig
2) 10 psig70 kPa

2. Water storage tank below grade above grade with fire pump.

G. Coordinate with Plumbing Contractor for installation of a floor drain with collection funnel below the backflow preventer.

1.9 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components of system, servicing requirements, and record drawings.

1.11 JOB CONDITIONS

A. Fire Protection Contractor shall determine the flow and pressure available at the service connection. The Fire Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 18 months.

B. Local fire authority or third-party consultant shall be contracted to determine the flow and pressure available at the service connection. The Fire Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 6 12 months.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS - WET PIPE SPRINKLER SYSTEMS

A. Piping – 2" and Under:

1. Design Pressure: 175 psig 300 psig

2. Pipe: Schedule 40, black steel galvanized, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.

[* * * * * OR * * * * *]

3. Pipe: Lightweight Schedule 40 alternative, black steel, ASTM A135, ASTM A795. corrosion resistance ratio (CRR) shall be greater than 1.0 per UL Directory Listing, UL/FM. Inner wall shall be coated with an anti-MIC (Microbiologically Influenced Corrosion) coating.

4. Joints: Threaded, grooved, or flanged.

5. Fittings:

a. Threaded:

1) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.4, ASME A153.

2) Malleable iron, Class 150, black galvanized, UL/FM, ANSI/ASME B16.3, ASME A153.

3) Ductile iron, Class 150, black galvanized, UL/FM, ANSI/ASME B16.3, ASME A153.

b. Grooved:

1) Ductile iron housing ASTM A-536, Grade 65-45-12, UL/FM, enamel galvanized coating, Grade E (Type A) EPDM molded pressure-responsive gaskets suited for 40°F to 150°F. Carbon steel Stainless steel bolts and nuts.

c. Flanged:

1) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.1, ASME A153.

6. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.

B. Piping – 2-1/2" and Above:

1. Design Pressure: 175 psig 300 psig

2. Pipe: Schedule 10, black steel galvanized, ASTM A135, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.

[* * * * * OR * * * * *]

3. Pipe: Lightweight Schedule 10 alternate, black steel, ASTM A135, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (Microbiologically Influenced Corrosion) coating.

[* * * * * OR * * * * *]

4. Pipe: Schedule 40, black steel galvanized, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.

a. Joints: Grooved or flanged.

b. Fittings:

1) Grooved:

a) Ductile iron housing ASTM A-536, Grade 65-45-12, UL/FM, enamel galvanized coating, Grade E (Type A) EPDM molded pressure-responsive gaskets suited for 40°F to 150°F. Carbon steel stainless steel bolts and nuts.

2) Flanged:

a) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.1, ASME A153.

C. Piping – 3" and Under:

1. Design Pressure: 175 psig

2. Tubing: Chlorinated polyvinyl chloride (CPVC), standard dimensional ratio (SDR) of 13.5, NSF certified for use with potable water, UL/FM.

   a. Joints: Solvent Cement, ASTM 493, ASTM F402, NSF certified for use with potable water.

   b. Fittings: Same as tubing. Fittings and tubing shall be a system provided by the same manufacturer. ASTM F437, ASTM F438, ASTM F439. Threaded adapters for threaded valves shall be metal threaded adapter with solvent socket, UL/FM.

3. CPVC shall be listed for use in the following situations:

   a. Light Hazard Occupancies, as defined in NFPA 13.

   b. Residential Occupancies, as defined in NFPA 13R.

   c. Air plenums per the requirements of UL 1887, as defined by NFPA 90A and the International Mechanical Code (IMC).

4. CPVC Compatibility:

   a. CPVC pipe and fittings shall be evaluated for chemical compatibility with internally coated anti-MIC coatings provided in steel piping. All CPVC piping must be compatible with steel pipe containing corrosion inhibitors.

   b. Ancillary products, such as firestopping, thread sealants, cutting oils, etc., coming into contact with both pipe and fittings shall be chemically compatible.

   c. When CPVC is used in combination (e.g., steel and CPVC) systems, the Contractor shall provide a letter stating that all products used in conjunction with the system have been investigated and found to be compatible with CPVC.

D. Piping – 3” and Under:

1. Design Pressure: 125 psig.

2. Piping - 3” and Under:

   a. Tubing: Type L drawn temper seamless copper tube, ASTM B88.

   b. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

   c. Fittings: Wrought copper solder joint, ASME B16.22.

3. Usage: Inside MRI spaces.

2.2 FLEXIBLE FIRE SPRINKLER CONNECTIONS

A. Flexible Connection: Stainless steel hose, 175 psig 300 psig max working pressure, fully welded non-mechanical fittings, stainless steel braid, maximum of 6’ hose length, leak-tested with a minimum 7/8” internal corrugated hose diameter made of 304 stainless steel, end fittings made of carbon or stainless steel. Outlet of end fittings shall be 1/2” or 3/4” to match sprinkler connection. UL/FM.

B. Ceiling Bracket: G90 galvanized steel, direct attachment type, integrated snap-on clip ends, tamper resistance screws, removable attachment hub with set screw for attachment and adjustment of stainless steel hose.

C. Acceptable Manufacturers: Flexhead Industries, Victaulic VicFlex, Sprinkflex, or approved equal.

2.3 PIPE AND FITTINGS - DRY PIPE SPRINKLER SYSTEMS

A. Piping – 2” and Under:

1. Design Pressure: 175 psig 300 psig

2. Pipe: Schedule 40, galvanized or black steel, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.

3. Joints: Threaded, roll grooved, or flanged.

4. Fittings:

a. Threaded:

1) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.4, ASME A153.

2) Malleable iron, Class 150, black galvanized, UL/FM, ANSI/ASME B16.3, ASME A153.

3) Ductile iron, Class 150, black galvanized, UL/FM, ANSI/ASME B16.3, ASME A153.

b. Grooved:

1) Ductile iron housing ASTM A-536, Grade 65-45-12, UL/FM, enamel galvanized coating, Grade E (Type A) EPDM molded pressure-responsive gaskets suited for 40°F to 150°F. Carbon steel stainless steel bolts and nuts. Provide flush gap style gasket. Lubricate gasket according to manufacturer recommendations.

c. Flanged:

1) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.1, ASME A153.

5. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.

B. Piping – 2-1/2” and Above:

1. Design Pressure: 175 psig 300 psig

2. Pipe: Schedule 10, black steel galvanized, ASTM A135, ASTM A795, UL/FM.

[* * * * * OR * * * * *]

3. Pipe: Schedule 40, black steel galvanized, ANSI/ASTM A53, ASTM A795, UL/FM. Inner wall shall be coated with an anti-MIC (microbiologically influenced corrosion) coating.

a. Joints: Roll grooved, cut grooved, or flanged.

b. Fittings:

1) Grooved:

a) Ductile iron housing ASTM A-536, Grade 65-45-12, UL/FM, enamel galvanized coating, Grade E (Type A) EPDM molded pressure-responsive gaskets suited for 40°F to 150°F. Carbon steel stainless steel bolts and nuts.

2) Flanged:

a) Cast iron, Class 125 Class 250, black galvanized, UL/FM, ANSI/ASME B16.1, ASME A153.

2.4 PIPE AND FITTINGS – PREACTION SYSTEM

A. Refer to Article 2.2 PIPE AND FITTINGS – DRY PIPE SYSTEMS.

2.5 PIPE AND FITTINGS – WET STANDPIPE SYSTEM

A. Refer to Article 2.1 PIPE AND FITTINGS – WET PIPE SYSTEMS.

2.6 PIPE AND FITTINGS – DRY STANDPIPE SYSTEM

A. Refer to Article 2.2 PIPE AND FITTINGS – DRY PIPE SYSTEMS.

2.7 VALVE OPERATORS

A. Provide handwheels for gate valves. Provide gear operators for butterfly valves.

2.8 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe.

2.9 BACKFLOW PREVENTERS

A. Provide backflow preventers as required by code and as specified on the drawings.

2.10 EQUIPMENT

A. Equipment shall be as scheduled on the drawings.

2.11 RISER LABELING AND IDENTIFICATION

A. Hydraulic nameplates shall be affixed to each riser and shall include the following minimum information:

1. Installation contractor
2. Date installed
3. Riser location
4. Number of sprinklers

5. Basis of design (density GPM/ft^2 and area of coverageft^2)
6. Water flow rate (GPM) and residual pressure (psi) at the base of riser
7. Hose stream allowance (GPM).
8. Occupancy classification
9. Commodity classification (If applicable)
10. Maximum storage height (if applicable)

B. A dedicated antifreeze placard is required where a remote antifreeze system is provided. The placard is to be placed on the main valve serving the antifreeze system to document the manufacturer type and brand of the solution and the system volume.

2.12 PIPE LABELING AND IDENTIFICATION

A. All pipe shall be marked along its length by the manufacturer in such a way as to properly identify the type of pipe.

B. The manufacturer pipe marking shall be visible on every piece of pipe over 2 ft600 mm long.

C. Manufacturer pipe identification shall include the manufacturer's name, model designation, and/or schedule.

D. Provide additional identification as described in Section 21 05 53.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING

A. General Installation Requirements:

1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over sprinkler piping and sprinklers.

2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material, inside and outside, before assembly.

3. Die cut screw joints with full cut standard taper pipe threads.

4. Coat threads with pipe joint compound or wrap with Teflon tape.

5. Locate piping to minimize obstruction of other work.

6. Route piping in concealed spaces above finished ceiling.

7. Use full and double lengths of pipe wherever possible.

8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.

9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

10. Comply with manufacturer's installation instructions.

B. Steel Piping:

1. In steel piping, main sized saddle branch connections or direct connection of branches to main is permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

C. Wall/Floor Penetration:

1. Provide sleeves when penetrating floors and walls.

2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend minimum 1.5” above finished floor.

3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required without restraining pipe.

D. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or space may be installed above equipment if other alternatives are not available.

E. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):

1. Provide non-ferrous semi-recessed chrome plated head and escutcheon.

2. All piping in MRI rooms shall be non-ferrous regardless of materials described in Part 2.

F. Hangers and Supports:

1. Provide hangers and supports as required by NFPA 13 and UL/FM, with the following exceptions:

a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.

b. Do not install fasteners to carry the load in tension, unless absolutely necessary.

2. Seismic supports shall be designed using Tolbrace by Tolco, or equivalent program accounting for Fp and Cp factors for 2-way and 4-way bracing. Seismic zone of influence shall be shown on the drawings to support these calculations. Tolbrace details shall also be included in the drawings.

G. Exposed Piping:

1. Install chrome plated steel escutcheons where exposed pipes penetrate walls or floors.

2. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

H. Dry Pipe System:

1. All fire protection piping within rooms served by dry pipe valves or preaction systems shall be downstream of dry pipe valve. Wet piping upstream of these devices shall not be installed above these rooms.

2. Refrigerated spaces served by dry pipe valves shall have a 30” easily removable section of pipe located immediately upstream and downstream of pipe entrance to a refrigerated space per NFPA 13. Piping shall be pitched back toward the dry pipe assembly. Air intake for compression devices serving preaction or dry pipe systems shall be from the refrigerated area.

3.2 INSTALLATION - VALVES

A. Install gate valves with stems upright or horizontal, not inverted.

B. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Units shall be field tested and tagged in accordance with manufacturer’s instructions by a certified tester before initial operation.

3. Install unit between 12" and 60" above finish floor.

4. Provide monitor switches on all shutoff valves.

C. Dry Pipe Valve:

1. Install dry pipe valve in heated area to prevent mechanical damage.

2. Provide all required trim and accessories for a fully functioning dry pipe valve system.

D. Shutoff Valve:

1. Install buried shutoff valves in valve boxes. Provide post indicators.

2. Provide drain valves at main shutoff valves, low points of piping and apparatus.

3. Provide monitor switches on all shutoff valves.

3.3 INSTALLATION - EQUIPMENT

A. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over system equipment and sprinklers.

B. Fire Department Connection:

1. Locate fire department connection in an accessible location as approved by the local fire department with sufficient clearance from walls, obstructions, and adjacent Siamese connectors to allow full swing of fire department wrench handle.

C. Alarm Bell Horn and Strobe:

1. Locate outside alarm bell horn and strobe on building wall as shown on drawings.

2. Wire all bells horn and strobes, flow switches and supervisory switches to fire alarm system. All wiring shall be in conduit and meet the requirements of the electrical specifications.

D. Test Valves:

1. Install test valves where required. Pipe to outdoors or drain. Test connection shall have flow equivalent to the smallest K-factor sprinkler.

E. Sprinklers:

1. Locate sprinklers to clear lights, ducts and diffusers. Do not run sprinkler pipes through ducts. Ductwork has priority over sprinkler pipes. Offset pipes as needed.

2. Center sprinklers in two directions in ceiling tiles and provide offsets as required.

3. Do not allow concealed sprinkler cover plates to be painted. Sprinkler cover plates are to be factory painted only. Do not field paint.

4. Apply strippable or paper covers so concealed sprinkler cover plates do not receive field paint finish.

F. Double Interlocked Preaction System:

1. Provide all valves, switches, detectors and all wiring to devices from the alarm control panel.

3.4 INSTALLATION - STANDPIPE AND HOSE SYSTEM

A. Locate and secure hose cabinet plumb.

B. Locate angle valve in cabinet at 60" above floor. Locate fire department connection below angle valve and not closer than 4" from side or bottom of cabinet.

C. Connect wet standpipe system to water source ahead of domestic water connection.

D. Where static pressure exceeds 175 psig at any hose station, provide pressure regulating valves to limit the pressure on hose to 100 175 psi.

E. Where residual pressure at Class III hose station (1-1/2") exceeds 100 psig, provide a pressure regulating valve to limit the residual pressure on the hose to 100 psig.

F. Provide connection for alarm and supervisory control to building alarm system.

G. Provide two-way fire department outlet on roof.

H. Install backflow preventer as required by local Authorities Having Jurisdiction and as indicated on Fire Protection Material List.

3.5 SYSTEMS CLEANING AND TESTING

A. General Requirement:

1. All water used for testing and remaining in the piping system shall be obtained from a potable water source.

B. Underground Piping:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:

   a. 390 gpm for 4" pipes.
   b. 880 gpm for 6" pipes.
   c. 1560 gpm for 8" pipes.
   d. 2440 gpm for 10" pipes.
   e. 3500 gpm for 12" pipes.

2. Branches from existing or new underground mains to sprinkler risers shall be flushed out through two 2-1/2" hoses (with flow through open hose butts) attached to the riser with 4" temporary piping. Flushing through the drain of an alarm check or dry pipe valve is not acceptable.

C. Interior Piping:

1. Verify adequate water flow at the inspector's test connection.

2. Flush all interior piping to remove scale and other foreign material before placing system into service.

3. Hydrostatically test the entire interior piping system at a minimum of 200 psig or 50 psig more than the normal system working pressure for systems subjected to pressures more than 150 psig. Maintain test pressure for 2 hours without loss of pressure. Test shall be performed with dry pipe valves in open position to prevent valve damage.

D. Standpipe and Hose Systems:

1. Hydrostatically test standpipe and hose systems in accordance with NFPA 14 and applicable building code requirements.

E. Dry Piping:

1. On dry-pipe systems, also test the interior piping with an air pressure of 40 psi for 24 hours. Pressure loss shall not exceed 1-1/2 psi in 24 hours with allowance made for temperature change. An odorant, such as oil of wintergreen, may be added to help locate leaks.

F. Fire Alarm System:

1. Test the alarm system by operating the inspector's test connection or the alarm test valves. Verify that the building fire alarm system activates.

2. Adjust all monitor switches for proper operation.

END OF SECTION

SECTION 21 22 00
CLEAN AGENT FIRE SUPPRESSION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fire Detection and Alarm System.
B. Control and Supervision System.
C. FM-200, FE-25, or Novec 1230 Storage and Distribution Suppression System.
D. Inergen Storage and Distribution Suppression System.

1.2 QUALITY ASSURANCE

A. Source Limitation: Obtain extinguishing agent and equipment through one source, including the detection and release equipment.

B. Perform work in accordance with ANSI/NFPA 2001, ANSI/NFPA 70 and ANSI/NFPA 72; applicable FM standards, and requirements of applicable codes and ordinances.

C. Extinguishing agent shall be in a virgin state as produced by the manufacturer. Recycled agent is not allowed.

D. Indicate manufacturer's name and pressure rating on valve bodies. Indicate manufacturer, type, size, part number, orifice code, or orifice diameter on discharge nozzles. Markings shall be standard and visible after installation.

E. Welding Materials and Procedures: Conform to ANSI/ASME SEC 9 and applicable state labor regulations.

F. System supplier is responsible for visiting the job site prior to bidding to evaluate job conditions and clearances.

G. ASME Compliance: Fabricate piping to comply with ASME B31.1, “Power Piping.”

H. FM Global Compliance: Provide components that are FM approved and are listed in FM’s “Fire Protection Approval Guide.”

I. UL Compliance: Provide equipment components complying with UL 1058, “Halogenated Agent Extinguishing System Units,” and listed for clean-agent extinguishing system units in UL’s “Fire Protection Equipment Directory.”

1.3 REFERENCES

A. All requirements of Authority Having Jurisdiction (AHJ).
B. ANSI/ASME B16.3 – Malleable Iron Threaded Fittings Class 300.
C. ANSI/ASME B16.9 – Factory Made Wrought Steel Butt-Welding Fittings.
D. ANSI/ASME B31.1 – Power Piping.
E. ANSI/ASME SEC 8 – Pressure Vessels.
F. ANSI/ASME SEC 9 – Welding and Brazing Qualifications.
G. ANSI/AWS D1.1 – Structural Welding Code.
H. ANSI/NFPA 70 – National Electrical Code.
I. ANSI/NFPA 72 – National Fire Alarm Code.
J. ANSI/NFPA 75 – Standard for the Protection of Electronic Computer/Data Processing Equipment
K. ANSI/NFPA 101 – Life Safety Code.

L. ANSI/NFPA 2001 – Clean Agent Fire Extinguishing Systems.
M. ASME B40.1 – Gauges – Pressure Indicating Dial Type-C Elastic Element.
N. ASTM A53 – Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
O. ASTM A106 – Seamless Carbon Steel Pipe for High-Temperature Service.
P. ASTM A135 – Electric-Resistance-Welded Steel Pipe.
Q. ASTM A234 – Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
R. FM – Factory Mutual Approval Guide.
S. UL – Fire Protection Equipment Directory.
T. UL 393 – Indicating Pressure Gauges for Fire and Protection Services.
U. UL 404 – Gauges, Indicating Pressure, for Compressed Gas Service.
V. UL 2127 – Standard for Inert Gas Clean Agent Extinguishing System Units
W. UL-2166 – Standard for Halocarbon Clean Agent Extinguishing System Units
X. US Environmental Protection Agency, Protection of Stratospheric Ozone 59 FR 13044 (Final SNAP Ruling).

1.4 SUBMITTALS

A. Submit shop drawings per Section 21 05 00. All the following shop drawings shall bear stamp of approval of AHJ and Owner's fire insurance underwriter.

1. Detailed layout of system, locating each component. Include control diagrams, wiring diagrams, and written sequence of operation.

2. Product data for each piece of equipment comprising the system including cylinders, manifolds, control panel, nozzles, detectors, alarm bells and horns, switches, and annunciators.

3. Provide complete hydraulic flow calculations from a UL-listed computer program. Calculation sheets must include the manufacturer’s name and UL listing for verification. The individual sections of pipe and each fitting to be used, as shown on submitted isometric drawings, must be identified and included in the calculations. Total agent discharge time must be shown and detailed by zone. Include nozzle flow rates, orifice code numbers, piping pressure losses, component flow data, and pipe sizes with the calculations.

4. Ventilation requirements for inert gas systems to ensure room or surrounding rooms will not be over-pressurized during system discharge.

B. Submit test reports indicating successful completion of tests.

C. Submit manufacturer's certificate that system meets or exceeds specified requirements and ANSI/NFPA 2001.

D. Include welders’ certification of compliance with ANSI/ASME SEC 9.

E. Submit manufacturer's installation instructions.

F. Submit project record documents. Accurately record exact location of equipment, equipment identification markings, conduit and piping routing details, and agent storage positions.

G. Submit operation and maintenance data. Include electrical schematic, written description of system design, drawings illustrating control logic and equipment locations, technical brochures describing equipment, list of recommended spare parts, checklists and procedures for emergency situations, troubleshooting techniques, abort functions, system control panel operation, trouble procedures, and safety requirements.

H. Upon completion, the fire suppression system manufacturer shall certify that the installation is in compliance with the manufacturer's recommendations and NFPA 2001.

I. Provide information on the system batteries as follows: Total battery capacity, total capacity used by all devices on this project, total available future capacity.

J. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

1.5 EXTRA MATERIALS

A. Provide two spare detectors of each type installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store equipment in shipping containers with labeling in place. Deliver agent in approved containers. Protect from damage.

B. Plugs and Cover Plates: Protect threaded ends, flanged ends, flanged openings, with gasketed metal cover plates to prevent damage during shipment and to prevent foreign materials from entering. Cap or plug drains, vents, small piping, and gauge connections.

1.7 SYSTEM DESCRIPTION

A. Provide a complete clean agent fire suppression system including charged storage tanks, piping distribution, nozzles, control panel, wiring, annunciators, release and abort stations, alarm, and all other equipment necessary for a complete operational system.

B. Design, fabrication, and installation shall comply with requirements and recommendations of ANSI/NFPA 2001, Underwriters Laboratories, Inc. (UL), and FM Global (FM).

C. Acceptable Halocarbon Clean Agents:

1. Extinguishing Agent: FM-200, heptafluoropropane. FM-200 is a trade name for HFC-227ea fire-extinguishing clean agent.

2. Extinguishing Agent: FE-25, pentafluoroethane. FE-25 is a trade name for HFC-125 fire-extinguishing clean agent.

3. Extinguishing Agent: Novec 1230, Dodecafluoro-2-methylpentan-3-one. Novec 1230 is a trade name for FK-5-1-12 fire-extinguishing clean agent, manufactured by 3M.

[* * * * * AND/OR * * * * *]

D. Acceptable Inert Gas Clean Agents:

1. Extinguishing Agent: Inergen, a mixture of nitrogen, argon, and carbon dioxide inert gases. Inergen is a trade name for IG-541 inert gas fire-extinguishing clean agent and manufactured by Ansul. Also acceptable is Argonite, manufactured by Kidde-Fenwal, or ProInert, manufactured by Fike. Both are trade names for the IG-55 inert gas mixture of nitrogen and argon.

E. System designed and installed to provide fire-extinguishing capability by totally flooding the area shown on the drawings, including the space volumes below the raised floor and above the suspended ceiling.

F. The system(s) shall be actuated by a combination of ionization and photoelectric smoke detectors installed for maximum coverage of 250 sq. ft. per detector, in the room, underfloor and above ceiling protected spaces. If HVAC supply airflow is one air change per minute or more, photoelectric detectors only shall be installed for maximum coverage of 125 sq. ft. per detector.

[* * * * * AND/OR* * * * *]

G. The system shall be actuated by an air sampling smoke detection system provided by fire alarm contractor. Refer to Section 28 31 50 for more information.

H. Detectors shall be cross-zoned detection requiring two detectors to be in alarm before release.

I. The system shall be capable of being actuated by manual release stations located at each exit.

J. The use of ozone-depleting substances, such as chlorofluorocarbon (CFC), hydrochlorofluorocarbon (HCFC) or halon, is prohibited.

1.8 DESIGN REQUIREMENTS

A. Provide sufficient extinguishing agent to extinguish fire. Consider the following when computing volume:

1. Volume of hazard area.

2. Specific volume of vapor.

3. Additional quantities needed to compensate for unclosable openings, pipe losses, and nitrogen dilution.

4. Forced ventilation, fan coast-down time and damper actuation time.

5. Computer room air conditioning units will not operate during discharge. Unit fans will have a coast-down period (delay).

6. Mechanical fire/smoke damper controls.

7. Room temperature of the hazard space.

8. Elevation above sea level.

9. Venting requirements for inert gas systems to ensure room or surrounding rooms will not be over-pressurized during system discharge.

10. Other special conditions affecting extinguishing efficiency.

B. Locate extinguishing agent supply and backup supply, if required, near each hazard area as indicated on drawings.

C. Interface system with building fire alarm system.

1.9 PERFORMANCE REQUIREMENTS

A. Design system for Class A or C fires as appropriate for areas being protected and include safety factor. Use clean agent indicated and in concentration suitable for occupied areas.

B. Halocarbon Clean Agents:

1. FM-200: Provide total flooding of 7.1% FM-200 minimum concentration by room volume for Class A fire protection or 7.6% FM-200 minimum concentration by volume for Class C fire protection, in maximum 10 seconds at 70°F for a 10-minute holding time.

a. FM-200 concentration greater than 10.5% immediately after discharge or less than 5.8% throughout holding time will not be accepted without written authorization from Owner and Authorities Having Jurisdiction (AHJ).

b. System Capabilities: Vapor pressure of 65.7 psia at 77°F. Super-pressurized with dry nitrogen to a working pressure of 360 psig at 70°F. Low pressure alarm shall activate at 288 psig.

2. FE-25: Provide total flooding of 8% FE-25 minimum concentration by room volume for Class A fire protection or 9.0% FE-25 minimum concentration by volume for Class C fire protection, in maximum 10 seconds at 70°F for a 10-minute holding time.

a. FE-25 concentration greater than 11.5% immediately after discharge or less than 6.7% throughout holding time will not be accepted without written authorization from Owner and Authorities Having Jurisdiction (AHJ).

b. System Capabilities: Vapor pressure of 200 psig at 77°F. Super-pressurized with dry nitrogen to a working pressure of 360 psig at 70°F. Low pressure alarm shall activate at 288 psig.

c. Safety Warning signage shall be posted in all rooms protected by FE-25 agent.

3. Novec 1230: Provide total flooding of 5.0% Novec 1230 minimum concentration by room volume for Class A fire protection or 5.2% Novec 1230 minimum concentration by room volume for Class C fire protection, in maximum 10 seconds at 70°F for a 10-minute holding time.

a. Novec 1230 concentration greater than 10% immediately after discharge or less than 4.2% throughout holding time will not be accepted without written authorization from Owner and Authorities Having Jurisdiction (AHJ).

b. System Capabilities: Vapor pressure of 5.85 psig at 77°F. Super-pressurized with dry nitrogen to a working pressure of 360 psig at 70°F. Low pressure alarm shall activate at 290 psig.

[* * * * * OR * * * * *]

C. Inert Gas Clean Agents:

1. Inergen: Provide total flooding of 38% Inergen concentration by room volume for Class A fire protection or 42% Inergen minimum concentration by room volume for Class C fire protection, in maximum 60 seconds at 70°F for a 10-minute holding time.

a. Inergen concentration greater than 40% immediately after discharge or less than 32% throughout holding time will not be accepted without written authorization from Owner and AHJ.

b. System Capabilities: Minimum 2175 psig calculated working pressure upstream from orifice union, minimum 620 psig calculated working pressure downstream from orifice union, and 2175 psiginitial charging pressure.

2. Argonite: Provide total flooding of 42% Argonite concentration by room volume for Class A fire protection or 45% Argonite minimum concentration by room volume for Class C fire protection, in maximum of 60 seconds at 70°F for 10-minute holding time.

a. Argonite concentration greater than 45% immediately after discharge or less than 35% throughout holding time will not be accepted without written authorization from Owner and AHJ.

b. System Capabilities: Minimum 2900 psig calculated working pressure upstream from orifice union, minimum 620 psig calculated working pressure downstream from orifice union, and 2900 psig initial charging pressure.

1.10 QUALIFICATIONS

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

B. Installer: Company specializing in installing the work of this section with minimum three years documented experience, approved by manufacturer, who maintains a recharging station and can provide replacement charge within 24 hours.

C. Special hazard systems submitted by the Contractor shall be prepared by a NICET Special Hazard Suppression Systems Layout Level III or Level IV designer or PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.

1.11 WARRANTY

A. Provide one-year warranty for the entire system. Warranty shall include the replacement agent in the event of a false discharge.

1.12 MAINTENANCE SERVICE

A. Conduct inspections six (6) and twelve (12) months from Date of Substantial Completion to verify proper operation of system and to check agent container weight and pressure. Include a thorough check of controls, detection and alarm systems.

B. Submit documents certifying satisfactory system conditions. Include manufacturer's certificate of acceptance of inspector's qualifications.

PART 2 - PRODUCTS

2.1 CLEAN AGENT FIRE SUPPRESSION SYSTEM MANUFACTURERS

A. Acceptable Manufacturers:

1. Fenwal Protection Systems
2. Kidde Fire Systems
3. Siemens Fire Products
4. Chemetron Fire Systems
5. Fike Corporation; Fire Protection Systems Division
6. Ansul Fire Protection

2.2 PIPE AND PIPING SPECIALTIES

A. Steel Pipe (All Sizes) (Downstream of Orifice Union):

1. Pipe: ASTM A53 or A106, Schedule 40, black.

2. Fittings: ASTM A-197 Malleable Iron Class 300 or ASTM A234 forged steel welding type fittings for all sizes.

3. Joints: Screwed or ANSI/AWS D1.1 welded.

B. Steel Pipe – 2-1/2” and Over (Downstream of Orifice Union):

1. Pipe: Standard weight black steel, mechanically coupled grooved type, ASTM A53.

2. Joints: Mechanically coupled grooved type with EPDM gaskets. (Machined groove only. Rolled grove fittings are not allowed).

3. Fittings: Malleable iron, ASTM A47, Grade 32510, black, mechanically coupled grooved type.

4. Flanges: Grooved end, flanged adapter.

C. Steel Pipe – Between Storage Tanks and Orifice Union:

1. Pipe: ASTM A53 or A106, Schedule 80, black.

2. Joints: Flanged, ASME B16.5, Class 600.

3. Fittings: Forged-steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.

D. Valves:

1. General: Brass, suitable for intended operation.

2. Container Valves: With rupture disc or electric solenoid, capable of immediate and total agent discharge and suitable for intended flow capacity.

3. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid or install valve and separate pressure-relief devices.

4. Valves in Manifolds: Check valve, installed, to prevent loss of extinguishing agent when container is removed from manifold.

E. Ordinary cast iron pipe, steel pipe conforming to ASTM A-120 or non-metallic pipe shall not be used.

F. Pipe Hangers: ANSI/ASME B31.1, UL listed and FM approved for sprinkler systems, split clamp up to 2-1/2" size, riser clamps over 2-1/2" size.

G. Escutcheons: Chrome plated pressed or stamped brass, one-piece or split pattern, minimum 2" larger than opening.

H. Gauges: ASME B40.1, UL 393 or UL 404 3-1/2" diameter cast aluminum case, phosphor bronze bourdon tube, rotary brass movement, brass socket, front recalibration adjustment, black figures on white background, 1% mid-scale accuracy, scale calibrated in psi.

2.3 DISCHARGE NOZZLES

A. Nozzles shall be UL listed and FM approved for installation below a 1’-0” to 12'-0" ceiling or plenum height with only a single layer of nozzles (not tiered).

B. Select for required rates of discharge and coverage and to distribute agent uniformly throughout protected area. No single nozzle shall discharge more than 20 lbs/sec of FM 200.

C. Provide one-piece chrome plated brass, stainless steel, or aluminum nozzle(s) with textured finish and female pipe thread integral on body. Direct discharge parallel to ceiling.

D. Permanently mark nozzles for identification and to show equivalent single orifice diameter.

2.4 CLEAN AGENT CYLINDERS

A. Design, fabricate, certify, and stamp cylinders in accordance with ANSI/ASME Boiler and Pressure Vessel Code, SEC 8 for unfired pressure vessels. Cylinders shall be standard model and size for ease of replacement and addition. Storage cylinders shall be constructed to meet or exceed the agent manufacturer’s recommended tank working and test pressure.

B. Fill cylinders with required clean agent. Pressurize FM-200, FE-25, and Novec 1230 cylinders with dry nitrogen.

C. Identify cylinders with permanent plate specifying agent, tare and gross weight, pounds of agent, and pressurization level. Install so plate is visible and legible.

D. Equip cylinders with pressure relief devices.

E. For systems with more than one cylinder, provide discharge manifold and rack to secure each cylinder. Provide check valves between each cylinder discharge and manifold.

F. Supply each storage container with a factory installed level indicator to determine agent content and pressure switch to indicate low tank pressure. The low-pressure switch shall be wired to the control panel to provide audible and visual “Trouble” alarm.

G. Each inert gas cylinder must have a calibrated gauge on cylinder head.

2.5 ORIFICE UNIONS/NIPPLE ASSEMBLIES

A. Description: UL-listed device with minimum 2000 psig pressure rating installed in the manifold to control flow and reduce pressure of Inergen gas in piping.

1. 2” and Smaller: Piping assembly with orifice, sized for system design requirements.

2. 2-1/2” and Larger: Piping assembly with nipple, size for system design requirements.

2.6 FIRE SUPPRESSION CONTROL PANEL, DETECTION, AND ALARM SYSTEM

A. Acceptable Manufacturers:

1. Fenwal Fire Protection Systems
2. Kidde Fire Systems
3. Siemens Fire Products
4. Chemtron Fire Systems PyrochemFike Corporation; Fire Protection Systems Division.

B. UL listed and FM approved as alarm and releasing device, with solid-state internal circuitry in NEMA ICS 6, Type 1 cabinet.

C. Control Unit Panel:

1. Control Unit Panel: Modular construction. Surface Flush wall-mounted enclosure, minimum 0.060 inch steel enclosure with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

2. Each loop (circuit) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer's system capacity of intelligent sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:

a. Minimum Total Addressable Points: 99
b. Minimum Total Analog System Sensors: 99

3. Provide the following control panel features:

a. Electrical contacts for shutting down fans, activating valves or dampers, and operating system electrical devices.

b. Automatic switchover to standby power at loss of primary power.

c. Storage container, low-pressure indicator.

d. Cross zoned and counting zone detection.

4. Signal Line Circuit Board (SLC):

a. Each board shall receive analog information for all intelligent analog sensors and shall process this information to determine normal, alarm, or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.

b. Each board shall contain its own microprocessor and shall be provided to monitor and control each signaling line circuit loop of intelligent analog sensors and addressable modules. The system shall have the ability to detect duplicate addresses on each SLC loop.

c. Circuits shall be Class A Style 6/7 or Class B Style 4.

5. Central Processing Unit:

a. The central processing unit (CPU) shall communicate with, monitor, and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.

b. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.

c. All power for the unit shall be supervised and supplied by the control unit panel.

6. Display:

a. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.

b. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all intelligent analog sensors and addressable modules. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.

c. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. A minimum of three different passwords with three levels of security shall be supported to prevent unauthorized manual control or programming.

7. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure. Memory shall have the capacity to store event log of up to a minimum of 800 events.

8. Power Supply:

a. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications.

b. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Overcurrent protections shall be provided on all power outputs.

c. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.

d. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state, followed by alarm mode for 10 minutes, plus 25% spare capacity for future devices.

9. Digital Communicator:

a. Provide dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats, with the capability of transmitting each device address point in a format compatible with the central station receiver.

b. Monitoring fees and initial connection charges are not part of this project.

c. Communicator shall be fully supervised and shall operate on loop start phase lines ahead of the building PBX system.

d. Communicator shall be FCC registered. Contractor shall provide two RJ31X jacks. Contractor to provide connection of communicators to Owner's telephone system as shown on the drawings.

e. Approvals: UL listed - UL 864/NFPA 72, FM approved.

f. The communicator shall be provided integral to the fire alarm panel as furnished by the fire alarm panel manufacturer. If the panel construction requires a separate unit, the unit shall be as manufactured by: Silent Knight, Ademco, Fenwal Protection Systems, or approved equal.

D. Maintenance Lock-Out Switch:

1. The maintenance lock-out switch shall be used to disable the fire suppression system during routine maintenance.

2. This switch shall be key operated, allowing removal of the key in either the "Normal" or "Lock-Out" position. A red indicator lamp on the switch assembly shall illuminate when in the "Lock-Out" position. The fire alarm control panel is to indicate a trouble condition when in the "Lock-Out" position.

E. Initiation Devices:

1. Intelligent Analog Smoke Sensors:

a. Sensors shall connect with two wires to one of the control panel loops. They shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

b. Analog Ionization Type Sensor: It shall use the dual chamber ionization principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

c. Mount sensors, where shown on the drawings, on twist-lock bases with all mounting hardware provided. Provide a two-piece head/base design.

d. The sensors shall have switches for address setting and shall store an internal identifying code that the control panel shall use to identify the type of sensor.

e. Provide dual alarm and power indicators that flash under normal conditions and remain continuous under alarm or trouble conditions. Provide a connection for attachment of a remote indicator.

2. Addressable Manual Release Stations:

a. Manual release stations shall connect with two wires to one of the control unit panel loops. They shall be single action, non-break glass type made of red painted metal. They shall notify the control panel of their state.

b. Stations shall be semi-flush mounted where shown on the drawings, with all mounting hardware provided.

c. Stations shall have double action push/pull levers to prevent accidental operation and shall lock on when manually pulled. Stations shall be restored to normal position only when reset with a key.

d. Stations shall provide address setting means using rotary decimal or DIP switches.

3. Manual Abort Stations:

a. Manual abort stations shall be momentary type switches and operate as ‘dead man’ switches, where the agent discharge sequence is interrupted as long as the station is active.

b. Stations shall be flush surface mounted where shown on drawings, with all mounting hardware provided.

c. Stations shall be engaged by manually pushing a large pushbutton switch and disengage when released.

4. Interface Modules:

a. Interface modules shall connect with two wires to one of the control unit panel loops. They shall notify the control panel of the state of supervised dry contacts wired for Style D or Style B operation.

b. Mount the modules in enclosures located in accessible service locations as near as possible to the devices controlled. Provide all mounting hardware.

c. Modules shall have address setting means using rotary decimal or DIP switches.

5. Addressable Relays:

a. Addressable relays represent addressable control points used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional slave relay(s) as required, rated for the electrical load being controlled (Contractor to match voltage, amps, etc.).

b. Relays shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.

c. Mount relays in enclosures located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. Provide all mounting hardware.

d. Relays shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

6. Pressure Operated Switches:

a. The system shall include pressure-operated switches actuated by the agent discharge for monitoring by the control unit and the building fire alarm panel.

b. The pressure-operated switch shall be wired into the Emergency Power Off (EPO) circuitry to shut down power in the event of an agent discharge. EPO wiring by the Electrical Contractor.

c. The switches shall be UL listed for use with the clean agent suppression system.

F. Notification Appliance Devices:

1. Audio Horn/Visual: NFPA 72 and ADA 4.28; semi-flush type fire alarm electronic horn. Sound Rating: 90 dBA at 10 feet. Alarm sound levels shall not exceed 120 dBA at 10 feet. Electronic horns shall be able to be field set to annunciate as a solid horn tone, ringing bell tone, hi-low chime, wail tone or hi-low whoop. Provide the housing and backbox with red housing with white lettered FIRE and clear high intensity xenon strobe or equivalent under a clear lens with 15, 30, 75 or 100 candela rating. Candela rating shall be visible from the outside of the device. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. **Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.**

2. Alarm Bells: NFPA 72 and ADA 4.28; electric vibrating, 10 inch, with operating mechanism behind dome. Sound Rating: 81 dBA at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA.

3. Rotating Flasher: Weatherproof yellow revolving beacon type. Provide with electronic piezo beeper with sound rating between 80 dBA and 91 dBA at 10 feet.

[* * * * * OR * * * * *]

2.7 FIRE SUPPRESSION CONTROL PANEL, DETECTION, AND ALARM SYSTEM

A. Acceptable Manufacturers:

1. Kidde-Fenwal, Inc.

2. Simplex Time Recorder.
3. Notifier.
4. Edwards System Technology.
5. Cerberus Pyrotronics.
6. Fike Corporation; Fire Protection Systems Division.
7. Ansul

B. UL listed and FM approved as alarm and releasing device, with solid-state internal circuitry in NEMA ICS 6, Type 1 cabinet.

C. Control Unit Panel:

1. Control Unit Panel: Modular construction. Surface Flush wall-mounted enclosure, minimum 0.060 inch steel enclosure with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

2. Each Initiating Device Circuit (IDC) shall not be loaded over 80% of the maximum device capacity. For example, if the maximum capacity of an IDC is 100 devices, the circuit shall contain no more than 80 devices. The minimum system capacity shall be as follows:

   a. Initiating Device Circuits: Class A (Style 6/7) or Class B (Style B). Provide 4 8 12 16 zones with total expansion of 4 8 12 16 zones.

   b. Notification Appliance Circuits: Class B (Style Y or B), provide notification appliance circuits as required to accommodate the signaling appliances shown on the drawings. Provide a minimum of 4 8 12 16 circuits with a total expansion capacity of 4 8 12 16 circuits.

3. Provide the following control panel features:

   a. Electrical contacts for shutting down fans, activating valves or dampers, and operating system electrical devices.

   b. Automatic switchover to standby power at loss of primary power.

   c. Storage container, low-pressure indicator.

   d. Cross zoned and counted zone detection.

4. Power Supply:

   a. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications.

   b. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Overcurrent protections shall be provided on all power outputs.

   c. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.

d. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 10 minutes, plus 25% spare capacity for future devices.

5. Digital Communicator:

a. Provide dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats. Monitoring fees and initial connection charges are not part of this project.

b. Communicator shall be fully supervised and shall operate on loop start phase lines ahead of the building PBX system.

c. Communicator shall be FCC registered. Contractor shall provide two RJ31X jacks. Contractor to provide connection of communicators to Owner's telephone system as shown on the drawings.

d. Approvals: UL listed - UL 864/NFPA 72, FM approved.

e. The communicator shall be provided integral to the fire alarm panel as furnished by the fire alarm panel manufacturer. If the panel construction requires a separate unit, the unit shall be as manufactured by: Silent Knight, Ademco, or approved equal.

6. Initiating Device Circuits: Supervised zone modules with alarm and trouble indication.

7. Notification Circuits: Supervised temporal signal modules or individual temporal devices.

8. Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified.

9. Provide TROUBLE ACKNOWLEDGE, DRILL, and ALARM SILENCE switch.

D. Initiation Devices:

1. Smoke Detectors:

a. Photoelectric Type Sensor: Detector shall use the photoelectric principle to measure smoke density and report to the control panel via the initiating device circuit.

b. Ionization Type Sensor: It shall use the dual chamber ionization principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.

c. Smoke detector shall connect directly to an initiating device circuit. Mount detectors, where shown on the drawings, on twist-lock bases with all mounting hardware provided. Provide a two-piece head/base design.

d. Provide dual alarm and power indicators that flash under normal conditions and remain continuous under alarm or trouble conditions. Provide a connection for attachment of a remote indicator.

2. Manual Release Stations:

a. Manual release stations shall be single action non-break glass type made of red painted metal.

b. The stations shall be semi-flush mounted where shown on the drawings, with all mounting hardware provided.

c. Stations shall have double action push/pull levers to prevent accidental operation and shall lock on when manually pulled. Stations shall be restored to normal position only when reset with a key.

3. Pressure Operated Switches:

a. The system shall include pressure-operated switches actuated by the agent discharge for monitoring by the control unit and the building fire alarm panel.

b. The pressure-operated switch shall be wired into the Emergency Power Off (EPO) circuitry to shut down power in the event of an agent discharge. EPO wiring by the electrical contractor.

c. The switches shall be UL listed for use with the clean agent suppression system.

E. Notification Appliance Devices

1. Audio Horn/Visual: NFPA 72 and ADA 4.28; semi-flush type fire alarm electronic horn. Sound Rating: 90 dBA at 10 feet. Alarm sound levels shall not exceed 120 dBA at 10 feet. Electronic horns shall be able to be field set to annunciate as a solid horn tone, ringing bell tone, hi-low chime, wail tone or hi-low whoop. Provide the housing and backbox with red housing with white lettered FIRE and clear high intensity xenon strobe or equivalent under a clear lens with 15, 30, 75 or 100 candela rating. Candela rating shall be visible from the outside of the device. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. **Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.**

2. Alarm Bells: NFPA 72 and ADA 4.28; electric vibrating, 10 inch, with operating mechanism behind dome. Sound Rating: 81 dBA at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA.

3. Rotating Flasher: Weatherproof yellow revolving beacon type. Provide with electronic piezo beeper with sound rating between 80 dBA and 91 dBA at 10 feet.

F. Auxiliary Devices

1. Control Relays:

a. Provide control relays as indicated on the drawings for unit shutdown, isolation valves or dampers, and/or smoke damper release. Contractor to provide additional slave relay(s) as required, rated for the electrical load being controlled (contractor to match voltage, amps, etc.).

b. Mount relays in enclosures located in accessible service locations as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. Provide all mounting hardware.

c. Relays shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2. Maintenance Lock-Out Switch:

a. The maintenance lock-out switch shall be used to disable the fire suppression system during routine maintenance.

b. This switch shall be key operated allowing removal of the key in either the “Normal” or “Lock-Out” position. A red indicator lamp shall be included on the switch assembly to be illuminated when in the “Lock-Out” position. The fire alarm control panel is to indicate a trouble condition when in the “Lock-Out” position.

3. Manual Abort Stations:

a. Manual abort stations shall be momentary type switches and operate as ‘dead man’ switches, where the agent discharge sequence is interrupted as long as the station is active.

b. Stations shall be flush surface mounted where shown on drawings, with all mounting hardware provided.

c. Stations shall be engaged by manually pushing a large pushbutton switch and disengage when released.

2.8 ANNUNCIATION

A. Remote LCD Annunciators:

1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability as shown on the drawings.

2. Communications and power to the annunciators shall be supervised. The annunciator shall receive power from the fire alarm control panel.

3. A single key switch shall enable all switches on the annunciator.

B. Building Automation System (BAS) Interface:

1. Provide addressable relays or contact outputs to report the following to the Building Automation System via dry contact monitoring on the Building Automation System:

a. General Alarm
b. System Trouble
c. Supervisory Alarm
d. Other Alarms (if applicable)

2.9 WIRING

A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer’s recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.

B. Approved manufacturers of fire alarm cable:

1. Comtran Corp.
2. Helix/HiTemp Cables, Inc.
3. Rockbestos-Suprenant Cable Corp.
4. West Penn Wire/CDT.

PART 3 - EXECUTION

3.1 SEQUENCES OF OPERATION

A. The Fire Suppression Contractor is responsible to ensure proper operation.

B. System Sequence:

1. Detection of a single detector or air sampling smoke detection system shall:

a. Energize alarm bell.
b. Close ductwork isolation and/or fire/smoke dampers.
c. Open the room pressure relief damper.
d. Signal building fire alarm system.

2. Detection of a second detector shall:

a. Signal building fire alarm system.
b. Activate audio horn/visual devices and de-energize alarm bell.
c. Shut down power to computer room air-conditioning units and close dampers.
d. Start time delay for up to 30 60 seconds (adjustable).

3. Activation of the manual fire suppression agent release shall:

a. Signal building fire alarm system.
b. Activate audio horn/visual devices and de-energize alarm bell (if operating). Annunciate the audio horn/visual devices with a distinctively faster pulse.
c. Shut down power to computer room air-conditioning units and close ductwork isolation and/or fire/smoke dampers.
d. Start time delay for 60 seconds (adjustable).

4. After completion of the time delay, the system shall:

a. Release agent into protected area.
b. If abort switch is engaged, delay release.
c. Upon abort switch disengagement, release agent unless system has been cleared and reset.
d. Shutdown all power to equipment in the hazard area via the pressure activated switch.
e. Activate the visual alarm (rotating flashers) at the protected area's entrance door(s).

C. Double Interlock Pre-Action Release Sequence:

1. System shall discharge when both of the following conditions occur:

a. Detection of smoke by a single smoke detector or air sampling system.

b. Loss of air pressure within the fire protection piping.

2. Systems shall alarm when either of the above listed conditions occur.

D. Warning signs at the protected area's entrance doors shall read, "Warning - Do not enter room when warning light is flashing. Fire extinguishing system has been activated." Sign shall be engraved plastic laminate with 3/4" minimum letter height.

E. The Fire Suppression Contractor shall test all sequences and submit test results to Engineer and Owner's representative.

3.2 EXAMINATION

A. Verify that spaces are ready to receive work.

B. Ensure enclosing walls are continuous above ceilings and below raised floors to allow required concentration to be maintained for required time to extinguish fire.

C. Beginning of installation means installer accepts existing conditions.

3.3 INSTALLATION - GENERAL

A. General Installation Requirements:

1. Install in accordance with manufacturer's recommendations and ANSI/NFPA 2001.

2. Paint in accordance with ANSI/NFPA 2001 requirements. Place directional arrows and system labels wherever piping changes direction and minimum 20 feet on straight runs.

3. Install engraved plastic instruction plate, detailing emergency procedures, at control panel and at each manual discharge and abort switch location. At control panel, identify control logic units, contacts, and major circuits with permanent nameplates.

4. Post warning signs at each entrance to the protected area.

5. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

B. Pipe Installation Requirements:

1. Ream pipe and tube ends. Remove burrs. Remove scale and dirt on inside and outside before assembly. Blow out pipe before nozzles or discharge devices are installed.

2. Route piping in orderly manner, plumb and parallel to building structure, and maintain gradient. Install piping to conserve building space, and not interfere with use of space and other work. All piping shall be concealed above ceilings, below floors or in walls. Piping to exposed nozzles shall be chrome plated.

3. Securely support piping per ANSI/ASME B31.1 with allowance for agent thrust forces and thermal expansion and contraction.

4. Install unions downstream of valves and at equipment connections.

5. At hazard area walls, pack space between pipe, pipe sleeve or surface penetration with mineral fiber with elastomer caulk to depth of 1/2". Provide escutcheons where exposed piping passes through walls, floors, and ceilings. Seal pipe penetrations of fire separations.

C. Cylinder Location:

1. Secure cylinders to wall. Where manifolded, mount and support by rack. For each system, provide same size cylinders containing equal amounts of clean agent.

D. Ceiling Requirements:

1. In rooms with suspended ceiling tiles, clip or retain tiles within 4-foot radius of the nozzles to prevent lifting during discharge.

2. Locate discharge nozzles approximately 6" below and or above ceiling and 6" below raised floors. Avoid interference with other piping and equipment.

3.4 INSTALLATION – CONTROL PANEL, DETECTION, AND ALARM SYSTEM

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Fire Suppression Control Panel:

1. Install the control panel where shown on the drawings.
2. All expansion compartments, if required, shall be located at the control panel.

C. Devices:

1. Smoke Detectors: Detectors shall be located where shown on the reflected ceiling and reflected floor drawings. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern. Devices shall be coordinated with light fixtures, diffusers, sprinklers, clean agent discharge nozzles, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacings shall not exceed the requirements of NFPA 72. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile. **Note: Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.**

2. Manual Abort and Release Stations: Stations shall be located at each exit door where shown and at 46” above the finished floor level. The locations shall be coordinated with other devices mounted in the proximity.

3. Control Relays and Monitor Modules: Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings. All modules shall be mounted in or on a junction box in an accessible location.

    a. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.

4. Notification Appliance Devices: Devices shall be located where shown on the drawings. If not shown on the drawings, the devices shall be installed in a neat and uniform pattern with spacings based on candela ratings and the requirements of NFPA 72.

    a. Wall-mounted alarm bells and combination audio/visual alarm devices shall be mounted 80" above the finished floor level to the bottom of the device 96" above the finished floor level to the top of the device.

    b. Ceiling mounted rotating flashers shall be mounted at the ceiling of each entrance, directly above the warning sign.

    c. The locations shall be coordinated with other devices mounted in the proximity.

D. Wiring:

1. Fire suppression wiring/cabling shall be provided by the Contractor in accordance with the manufacturer’s recommendations and pursuant to National Fire Codes.

2. Wiring shall be installed in electrical metallic tubing (EMT) conduit. All junction boxes shall be painted red with SLC or IDC and NAC circuits identified on cover. Refer to Section 26 05 33.

3. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.

    a. Temporal audible notification for all audio appliances.

    b. Synchronization of all visual devices where two or more devices are visible from the same location.

    c. Ability to silence audible alarm while maintaining visual device operation.

4. No wiring other than that directly associated with the control unit detection or alarm shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with “E-Z Markers” or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conducts are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.

E. Device surface mounted in finished areas shall be mounted on surface backbox. Backbox shall be painted to match device and not have visible knockouts.

F. Make conduit and wiring connections to pressure switches, fire suppression system control panels, and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

3.5 MANUFACTURER'S FIELD SERVICES

A. Provide experienced manufacturer's field engineer to supervise installation and performance testing of the system.

3.6 TESTING

A. Testing and Inspection Requirements:

1. The completed clean agent fire suppression system piping shall be pneumatically tested in a closed circuit for a period of 10 minutes at 40 psig. At the end of 10 minutes, the pressure drop shall not exceed 20% of the test pressure. When pressurizing the piping, pressure shall be increased in 5 psi increments. A written report of the test results shall be provided to the Architect/Engineer.

2. The piping system shall be inspected in accordance with NFPA Standard 2001, Section 6-7.2.2 latest edition.

3. The equipment manufacturer’s representative shall verify that all nozzles are installed in the correct location and that the area of coverage for each nozzle is within the approved range of the manufacturer’s listings and approvals. The equipment manufacturers shall provide written certification to that effect.

4. The Fire Suppression Contractor shall provide a “puff test” of the completed piping system to certify to the Architect/Engineer that the piping network is free and clear of obstructions. The equipment manufacturers shall submit a procedure for approval prior to beginning the “puff test.” The equipment manufacturers shall provide certified results of the testing to the Architect/Engineer signed by the equipment manufacturer’s representative.

5. Conduct an enclosure integrity test in accordance with NFPA 2001, Appendix C, latest edition. Prior to conducting testing, the equipment manufacturers shall verify with the general equipment manufacturers that all contemplated enclosure penetrations have been completed and that all enclosure sealing has been accomplished.

B. Certification Requirements:

1. Certified “as installed” piping isometric drawings and clean agent flow calculations shall be completed by the Fire Suppression Contractor prior to ordering clean agent discharge nozzles. The certified isometric drawing and clean agent flow calculations shall be stamped “CERTIFIED AS INSTALLED” and signed by the equipment manufacturer’s representative.

2. The Fire Suppression Contractor shall provide certified volumetric calculations of the final as-built hazard enclosure to verify the clean agent design concentration. The certified volumetric calculations shall be stamped “CERTIFIED VOLUMETRIC CALCULATIONS” and signed by the equipment manufacturer’s representative.

3. The equipment manufacturers shall perform a certified weight check of all clean agent storage containers prior to turning the system over to the Architect/Engineer. This weight check shall be accomplished by means other than the liquid level indicator installed in the container. The results of this weight check shall then be correlated to the liquid level indicator to form the basis for future testing.

4. The following shall not occur until construction is 100% complete and the Owner has provided written approval.

    a. Upon completion of all testing, the equipment manufacturers shall arm the system and leave it in 100% working order.

3.7 DEMONSTRATION

A. Provide systems demonstration.

B. Demonstrate that components, except cylinder discharge assembly, are functioning properly and in conjunction with controls system.

END OF SECTION

SECTION 22 05 00
BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. CCR California Code of Regulation
B. CBC California Building Code
C. CFC California Fire Code
D. CEC California Electric Code
E. CMC California Mechanical Code
F. CPC California Plumbing Code
G. California Title 24 - Building Energy Efficiency Standards
H. SCAQMD Southern California Air Quality Management Division

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.

C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Scope of Work:

1. Plumbing Work shall include, but is not necessarily limited to:

a. Furnish and install all items listed in the Plumbing Material List.

b. Furnish and install a new domestic water service to the building.

c. Furnish and install water meter and domestic water backflow preventer as required by Code.

d. Furnish and install a complete Extend existing domestic water piping system including cold, hot, and hot water circulating piping within the building. Insulate all piping as specified.

e. Furnish and install gas piping system including all meter requirements.

f. Furnish and install water softener.

g. Furnish and install Revise and/or replace water heaters.

h. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.

i. Furnish and install all fire hydrants and associated piping, valves, and supports including connection to the water main.

j. Furnish and install makeup water connection to hydronic heating and/or cooling systems including reduced pressure principle type backflow preventer.

k. Furnish and install a complete storm water drainage system.

l. Furnish and install condensate drain piping from plumbing related equipment such as ice machines.

m. Furnish and install site storm water piping, cleanouts, and manholes.

n. Furnish and install a complete sanitary sewer and vent system.

o. Furnish and install sanitary sewage ejector basins and pumps.

p. Furnish and install site sanitary sewer piping, cleanouts, and manholes.

q. Furnish and install Modify existing laboratory gas systems including all piping and valves.

r. Furnish and install Modify existing medical gas systems including all piping, valves, alarms, and testing. Furnish and install all items on the Medical Gas material list and medical gas equipment Schedules.

s. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 22 05 50.

t. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

2. Heating Work shall include, but is not necessarily limited to:

a. Furnish and install heating hydronic boilers and accessories.

b. Furnish and install steam heating boiler, condensate return equipment, and accessories.

c. Furnish and install steam-to-water heat exchanger with connection to steam system.

d. Furnish and install a complete heating water system including pumps, piping, insulation, air control equipment, terminal heating equipment, and specialties. Make final connections to all coils, including those furnished by others.

e. Furnish and install a complete steam distribution system including piping, insulation, terminal heating equipment, traps, and specialties. Make final connections to all coils, including those furnished by others.

f. Furnish and install a complete reheat water system including pumps, piping, insulation, air control equipment, specialties, and connections to terminal heating coils.

g. Furnish and install gas piping system including all meter requirements.

h. Furnish and install humidifiers, piping, and accessories.

i. Furnish and install chillers and cooling towers.

j. Furnish and install a complete condenser water system including pumps, piping, insulation, and specialties.

k. Furnish and install a complete chilled water system including pumps, piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to coils, including those furnished by others.

l. Furnish and install refrigerant piping, accessories, and final charge of refrigerant.

m. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.

n. Furnish and install Modify existing medical gas system including all piping, valves, alarms, and testing. Furnish and install all items on the Medical Gas material list and medical gas equipment Schedules.

o. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

p. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

3. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

a. Furnish and install built-up air handling units complete with louvers, dampers, filters, coils, fans, motors, housing, and vibration isolation.

b. Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors.

c. Furnish and install package rooftop air handling units complete with curbs.

d. Furnish and install air-cooled condensing units and curbs.

e. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.

f. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.

g. Furnish and install all terminal air boxes and reheat coils.

h. Furnish and install combustion air louver, damper, and ductwork.

i. Furnish and install complete fume hood exhaust systems including fans, ductwork, and fittings.

j. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.

k. Furnish and install mechanical room ventilation systems including louvers, ductwork, insulation, and fans.

l. Furnish and install gas flues, stacks, and breechings.

m. Furnish and install all temperature control systems.

n. Furnish and install all fire dampers.

o. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

p. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

4. Temperature Control Work shall include, but is not necessarily limited to:

a. Furnish and install a complete temperature control system as specified in Section 23 09 00.

b. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.

c. Furnish automatic control valves and dampers for installation by others.

d. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

f. The temperature controls will be provided by the Owner, separate from this work. This Contractor shall install all devices so noted in Section 23 09 00.

5. Fire Protection Work shall include, but is not necessarily limited to:

a. Furnish and install a new fire protection service to the building including backflow preventer as required by Code.

b. Furnish and install all fire hydrants and associated piping, valves, and supports including connection to the water main.

c. Furnish and install a complete Extend existing wet pipe sprinkler system for areas noted on the drawings.

d. Furnish and install a complete Extend existing dry pipe sprinkler system for areas noted on the drawings.

e. Furnish and install a complete Extend existing fire valve/fire hose standpipe system.

f. Furnish and install all items listed on the Fire Protection Material List.

g. Furnish all hydraulic calculations and working sprinkler drawings.

h. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 21 05 50.

i. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

6. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

1.4 OWNER FURNISHED PRODUCTS

A. The Owner will supply the following items for installation and/or connection by This Contractor:

B. The following items shall be relocated, installed and/or connected by This Contractor:

C. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.

D. This Contractor shall make all plumbing system connections shown on the drawings **or** as required for fully functional units.

E. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

B. Schedule overtime for the following work:

C. Itemize all work and list associated hours and pay scale for each item.

1.6 ALTERNATES

1.7 UNIT PRICES

1.8 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

a. Plumbing Contractor.
b. Heating Contractor.
c. Air Conditioning and Ventilating Contractor.

d. Temperature Control Contractor.
e. Fire Protection Contractor.
f. Testing, Adjusting, and Balancing Contractor.

2. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

3. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements, California Code of Regulation Title 24, Article E725.

5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

   a. Light fixtures.
   b. Gravity flow piping, including steam and condensate.
   c. Electrical busduct.
   d. Sheet metal.
   e. Electrical cable trays, including access space.
   f. Sprinkler piping and other piping.
   g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

   a. Boiler Feed Pumps.
   b. Burners.
   c. Chillers.
   d. Computer Room Air Conditioning Units.
   e. Condensate Return Stations.
   f. Condensing Units.
   g. Makeup Air Units.
   h. Electric Humidifiers.
   i. Gas Trains.
   j. Package Air Handling Units.
   k. Packaged Rooftop Units.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

4. Temperature Control Contractor's Responsibility:

   a. Wiring of all devices needed to make the Temperature Control System functional.

   b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor Contractor.

   c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor Contractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.

5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.

6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.9 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

    a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

    a. Scale of drawings:

        1) General plans: 1/4 Inch = 1 '-0" (minimum).

        2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

        3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

        4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

        5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

    c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.10 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the Los Angeles, California, 2019 CPC Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.

4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

2. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Utility Company Requirements:

1. Secure from the appropriate private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. Make application for and pay for service connections, such as sewer, and water. [and gas.]

4. Make application for and pay for all meters and metering systems required by the utility company.

F. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.

    b. Any item listed as installed shall also be furnished, unless otherwise noted.

G. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

H. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor’s use of these documents.

1.11 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

Referenced Specification Section	**Submittal Item**
22 05 00	Owner Training Agenda
22 05 03	Fire Seal Systems
22 05 13	Motors
22 05 15	Variable Frequency Drives
22 05 16	Expansion Compensation
22 05 29	Hangers and Supports
22 05 29	Prefabricated Curbs
22 05 48	Vibration Isolation Equipment
22 05 50	Seismic Restraint Systems
22 05 53	Plumbing Identification

Referenced Specification Section	Submittal Item
22 07 16	Plumbing Equipment Insulation
22 07 19	Plumbing Pipe Insulation
22 09 00	Instrumentation
22 10 00	Plumbing Piping Systems and Valves
22 10 23	Natural Gas and Propane Piping Systems
22 10 30	Plumbing Specialties
22 11 23	Domestic Water Pumps
22 12 00	Plumbing Tanks
22 13 29	Sanitary Sewage Pumps
22 14 29	Sump Pumps
22 15 19.13	Air Compressors
22 30 00	Plumbing Equipment
22 33 39	Solar Water Heating Systems
22 40 00	Plumbing Fixtures
22 60 00	Medical Gas Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor's review shall include, but not be limited to, verification of the following:

      1) Only approved manufacturers are used.
      2) Addenda items have been incorporated.
      3) Catalog numbers and options match those specified.
      4) Performance data matches that specified.
      5) Electrical characteristics and loads match those specified.
      6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7) Dimensions and service clearances are suitable for the intended location.
      8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

   d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

   e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

   b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor’s responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer’s approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. Submittal file name: 22 XX XX.description.YYYYMMDD
b. Transmittal file name: 22 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. The Contractor shall submit ten (10) paper copies of each shop drawing.

3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.12 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

3. Itemize the cost for each of the following:

a. Overhead and profit.
b. Bonds.
c. Insurance.
d. General Requirements: Itemize all requirements.

4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:

a. Excavation and backfill for underground piping systems inside the building.
b. Underground piping systems inside the building (sanitary, storm, etc.) listed separately. Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
c. Each aboveground piping system (sanitary, storm, domestic water, etc.). Break down the material and labor for each piping system based on geography (building, floor, wing and/or phase).
d. Pipe insulation with separate material and labor line items for each piping system listed above.
e. Each piece of equipment requiring shop drawings (e.g., backflow preventer, water heater, water softener, etc.) using the project nomenclature (BFP-1, WH-1, WS-1, etc.).
f. Each plumbing fixture (e.g., WC, lavatory, sink, etc.). Multiple units of the same type can be listed together, provided quantities are also listed so unit costs can be determined.

g. Site utilities (5’ beyond building)
h. Seismic design
i. Water balancing
j. Commissioning
k. Record drawings
l. Punchlist and closeout

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.13 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.14 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Fire Seal Systems
2. Seismic Restraints and Equipment Bracing

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner’s Operation and Maintenance Manuals.

1.15 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.16 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.17 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.18 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.19 CONTINGENCY

A. The Plumbing Contractor shall include in the Base Bid a contingency of one percent (1%) to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.20 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

1.21 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and 22 08 00, and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer’s consultants shall be indemnified and shall be made additional insureds under the Contractor’s general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found at the following website (https://call811.com/) or by calling 811.

2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his/her work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workers.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Provide all necessary sand and/or CA6 for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris, or earth with a high void content.

5. Backfill all trenches and excavations immediately after installing pipes or removal of forms, unless other protection is provided.

6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

7. Lay all piping on a compacted bed of CA6 at least 3 inches deep. Backfill around pipes with CA6, 6 inch layers, and compact each layer.

8. Use sand or CA6 for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand or CA6 backfill to 6 inches above the top of the pipe.

9. Place all backfill above the sand/CA6 in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.

10. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:

a. Pipe insulation is installed and fully sealed.
b. Pipe wall penetrations are sealed.
c. Pipe identification and valve tags are installed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.

3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up or reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Start-up reports on all equipment requiring a factory installation inspection or start-up.

5. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div22.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, 5 paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.

3. Binder Labels: Label the front and spine of each binder with “Operation and Maintenance Instructions”, title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copy of final approved test and balance reports.

5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.

7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.

9. Capacities and utility consumption of equipment.

10. Detailed parts lists with lists of suppliers.

11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.

15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

D. The instructions shall include:

1. Explanation of all system flow diagrams.

2. Maintenance of equipment.
3. Start-up procedures for all major equipment.
4. Explanation of seasonal system changes.

E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.

F. Minimum hours of instruction for each item shall be:

1. Domestic Hot Water System - _____ hours.
2. Domestic Water Pressure Booster System - _____ hours.
3. Water Softener System - _____ hours.
4. Medical Gas System(s) - _____ hours.

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two four weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.

2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM STARTING AND ADJUSTING

A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.

B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.

C. Before completion of the project, a set of reproducible plumbing drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.9 PAINTING

A. This Contractor shall paint the following items:

1. All piping in mechanical room
2. Piping exposed in kitchen

B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor.

D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.

F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.

H. Paint all outdoor exposed natural gas propane piping the color selected by Owner or Architect/Engineer.

I. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.

3. Color of paint shall be as follows:

a. All piping in mechanical room:

1) Domestic Cold Water: Blue pipe/white letters
2) Domestic Hot Water: Red pipe/white letters
3) Sanitary Waste: Green pipe/black letters
4) Natural Gas: Yellow pipe/black letters

b. Piping exposed in kitchen:

1) All Piping: White

3.10 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.11 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

2. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

3.12 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

a. Minimizing the amount of dust generated.
b. Reducing solvent fumes and VOC emissions.
c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
d. Protect stored on-site and installed absorptive materials from moisture damage.

2. Request that the Owner designate an IAQ representative.

3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.

4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.

5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.

6. Request copies of and follow all of the Owner's IAQ and infection control policies.

7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.

8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.

9. In addition to the criteria above, provide measures as recommended in the SMACNA “IAQ Guidelines for Occupied Buildings Under Construction”.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * *

SECTION 23 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials.
B. UL 723 - Surface Burning Characteristics of Building Materials
C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
F. Intertek / Warnock Hersey - Directory of Listed Products
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
I. The Building Officials and Code Administrators National Building Code
J. 1994 1997 Uniform Building Code
K. Wisconsin Administrative Code
L. 2000 2003 2006 2009 2012 2015 International Building Code
M. NFPA 5000 – Building Construction Safety Code
N. CBC California Building Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Section 23 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

    a. Floor penetrations located outside wall cavities.
    b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
    c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
    d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq. ft at both ambient temperature and 400°F for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

3. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)

7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Dow Corning Corp.
10. Fire Trak Corp.
11. International Protective Coating Corp.

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
   F Rating = Floor/Wall Rating
   T Rating = Floor/Wall Rating
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
   F Rating = Wall Rating
   T Rating = 0
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999

Penetrating Item	UL System No.
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Walls) = 0 or Wall Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 22 05 05
PLUMBING DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanical demolition.
B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.

B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.

C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.

D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.

E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.

F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.

G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

A. Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

C. Existing Plumbing System: Maintain service to all plumbing fixtures until new piping is installed. Obtain permission from Owner at least 48 hours before shutting down system for any reason. Make changeover to new piping with minimum outage. Do not disconnect any roof drainage piping until new piping is in place and operational.

D. Existing Medical Gas System: Maintain existing system in service until new system is complete and ready for service. Modify existing system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before system modification. Minimize outage duration. Certify system same day as new connections are made.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Demolish and extend existing plumbing work under provisions of Division 2 and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned piping to source of supply and/or main lines.

D. Remove exposed abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.

E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Extend existing installations using materials and methods compatible with existing installations, or as specified.

H. Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 2 feet from main to prevent “dead legs”.

I. Temporarily cap all openings to the sanitary and vent system to prevent odor from entering the work area and building.

3.4 CUTTING AND PATCHING

A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 22 05 29 for additional requirements.

B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.

D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.

E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.

F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.

G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.

C. PLUMBING ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

3.6 SPECIAL REQUIREMENTS

A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.

B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

C. All medical gas piping scheduled for removal, relocation, extension, and/or revision will require re-certification by an independent agency acceptable to the Owner and NFPA-99 requirements. All testing shall conform to NFPA-99.

END OF SECTION

SECTION 22 05 29
PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices
D. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 22 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 22 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel, cast iron, and glass pipe.
Column #2: Copper and plastic pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

1.

2.3 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).

2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

a. Insulation Couplings:

1) Insulation Coupling: Molded thermoplastic, -65ºF to 275ºF, sizes up to 4-1/8” OD, and receive insulation thickness up to 1”. Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

2) Horizontal Strut Mounted Insulated Pipe:

a) Acceptable Manufacturers: Klo-Shure or equal.

3) Vertical:

a) Acceptable Manufacturers: Klo-Shure Titan or equal.

3. Copper piping located in an exposed area, including indirect waste piping in kitchens and janitor’s closets, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:	
Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

   Acceptable Products:
   Cooper/B-Line - Fig B3373 Series
   Erico - 510 Series
   Nibco/Tolco - Fig. 82

2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

   Acceptable Products: Mason RBA, RCA, or BR.

3. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.

4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.

3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

   Acceptable Products:
   Anvil - Fig. 160, 161, 162, 163, 164, 165
   Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165
   Erico - Model 630, 631, 632, 633, 634, 635
   Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation insert and shield sections may be used.

Acceptable Products:
Cooper/B-Line - Fig. B3380 through B3384
Pipe Shields - A1000, A2000

6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:
Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

b. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

c. Padded Clevis Type:
Service: Glass Pipe

Acceptable Products:	Hangers	Pads
Anvil	Fig. 260	Fig. 3195
Cooper/B-Line	Fig. 3100	
Erico	Model 400	
Nibco/Tolco	Fig 1	

d. Continuous Channel with Clevis Type:
Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:
Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

e. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

   a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

   b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

   a. Clamp Type:
   Service: Bare Metal Pipe
   Rigid Plastic Pipe
   Insulated Cold Pipe
   Insulated Hot Pipe - 3 inches and smaller

      1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

      2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

   b. Roller Type:
   Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps

1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists):

Acceptable Products:	
Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300
Nibco/Tolco	68

2) Scissor Type Beam Clamps (For use with bar-joists and wide flange):

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

b. Concrete

1) Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

2) Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

3) Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

4) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 22 05 50 for additional requirements for concrete bases in seismic applications.

2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6”x6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

5. Equipment requiring bases is as follows:

a. Expansion Tank
b. Day Tank
c. Heat Exchanger
d. Pump
e. Tank
f. Water Heater
g. Water Softener

C. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum 302 stainless steel 316 stainless steel PVC coated powder coated zinc trivalent chromium finish.

7. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load), Miro Industries 1.5, 3-R, 4-R or 5-R (to match pipe).

D. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

E. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120ºF, sleeves may be thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.

5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40ºF to 250ºF
T	High/Low Temperature	Silicone	-67ºF to 400ºF
T	Fire Seals (1 hour)	Silicone	-67ºF to 400ºF
FS	Fire Seals (3 hours)	Silicone	-67ºF to 400ºF
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.8 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

   a. The hanger is attached within 6” from a web/chord joint.

   b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the spacing as defined in 2016 CPC, Table 313.3 as applied to each piping system.

I. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"

	Pipe Material	Maximum Spacing
3.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"

5. Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:

   a. Continuous channel with hangers maximum 8’-0” OC.

6. Rigid Plastic Pipe:

   a. Hangers shall be spaced based on the piping system manufacturers’ instructions or, if no system instructions are available, space hangers at 4’-0” maximum centers.

7. Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.

END OF SECTION

SECTION 22 05 53
PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 22.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
B. ASTM B-1, B-3, and B-8 for copper conductors.
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kV Cables.
D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
E. NFPA-99 – Health Care Facilities.
F. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturer’s recommendations.

B. Degrease and clean surfaces to receive adhesive for identification materials.

C. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide one Plexiglas framed valve directory listing all valves, with respective tag numbers, uses and locations. Mount directory in location chosen by the Architect/Engineer.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.

2. Tracer wire shall be taped directly to plastic water or drain pipe.

3. Tracer wire shall not be fastened directly or indirectly to gas piping.

4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.

5. Tape shall be Polyken “930-35”, Protecto-Wrap “310”, or approved equal.

6. Tracer wire shall be continuous between boxes and shall be tested for continuity.

7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**

8. The tracer wire shall daylight to grade through a 2” PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
HIGH TEMP HOT WATER - OVER 240ºF	Black	Yellow
CONDENSATE DRAIN	Black	Yellow
COMPRESSED AIR	Black	Yellow
CONTROL COMPRESSED AIR	Black	Yellow
DOMESTIC COLD WATER	White	Green
DOMESTIC HOT WATER - 115°F	Black	Yellow
DOMESTIC HOT WATER - 140°F	Black	Yellow
DOMESTIC HOT WATER CIRCULATING - 115°F	Black	Yellow
DOMESTIC HOT WATER CIRCULATING - 140°F	Black	Yellow
SANITARY SEWER	Black	Yellow
VENT	Black	Yellow
STORM SEWER (PRIMARY AND SECONDARY)	White	Green
NATURAL GAS	Black	Yellow
TEMPERED WATER	Black	Yellow
TEMPERED WATER RETURN	Black	Yellow
NON-POTABLE WATER	Black	Yellow
MEDICAL VACUUM - 15-30 IN. HG	Black	White
WASTE ANESTHETIC GAS DISPOSAL - 15-30 IN. HG	White	Violet
CARBON DIOXIDE - 50-55 PSI	White	Gray
INSTRUMENT AIR - 160-185 PSI	White	Red
MEDICAL AIR - 50-55 PSI	Black	Yellow
NITROGEN - 160-185 PSI	White	Black
NITROUS OXIDE - 50-55 PSI	White	Blue
OXYGEN - 50-55 PSI	White	Green
HYPERBARIC OXYGEN - 70-75 PSI	White	Green
DEIONIZED WATER	White	Green
DISTILLED WATER	White	Green
RO WATER	White	Green
FUEL OIL SUPPLY	Black	Yellow
FUEL OIL RETURN	Black	Yellow
All Underground Pipes	Varies	Varies
Tracer Wire - Water Pipe Lines	---	Blue
Tracer Wire - Natural Gas Pipe Lines	---	Yellow
Tracer Wire - All other buried types	---	Green

B. Medical gas pipe markers shall include the system operating pressure shown in table above.

C. Medical gas pipe markers for systems not listed shall meet the pipe labeling requirements of NFPA-99.

END OF SECTION

SECTION 22 07 19
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.
B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

2. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
C. ANSI/ASTM C534 - Elastomeric Foam Insulation.
D. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
E. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
F. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
G. ASTM E84 - Surface Burning Characteristics of Building Materials.
H. NFPA 255 - Surface Burning Characteristics of Building Materials.
I. UL 723 - Surface Burning Characteristics of Building Materials.
J. California Title 24 - Building Energy Efficiency Standards

1.4 SUBMITTALS

A. Submit shop drawings per Section 22 05 00. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white Kraft jacket for above grade installations.

D. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300ºF; 1200ºF maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

E. Type E: Preformed rigid cellular polyisocyanurate insulation; ANSI/ASTM C591; maximum 'K' value of 0.19 at 75ºF; moisture resistant; suitable for -297ºF to +300ºF.

2.2 VAPOR BARRIER JACKETS

A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer’s recommended installation guidelines.

2.3 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

B. Stainless Steel Jackets: ASTM C1767. Type 304 316 stainless steel; 0.010" thick (thicker where required by ASTM C1729); smooth finish with Z edge seams and stainless steel bands for outdoor use.

C. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.020" 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40ºF to 150ºF. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.

2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

3. On all insulated piping, provide at each support an insulation insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi. Polyisocyanurate insulation with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3”75 and below, minimum 60 psi for pipe sizes 4” and above, and operate below 300°F. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

4. Neatly finish insulation at supports, protrusions, and interruptions.

5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3-1/2"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5” to 6"	18" long x 16 gauge
d.	8” to 14"	24" long x 14 gauge
e.	16” to 24"	24" long x 12 gauge

7. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

2. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, and strainers.

2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

E. Exposed Piping:

1. Locate and cover seams in least visible locations.

2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping shall be insulated unless local code allows it to be uninsulated. In no instance should the uninsulated portion of the piping be more than 4ft in developed length.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.

2. Insulate fittings with prefabricated fittings.

D. Type D Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.

2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

E. Type E Insulation:

1. Indoors, above grade or below grade, Polyvinylidene chloride (PVDC or Saran) vapor retarder film and tape: Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner. Refer to manufacturer’s recommendations for installation guidelines.

2. Insulate pipe fittings with prefabricated insulation fittings.

3.4 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum stainless steel jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.

2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.

3. Interior joints do not need to be sealed.

4. Use metal covering on the following pipes:

a. All exterior piping.

b. Cover insulation with aluminum jacketing.
c. All Type D insulation.
d. _____.

5. Use colored aluminum jacket covers on the following pipes:

a. All exterior piping.
b. _____.

B. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.

2. Solvent weld all joints with manufacturer recommended cement.

3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.

4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1” on circumferential and 1.5” to 2” on longitudinal seams.

5. Use plastic insulation covering on all exposed pipes including, but not limited to:

a. All exposed piping in areas noted on drawings.
b. All exposed piping in locker rooms.
c. All exposed piping below 8'-0" above floor.
d. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
e. All kitchen areas.

6. Elastomeric piping insulation may have two coats of latex paint instead of plastic jacket.

7. Use colored plastic covering on the following pipes:

a. All exterior piping.
b. _____.

3.5 SCHEDULE

Refer to attached insulation schedule.

END OF SECTION

PLUMBING For Use With: ASHRAE 90.1-2010 | ASHRAE 90.1-2013 | ASHRAE 90.1-2016 | IECC -2018 | IECC -2015															
	Insulation Thickness per Pipe Size														
Piping System	< 1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Domestic Hot Water & Circulating - Potable and Non-Potable - over 140°F	A 1-1/2"		E 1-1/2" *	A 1-1/2"		E 1-1/2" *	A 2"		E 1-1/2" *	A 2"		E 1-1/2" *	A 2"		E 2" *
Domestic Tempered Water & Circulating - Potable and Non-Potable (60°F-104°F)	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Domestic Cold Water - Potable and Non-Potable	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage HORIZONTAL (include drain bodies and piping within the building, except underground)	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage VERTICAL (include drain bodies and piping within the building, except underground)	None			None			None			None			None		
Plumbing Vents Within 10' from Roof Penetration	A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"	
Chilled Drinking Water	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Above Grade Drains at Ice Machines (include drain bodies, P-trap, and 10' of downstream drain piping)	A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"	
Underground Domestic Hot Water & Circulating Lines		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"
Insulation Inserts at Hangers	Type C or D or E* - Match Pipe Insulation Thickness														
Medical Air Compressor Intake	A 2"			A 2"			A 2"			A 2"			A 2"		
Medical Vacuum System Exhaust (within 10' of outside wall roof penetration	A 1"			A 1"			A 1"			A 1"			A 1"		
SPARE															
SPARE															
SPARE															
SPARE															

KEY NOTES FOR CONTRACTORS: * Type E not allowed in Return Air Plenum (not 25/50 rated)

+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1".

PLUMBING For Use With: California Title 24 Table 120.3-A															
	Insulation Thickness per Pipe Size														
Piping System	< 1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Domestic Hot Water & Circulating - Potable and Non-Potable - over 140°F	A 1-1/2"		E 1-1/2" *	A 1-1/2"		E 1-1/2" *	A 2"		E 2" *	A 2"		E 2" *	A 2"		E 2" *
Domestic Tempered Water & Circulating - Potable and Non-Potable (60°F-104°F)	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Domestic Cold Water - Potable and Non-Potable	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage HORIZONTAL (include drain bodies and piping within the building, except underground)	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage VERTICAL (include drain bodies and piping within the building, except underground)	None			None			None			None			None		
Plumbing Vents Within 10' from Roof Penetration	A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"	
Chilled Drinking Water	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Above Grade Drains at Ice Machines (include drain bodies, P-trap, and 10' of downstream drain piping)	A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"	
Underground Domestic Hot Water & Circulating Lines		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"
Insulation Inserts at Hangers	Type C or D or E* - Match Pipe Insulation Thickness														
Medical Air Compressor Intake	A 2"			A 2"			A 2"			A 2"			A 2"		
Medical Vacuum System Exhaust (within 10' of outside wall roof penetration	A 1"			A 1"			A 1"			A 1"			A 1"		
SPARE															
SPARE															
SPARE															
SPARE															

KEY NOTES FOR CONTRACTORS: * Type E not allowed in Return Air Plenum (not 25/50 rated)

+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1".

PLUMBING For Use With: IECC -2012															
	Insulation Thickness per Pipe Size														
Piping System	< 1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *
Domestic Hot Water & Circulating - Potable and Non-Potable - over 140°F	A 1-1/2"		E 1-1/2" *	A 1-1/2"		E 1-1/2" *	A 2"		E 2" *	A 2"		E 2" *	A 2"		E 2" *
Domestic Tempered Water & Circulating - Potable and Non-Potable (60°F-104°F)	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Domestic Cold Water - Potable and Non-Potable	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage HORIZONTAL (include drain bodies and piping within the building, except underground)	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *	A 1"	B 1"	E 3/4" *
Storm Drainage VERTICAL (include drain bodies and piping within the building, except underground)	None			None			None			None			None		
Plumbing Vents Within 10' from Roof Penetration	A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"		A 1/2"	B 1/2"	
Chilled Drinking Water	A 1"	B 1"	E 1" *	A 1"	B 1"	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1" *	A 1-1/2"	B 1-1/2" +	E 1-1/2" *
Cooling Coil Condensate Drains & Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Above Grade Drains at Ice Machines (include drain bodies, P-trap, and 10' of downstream drain piping)	A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"		A 1"	B 1"	
Underground Domestic Hot Water & Circulating Lines		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"		C 1"	E 1"
Insulation Inserts at Hangers	Type C or D or E* - Match Pipe Insulation Thickness														
Medical Air Compressor Intake	A 2"			A 2"			A 2"			A 2"			A 2"		
Medical Vacuum System Exhaust (within 10' of outside wall roof penetration	A 1"			A 1"			A 1"			A 1"			A 1"		
SPARE															
SPARE															
SPARE															
SPARE															

KEY NOTES FOR CONTRACTORS: * Type E not allowed in Return Air Plenum (not 25/50 rated)

+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1".

SECTION 22 10 00
PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Domestic Water Piping System.
D. Compressed Air Piping System (Non-Medical).
E. Vacuum Piping System (Non-Medical).
F. Sanitary Drainage and Vent Piping System.
G. Storm Drainage Piping System.
H. Acid Waste and Vent Piping System.
I. Absorption Field Tile.
J. Footing Tile.
K. Dielectric Connections.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

E. Pipe hangers and supports shall be spaced per 2016 CPC, Table 313.3, as applied to each pipe system listed. Refer to Section 22 05 29 for hanger and support components. Seismic supports shall be submitted as a deferred approval using OPM guidelines. Shop drawings shall be submitted for review to the AHJ: State, local or agency reviewing the project, DSA. Upon approval, these shop drawings shall be included in the record set.

F. Potable water piping and fittings shall comply with California Assembly Bill AB1953 limiting lead content. Also described in 2016 CPC: 604.2 Lead Content.

G. Valves for potable water systems shall comply with California Assembly Bill AB1953 limiting lead content. Also described in 2016 CPC: 604.2 Lead Content.

1.3 REFERENCES

A. ANSI/ASME A112.3.1 – Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.
B. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
C. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
F. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
G. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.

H. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
I. ANSI/ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
J. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
K. ANSI/ASTM B32 - Solder Metal.
L. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
M. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
N. ANSI/AWS D1.1 - Structural Welding Code.
O. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
P. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
Q. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
R. ANSI/AWWA C153 – Compact Ductile Iron Fittings 3” through 48”, for Water and Other Liquids.
S. ASME - Boiler and Pressure Vessel Code.
T. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
U. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
V. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.
W. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
X. ASTM A312 – Standard for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
Y. ASTM A554 – Standard for Welded Stainless Steel Mechanical Tubing.
Z. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
AA. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.
BB. ASTM B88 - Seamless Copper Water Tube.
CC. ASTM B306 - Copper Drainage Tube (DWV).
DD. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
EE. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
FF. ASTM C1540 - Shielded Coupling Joining Hubless Cast Iron Soil Pipe and Fittings.
GG. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
HH. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
II. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
JJ. ASTM D2661 - ABS DWV Pipe & Fittings.
KK. ASTM D2665 - PVC DWV Pipe & Fittings.
LL. ASTM D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
MM. ASTM D3033 - Type PSP (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
NN. ASTM D3034 - Type PSM (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
OO. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
PP. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
QQ. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
RR. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.
SS. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
TT. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
UU. AWS A5.8 - Brazed Filler Metal.

VV. AWWA C651 - Disinfecting Water Mains.
WW. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
XX. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
YY. FM 1680 - Couplings Used in Hubless Cast Iron Systems.
ZZ. NFPA 24 - Private Fire Service Mains and Their Appurtenances.
AAA. NFPA 54 - National Fuel Gas Code.
BBB. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.
CCC. NSF - National Sanitation Foundation
DDD. CCR - California Code of Regulation
EEE. CBC - California Building Code
FFF. CPC - California Plumbing Code

1.4 SUBMITTALS

A. Submit shop drawings per Section 22 05 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE
HOT WATER - POTABLE AND NON-POTABLE
TEMPERED WATER - POTABLE AND NON-POTABLE

A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.

B. Piping - All Sizes:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping - 4” and Under (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

D. Piping - 2” and Under (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical push-to-connect.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61 and stainless steel retention ring.

4. Acceptable Manufacturers: Victaulic PermaLynx.

E. Piping - 2-1/2" through 8” (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88, roll grooved per mechanical coupling manufacturers specifications.

2. Joints: Mechanically coupled grooved type.

3. Mechanical Couplings: Ductile iron, ASTM A-536, (Grade 65-45-12), rigid grooved type, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633

4. Gaskets: Molded pressure responsive design, EPDM Grade E, ASTM D-2000, suitable for domestic water with temperatures ranging from 32°F to 230°F.

5. Fittings: Copper, ASTM B-75 and ANSI B-16.22, Full flow wrought copper, manufactured by mechanical coupling manufacturer

6. Flanges: Grooved end type, Ductile iron, ASTM A-536, (Grade 65-45-12), Flange shall conform to ANSI Class 125 cast iron and Class 150 steel flange bolt hole pattern, coated with non-toxic, no-lead paint, bolts and hex nuts zinc electroplated plated, ASTM B-633.

7. Acceptable Manufacturers: Gruvlok, Victaulic, Grinnell.

F. Piping – 4" and Under (Contractor's Option):

1. Pipe: Schedule 5 Type 304 316 stainless steel, ASTM A312 and ASTM A554 in copper tube size conforming to ASTM B88.

2. Joints: Mechanical press connections.

3. Fittings: Type 304 316 stainless steel, ASTM B88 and ANSI B16.22 with embedded O-ring. NSF-61 stainless steel grip ring for 2 1/2" to 4” diameter sizes.

4. Transitions to other materials: Provide dielectric connection as required in this section. Refer to article “CONNECTIONS BETWEEN DISSIMILAR METALS.”

5. Special Requirements: Mechanical press fitting manufacturer shall provide contractor training prior to installation.

6. Acceptable Manufacturers: Viega ProPress.

G. Piping – 6" and Over (Contractor's Option):

1. Pipe: Standard weight galvanized steel, ASTM A53, grooved ends or threaded and coupled.

2. Joints: Mechanically coupled grooved type or screwed.

3. Mechanical Couplings: Malleable iron, ASTM A97, Grade 32510, grooved type.

4. Fittings: Malleable iron, ASTM A47, Grade 32510, galvanized with grooved ends or 125# steam - 175# CWP, galvanized cast iron, ASTM A126, ANSI B16.4.

5. Flanges: Grooved end, galvanized flanged adapter nipples, Gustin Bacon No. 54, Victaulic No. 54 or 125# steam - 175# CWP, galvanized cast iron, screwed, ASTM A126, Grade B, ANSI B16.1, with galvanized or cadmium plated bolting.

H. Piping - 1-1/2” and Under:

1. Design Pressure/Temperature: 100 psig at 180°F.

2. Tubing: Cross-linked polyethylene (PEX), ASTM F876/F877, NSF Certified.

3. Joints: Bending the tubing greater than eight (8) times the outside diameter shall be permitted. Bends less than eight (8) times the outside diameter shall be barbed insertion fittings provided by the manufacturer.

4. Fittings: Brass or stainless steel with stainless steel or copper crimp ring. Fittings and tubing shall be a system provided by the same manufacturer. Fitting system shall conform to ASTM F1807.

5. Limitations:

   a. Shall only be used for branch runouts to fixtures, above or below grade.

   b. Shall not be used in a return air plenum unless specifically listed to ASTM E84/UL723.

I. Piping - 2" and Under:

1. Design Pressure/Temperature: 100 psig at 180°F, 200 psig at 140°F.

2. Tubing: Virgin rigid chlorinated polyvinyl chloride (CPVC). Copper tube size (CTS) manufactured to standard dimensional ratio (SDR) 11, ASTM D1784: ASTM D2846, NSF Certified.

3. Joints: Solvent cement, ASTM F493

4. Fittings: Same as tubing. Fittings and tubing shall be a system provided by the same manufacturer. Threaded adapters for threaded valves shall be metal threaded adapter with solvent socket.

5. Limitations: Shall not be used in a return air plenum unless specifically listed to ASTM E84/UL723.

6. Special Requirements: Provide expansion loop(s) and/or Schedule 80 expansion joints in the piping system per the manufacturer’s guidelines and as shown on the drawings. Refer to Section 22 05 16 for expansion joint requirements.

J. Piping - 2 1/2" to 8":

1. Design Pressure/Temperature: 100 psig at 180°F for 2-1/2" pipe, 185 psig at 140°F for 3" pipe, 160 psig at 140°F for 4" pipe, 140 psig at 140°F for 6" pipe, and 125 psig at 140°F for 8" pipe.

2. Tubing: Virgin rigid chlorinated polyvinyl chloride (CPVC). Iron Pipe Size (IPS) Schedule 80 with a cell class of 23447-B, ASTM D1784, NSF Certified.

3. Joints: Solvent cement, ASTM F493.

4. Fittings: Same as tubing. Fittings and tubing shall be a system provided by the same manufacturer.

5. Limitations: Shall not be used in a return air plenum unless specifically listed to ASTM E84/UL723.

6. Special Requirements: Provide expansion loop(s) and/or Schedule 80 expansion joints in the piping system per the manufacturer's guidelines and as shown on the drawings. Refer to Section 22 05 16 for expansion joint requirements.

K. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Stockham LD722-B&3-E, Nibco LD2000N Series, Milwaukee CL series, Hammond 5200 series.

3) Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic #608, Nibco GD4765.

3. Ball Valves:

a. BA-1:

1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

a) Provide extended shaft for all valves in insulated piping.

b) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

L. Throttling/Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Globe Valves:

a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.

b. GL-2: 2-1/2" thru 10", 125# steam @ 353ºF, 200# CWP @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.

M. Check Valves:

1. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.

3. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

N. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.

3. ST-7: 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co. #851.

2.2 COLD WATER - POTABLE AND NON-POTABLE (UNDERGROUND)
HOT WATER - POTABLE AND NON-POTABLE (UNDERGROUND)
TEMPERED WATER - POTABLE AND NON-POTABLE (UNDERGROUND)

A. Design Pressure: 150 psi.
Maximum Design Temperature: 200ºF.

B. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32. BCuP silver braze, AWS A5.8.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Piping - 4” and Under (Contractor’s Option):

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

D. Piping - 1-1/2" and Under:

1. Design Pressure/Temperature: 100 psig at 180°F.

2. Tubing: Cross-linked polyethylene (PEX), ASTM F876/F877, NSF Certified.

3. Joints: Bending the tubing greater than eight (8) times the outside diameter shall be permitted. Bends less than eight (8) times the outside diameter shall be barbed insertion fittings provided by the manufacturer.

4. Fittings: Brass or stainless steel with stainless steel or copper crimp ring. Fittings and tubing shall be a system provided by the same manufacturer. Fitting system shall conform to ASTM F1807.

E. Pipe Sleeving - All Sizes:

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe. Provide long/extra-long radius fittings to eliminate pipe kinking.

4. Size: Minimum 6". Refer to drawings for additional sizes.

5. Use: All underground piping to fixtures.

2.3 SERVICE WATER - POTABLE

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150ºF.

B. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

[* * * * * OR * * * * *]

C. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

[* * * * * OR * * * * *]

D. Piping - 2" and Under:

1. Tubing: Type K soft annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

E. Shutoff Valves:

1. Gate Valves:

a. GA-1: 2" and under, 150# steam @ 406ºF, 300# CWP @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, Nibco T-131.

b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi CWP @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, Nibco F-617-0.

c. GA-12: 2-1/2" thru 12", 200# CWP, hub ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-5, Kennedy #56.

d. GA-13: 2" thru 12", 200# CWP, mechanical joint ends, iron body, bronze mounted, double disc, parallel seat, "O" ring stem seals, non-rising stem with mounting flange for indicator post or valve box and 2" square nut, counter-clockwise to open, AWWA. Mueller #A-2380-20, Kennedy #571X.

2. Ball Valves:

a. BA-11: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece “T” style cap and stem. A.Y. McDonald 6100 Series, Mueller 300 Series.

b. BA-12: 2" and under, 300 psig water, standard port, screwed or compression. Bronze body and ball of a copper alloy containing less than 15% zinc, chrome plated, Teflon coated, or stainless steel ball. Teflon or Buna-N seats. One piece "T" style cap and stem. Minneapolis Pattern threaded top. A.Y. McDonald 6100 Series, Mueller 300 Series.

F. Valve Box/Curb Box:

1. VB-1: 2" and under, extension type curb box with arch pattern base and sufficient length to allow top to terminate flush with finished grade. Cast iron lid with integrally cast brass bushing and marked “water” in integrally cast raised letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Mueller H-10000 Series, A.Y. McDonald 5600 Series, Tyler Pipe 6500 Series.

2. VB-2: 2" and under, extension type curb box with Minneapolis pattern base and sufficient length to allow top to terminate flush with finished grade. Cast iron lid with integrally cast brass bushing and marked “water” in integrally cast raised letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Mueller H-10000 Series, A.Y. McDonald 5600 Series.

3. VB-3: 3" through 12", extension type valve box with flat base, 5-1/4" shaft and sufficient length to allow top to terminate flush with finished grade. Cast iron lid marked “water” in integrally cast letters. Furnished with valve operating wrench of sufficient length to extend 3' above finished grade when engaged with valve. Construction of curb box shall meet all local codes and requirements. Tyler Pipe 6855 Series.

2.4 COMBINATION WATER AND FIRE PROTECTION SERVICE
FIRE PROTECTION SERVICE

A. Design Pressure: 200 psi.
Maximum Design Temperature: 150°F.

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

[* * * * * OR * * * * *]

B. Piping:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.

C. PVC Pressure Pipe (Outside Building-Underground):

1. Pipe: PVC pressure pipe, Class 150 Class 200 ANSI/AWWA C900 approved, bell and spigot ends.

2. Joints: Push-On Type, elastomeric ring seal per ASTM F477, bevel spigot ends.

3. Fittings: Cast iron bell and spigot type, 150 psig 200 psig rating, corrosion protective coating outside, cement mortar lined inside, ANSI A21.10 or A21.11.

2.5 COMPRESSED AIR (NON-MEDICAL)

A. Design Pressure: 125 psi.
Maximum Design Temperature: 350ºF

B. Piping - 2" and Under:

1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.

2. Joints: Screwed. (For below ground, all sizes to have welded joints, primed and painted.)

3. Fittings: 150# steam 300# CWP, galvanized malleable iron, banded, ASTM A197, ANSI B16.3.

4. Unions: 250# steam - 500# CWP, galvanized malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight galvanized steel, beveled ends, ASTM A53.

2. Joints: Butt welded and flanged. (All welded joints shall be ground, primed, and painted.)

3. Fittings: Standard weight seamless galvanized steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.

4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5.

D. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Stockham #3951-CS-R-66-LL, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2. Plug Valves:

a. PL-1: 2" and under, 125# steam @ 450ºF, 175# CWP @ 180ºF, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.

b. PL-2: 2-1/2" thru 4", 125# steam @ 450ºF, 175# CWP @ 180ºF, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.

c. PL-3: 6" and larger, 125# steam @ 450ºF, 175# CWP, cast iron body, flanged, resilient faced plug, gear and handwheel operator, full port. Walworth #1700F, DeZurik #118, F-RS24.

E. Throttling Valves:

1. Globe Valves:

a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.

b. GL-2: 2-1/2" thru 10", 125# steam @ 450ºF, 200# CWP @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.

F. Check Valves:

1. CK-5: 2" and under, 250# CWP, screwed, all iron, horizontal swing. Crane #346-1/2.

2. CK-6: 2-1/2" thru 12", 125# steam @ 450ºF, 200# CWP @ 150ºF, flanged, all iron, horizontal swing. Crane #373-1/2, Hammond #IR1126, Stockham #G933, Walworth #8928-1/2F, Milwaukee #F-2971, Watts #F-511-R, Nibco F-918N.

3. CK-20: 2" and larger, 125# CWP, flanged, iron body, cast iron or carbon steel body with stainless steel internals. Hoerbiger Design "CT". NOTE: Use only for compressor discharge.

G. Strainers:

1. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi CWP @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#751, Sarco #CI-125, Watts #77F-D.

2. ST-4: Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 300# CWP @ 150°F. Armstrong #A1SC, Metraflex #SM, Mueller Steam Specialty Co. #11, Sarco #IT.

2.6 COMPRESSED AIR
VACUUM

A. Design Pressure: 125 psi.
Maximum Design Temperature: 250ºF

B. Piping:

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

C. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Stockham #3951-CS-R-66-LL, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2. Plug Valves:

a. PL-13: 2" and under, 175# CWP, 250ºF elastomer, screwed, bronze body, resilient plug facing (RS-55), adjustable memory stop, non-removable lever handle. DeZurik #120-S.

b. PL-15: 2-1/2" thru 8", 150# CWP, 250ºF elastomer, flanged, bronze body, resilient plug facing (RS-55 or RS-56), adjustable memory stop. DeZurik #120-F.

D. Throttling Valves:

1. Globe Valves:

a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413, Watts #B-4010-T, Nibco T-235Y.

2. Plug Valves:

a. PL-13: 2" and under, 175# CWP, 250ºF elastomer, screwed, bronze body, resilient plug facing (RS-55), adjustable memory stop, non-removable lever handle. DeZurik #120-S.

b. PL-15: 2-1/2" thru 8", 150# CWP, 250ºF elastomer, flanged, bronze body, resilient plug facing (RS-55 or RS-56), adjustable memory stop. DeZurik #120-F.

3. Ball Valves:

a. BA-9: 2" and under, 150 psi saturated steam, 600 psi CWP, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-255-FB-P-UL, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

NOTE: Provide solid extended shaft for all valves in insulated piping.

E. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #B-5000, Nibco T-413B.

2. CK-20: 2" and larger, 125# CWP, flanged, iron body, cast iron or carbon steel body with stainless steel internals. Hoerbiger Design "CT". NOTE: Use only for compressor discharge.

F. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.

2. ST-7: 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co. #851.

2.7 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
STORM DRAINAGE (ABOVE GROUND)
CONDENSATE DRAINAGE (ABOVE GROUND)

A. Design Pressure: Gravity
Maximum Design Temperature: 180ºF

B. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

2. Joints: Compression gasket, ASTM C564 or lead and oakum, ASTM B29.

3. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 3011. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

[* * * * * OR * * * * *]

C. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

4. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 3011. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.

5. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

[* * * * * OR * * * * *]

D. Piping - 1-1/4" through 4":

1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.

[* * * * * OR * * * * *]

1. Pipe: Type M hard temper seamless copper drainage tube, ASTM B306.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

[* * * * * OR * * * * *]

E. Piping - 1-1/4” through 16” (Maximum Design Temperature: 140°F):

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe.

4. Limits: Schedule 40 PVC-DWV, or ABS-DWV pipe must not be threaded. Do not use where exposed or in return air plenums.

5. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

[* * * * * OR * * * * *]

F. Piping - 4" and Under:

1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Galvanized cast iron screwed drainage type, ANSI B16.12.

[* * * * * OR * * * * *]

G. Piping - 5" and Over:

1. Pipe: Standard weight galvanized steel, threaded, coupled or beveled as required.

2. Joints: Screwed or butt welded.

3. Fittings:

a. Screwed type - galvanized cast iron drainage type, ANSI B16.12.

b. Butt weld type, standard weight galvanized steel, ASTM A234, Grade WPB, ANSI B16.9, cadmium plated bolting.

4. Other: Grind galvanizing off areas to be welded before welding, perform welding, and then clean surfaces and paint with one coat of rust-inhibiting metal primer and when dry one coat of oil base aluminum enamel.

[* * * * * OR * * * * *]

H. Piping – All Sizes:

1. Pipe: Stainless Steel Type 304, ASME A112.3.1

2. Fittings: Stainless Steel Type 304, ASME A112.3.1, push-on joints.

3. Joints: Push-on joint with integral rubber gaskets suitable for use with acid waste piping.

4. Adapters: Transition from stainless steel pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C564, 300 Series stainless steel shield, clamp and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

I. Vent Flashing: Flash vents with 3# seamless sheet lead of sufficient size to extend 15" into roofing felts for built-up roofs or under shingles for wood sloped roofs.

[* * * * * OR * * * * *]

J. Vent Flashing: Flash vents with premolded EPDM pipe flashing cones for single-ply membrane roofs.

2.8 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
SANITARY VENT (BELOW GROUND - INSIDE BUILDING)
STORM DRAINAGE (BELOW GROUND - INSIDE BUILDING)

A. Design Pressure: Gravity
Maximum Design Temperature: 180ºF

B. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF certified, CISPI trademark.

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Compression gasket, ASTM C564.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

[* * * * * OR * * * * *]

C. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

D. Piping - 1-1/4” through 16” (Maximum Design Temperature: 140°F):

1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.

3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.9 SANITARY DRAINAGE (BELOW GROUND - OUTSIDE OF BUILDING)
STORM DRAINAGE (BELOW GROUND - OUTSIDE OF BUILDING)

A. Design Pressure: Gravity
Maximum Design Temperature: 160ºF

B. Piping - 12" and Over:

1. Pipe and Fittings: Reinforced concrete, Class III, unless noted otherwise on drawings, with tongue and groove ends, ASTM C76.

2. Joints: Flexible, watertight rubber gaskets, ASTM C443.

3. Option: As an option, the same pipe, fittings and joints specified for 10" and under may be used for sizes 12" and over.

C. Piping – 12” through 18”:

1. Pipe and Fittings: Reinforced concrete, Class III, unless noted otherwise on drawings, with bell and spigot ends, ASTM C76.

2. Joints: Flexible, watertight rubber gaskets, ASTM C443.

D. Piping 21” and Over:

1. Pipe and Fittings: Reinforced concrete, Class III, unless noted otherwise on drawings, with tongue and groove ends, ASTM C76.

2. Joints: Flexible, watertight rubber gaskets, ASTM C443 or Mastic with geotextile wrap.

[* * * * * OR * * * * *]

E. Piping - All Sizes:

1. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight hub and spigot cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Compression gasket, ASTM C564.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

[* * * * * OR * * * * *]

F. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

[* * * * * OR * * * * *]

G. Piping 4” and Larger:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class. Cement mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, long radius, push-on joints.

3. Joints: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

H. Piping - All Sizes (Maximum Design Temperature: 140°F):

1. Pipe and Fittings: PVC pipe, Schedule 40 and SDR 26 or less with bell and spigot ends, ASTM D1785 or ASTM D3034. Cellular core piping is not acceptable.

2. Joints: Elastomeric gaskets, ASTM F477.

3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

2.10 GREASE SANITARY DRAINAGE (BELOW GROUND)
GREASE SANITARY DRAINAGE (ABOVE GROUND)
GREASE SANITARY VENT (BELOW GROUND)
GREASE SANITARY VENT (ABOVE GROUND)

A. Design Pressure: Gravity.

1. Design Temperature: 200°F Minimum.

B. Piping – 2” through 8”:

1. Pipe: Stainless Steel Type 316L, ASME A112.3.1

2. Fittings: Stainless Steel Type 316L, ASME A112.3.1, push-on joints.

3. Joints: Push-on joint with integral rubber gaskets suitable for use with greasy waste typical for kitchen grease sanitary applications.

4. Adapters: Transition from stainless steel pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C564, 300 Series stainless steel shield, clamp and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

5. Acceptable Manufacturers: Blucher, Watts, Josam, or approved equivalent.

[* * * * * OR * * * * *]

C. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, epoxy paint corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

3. Restraints: Install pipe and fittings per the Cast Iron Soil Pipe Institute's Designation 3011. Restrain pipe and fittings using an engineered and tested product manufactured for restraining no-hub cast iron soil pipe. Install per manufacturer's recommendations.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

5. Acceptable Manufacturers: New Age Casting or approved equivalent.

2.11 SANITARY - PUMPED (BELOW GROUND - OUTSIDE OF BUILDING)
STORM - PUMPED (BELOW GROUND - OUTSIDE OF BUILDING)

A. Piping - All Sizes:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, long radius, push-on joints.

3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.

[* * * * * OR * * * * *]

B. Piping - All Sizes:

1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.

2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar line per ANSI/AWWA C104/A21.4, long radius, mechanical joints.

3. Joint: Mechanical joint with glands and gaskets and steel bolts, ANSI/AWWA C111/A21.11.

2.12 SANITARY - PUMPED (BELOW GROUND - INSIDE BUILDING)
STORM - PUMPED (BELOW GROUND – INSIDE BUILDING)

A. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Long Radius Style, Wrought copper solder joint, ANSI B16.22.

B. Piping - 4" and Under (Contractor's Option):

1. Tubing: Type K hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Long Radius Style, Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

2.13 SANITARY – PUMPED (ABOVE GROUND)
STORM - PUMPED (ABOVE GROUND)

A. Piping - All Sizes:

1. Tubing: Type K annealed copper tube, ASTM B88.

2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

3. Fittings: Long Radius Style, Wrought copper solder joint, ANSI B16.22.

B. Piping - 4” and Under (Contractor’s Option):

1. Tubing: Type K hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Long Radius Style, Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valves, Mueller Streamline PRS.

C. Piping - 4" and Under:

1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Galvanized cast iron screwed drainage type, ANSI B16.12, long radius.

D. Piping - 5" and Over:

1. Pipe: Standard weight galvanized steel.

2. Joints: Butt welded.

3. Fittings: Butt weld type, standard weight galvanized steel, ASTM A234, Grade WPB, ANSI B16.9, long radius, cadmium plated bolting.

4. Special Requirements: Grind galvanizing off areas to be welded before welding, perform welding and then clean surfaces and paint with one coat of rust-inhibiting metal primer and when dry one coat of oil base aluminum enamel.

E. Shutoff Valves:

1. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze or brass body, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi CWP ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

3) Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic #608, Nibco GD4765.

3. Gate Valves:

a. GA-7: 2-1/2" thru 12", 200# CWP @ 150ºF, flanged, iron body, bronze trim, OS&Y. Crane #475-1/2, Hammond #IR1146, Stockham #G624, Walworth #8727F, Milwaukee #F2891, Nibco F-617-0.

F. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #B-5000, Nibco T-413-Y.

2. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG-970 BUNA, NIBCO W-920-W, Crane.

2.14 ACID WASTE AND VENT

A. Design Pressure - Gravity

B. Piping - All Sizes:

1. Pipe: Fire retardant polypropylene Schedule 40 drainage pipe.

2. Joints:

a. Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

b. Above Floor Only: Mechanical joint with gasket, stainless steel outer sleeve and corrosion resistant nuts and bolts or threaded fittings with gasket and compression nuts.

3. Fittings: Fire retardant polypropylene DWV pattern with socket ends for electrically fused joints.

4. Limitations: For use in non-return air plenums.

[* * * * * OR * * * * *]

C. Piping – All Sizes:

1. Pipe and Fittings: Polyvinylidene fluoride (PVDF) Schedule 40 drainage pipe, ASTM E-84, UL 723.

2. Joints:

a. Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

b. Above Floor Only: Mechanical joint with gasket, stainless steel outer sleeve and corrosion resistant nuts and bolts or threaded fittings with gasket and compression nuts.

3. Fittings: Polyvinylidene fluoride (PVDF) DWV pattern with socket ends for electrically fused joints.

4. Limitations: For use in return air plenums.

D. Piping - All Sizes:

1. Pipe and Fittings: Chlorinated polyvinyl chloride (CPVC) Schedule 40 drainage pipe, ASTM F1412, NSF Listed.

2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer, ASTM F493.

3. Fittings: Chlorinated polyvinyl chloride (CPVC) DWV pattern with socket ends for Schedule 40 pipe.

4. Limitations: CPVC shall not be used in a return air plenum unless it is specifically listed to ASTM E84 and/or UL723. CAN ULC S102.2 listing is not acceptable.

2.15 ACID WASTE AND VENT (ABOVE AND BELOW GROUND - INSIDE BUILDING)

A. Design Pressure/Temperature: 45 psig 90 psig 150 psig at 68°F

B. Piping - Sizes (4” to 48” for 45 psig 2” to 32” for 90 psig 3/8” to 18” for 150 psig).

1. Pipe and Fittings: Polypropylene SDR 11 (150 psig) SDR 17.6 (90 psig) SDR 32.5 (45 psig), ASTM D4101

2. Joints:

a. Pipe and pressure fittings 1/2” through 4” shall be socket fusion type.

b. Pipe, drainage pattern fittings, and pressure fittings 2” and larger shall be butt fusion welded per ASTM D2657.

3. Limitations: Not for use in return air plenums.

4. Manufacturer: Simtech or approved equal.

2.16 ACID WASTE AND VENT (ABOVE AND BELOW GROUND - INSIDE BUILDING)

A. Design Pressure/Temperature - 150 psig 232 psig at 73°F

B. Piping - Sizes (2-1/2” to 12” for 150 psi 3/8” to 4” for 232 psig):

1. Pipe and Fittings: Polyvinylidene fluoride (PVDF) SDR 7.4 (232 psig) SDR 11 (150 psig), ASTM D3222.

2. Joints:

a. Pipe and pressure fittings 3/8” through 1-1/2” shall be socket fusion type.

b. Pipe, drainage pattern fittings, and pressure fittings 2” and larger shall be butt fusion welded per ASTM D2657-87.

3. Limitations: Not for use in return air plenums.

4. Manufacturer: Simtech or approved equal.

C. Piping - 1-1/2" through 6":

1. Pipe and Fittings: Transparent, tempered borosilicated glass with beaded ends. ASTM C1053-90. Underground piping shall be covered with polystyrene and limited to five-foot lengths.

2. Joints: Mechanical sleeve type single bolt preassembled compression coupling with Teflon seal ring, synthetic rubber compression ring and all stainless steel bolted clamping collar.

3. Other:

a. Fabricate and install piping in this category, including connections to other pipe materials, per manufacturer's published installation instructions.

b. Tighten each coupling bolt with a torque wrench and retightened within 24 hours.

c. A representative of the manufacturer of the pipe and fittings shall inspect and approve the installation before the piping is covered or enclosed.

D. Acid Vent Flashing: Flash penetrating roofs with 3# seamless lead sheet sufficient size to extend a minimum of 15" into roofing felts for built-up roofs or under shingles for wood sloped roofs.

[* * * * * OR * * * * *]

E. Acid Vent Flashing: Flash with premolded EPDM pipe flashing cones for single-ply membrane roofs.

2.17 ACID WASTE AND VENT (BELOW GROUND - INSIDE/OUTSIDE BUILDING)

A. Design Pressure - Gravity

B. Piping - All Sizes

1. Pipe: Non-fire retardant polypropylene Schedule 40 drainage pipe.

2. Joints: Join pipe and fittings with electrically fused joints. Make fittings between dissimilar materials with adapters furnished by the polypropylene pipe manufacturer.

3. Fittings: Non-fire retardant polypropylene DWV pattern with socket ends for electrically fused joints.

2.18 ABSORPTION FIELD TILE

2.19 CONDENSATE DRAINAGE

A. Design Pressure: Gravity

B. Piping:

1. Pipe: Schedule 40 rigid, unplasticized polyvinyl chloride PVC-DWV, or ABS- DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.

2. Joints: Solvent-weld socket type with solvent as recommended by pipe manufacturer.

3. Fittings: Unplasticized polyvinyl chloride PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket type ends for Schedule 40 pipe.

4. Limitations:

a. Schedule 40 PVC-DWV, or ABS-DWV pipe must not be threaded.

b. Do not use in return air plenums.

c. Not for condensate greater than 140°F.

5. Application: Use PVC or ABS only where allowed by local jurisdiction. Comply with any special requirements or limitations.

C. Piping - All Sizes:

1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.

[* * * * * OR * * * * *]

2. Pipe: Type M hard temper seamless copper drainage tube, ASTM B306.

3. Joints: Solder with 100% lead-free solder and flux, ASTM B32.

4. Fittings: Cast brass solder joint drainage type, ANSI B16.23 or wrought copper solder joint drainage type, ANSI B16.29.

D. Piping - 1-1/2" through 15":

1. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888, NSF certified, CISPI trademark.

[* * * * * OR * * * * *]

2. Pipe and Fittings: Standard weight no-hub cast iron soil pipe, corrosion protective coating inside and outside, CISPI 301 or ASTM A888.

3. Joints: Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with at least four screw type clamps, FM 1680 or ASTM C1540.

4. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.

2.20 FOOTING TILE

A. Schedule 40 Perforated PVC Footing Tile - ASTM D1785/76 or DWV Perforated Footing Tile - ASTM D2665/76.

B. Geotextile Fabric: As recommended by the manufacturer for this application. Acceptable Manufacturers: Typar, Cerex, Big 'O'.

[* * * * * OR * * * * *]

C. Corrugated Polyethylene Footing Tile - ASTM F405.

D. Geotextile Fabric: As recommended by the manufacturer for this application. Acceptable Manufacturers: Typar, Cerex, Big 'O'.

2.21 LOCK OUT TRIM

A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120°F, in compressed air piping, and as indicated on the drawings.

2.22 VALVE OPERATORS

A. Provide handwheels for gate valves and gear operators for butterfly valves.

2.23 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

2.24 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron and steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 647, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install all products per manufacturer’s recommendations.

B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

C. Remove scale and dirt, on inside and outside, before assembly.

D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

E. Connect to equipment with flanges or unions.

F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.

G. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 TESTING PIPING

A. Sanitary Drainage:
Sanitary Vent:
Storm Drainage:
Acid Waste:
Acid Vent:

1. Test all piping with water to prove tight.

2. Test piping before insulation is applied.

3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.

4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.

5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.

6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.

7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.

8. Test piping per CPC requirements

B. Hot Water - Potable and Non-Potable:
Cold Water - Potable and Non-Potable:
Tempered Water - Potable and Non-Potable:
Service Water:

1. Test pipes underground or in chases and walls before piping is concealed.

2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.

3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen. Exception: Inert gas test shall not be used to test plastic piping.

4. Hold test pressure for at least 2 hours.

5. Test to be witnessed by the Architect/Engineer’s representative, if requested by the Architect/Engineer.

C. Fire Service:

1. Hydrostatically test the entire system for two hours at 200 psig. Maximum leakage shall be:

   a. Interior Piping: 0 quarts per hour.

   b. Underground Piping: 2 quarts per 100 joints per hour.

D. Vacuum Piping:

1. Testing pipes in chases, walls, or above non-accessible ceilings before piping is concealed.

2. Test with 100 psig compressed air or nitrogen.

3. During the test, strike all soldered joints sharply with a rubber or rawhide mallet to cause failure of any weak joints. After striking, soap test each joint.

4. Repair and retest all leaking joints.

5. After all joints pass the soap test, the system must maintain test pressure for 24 hours. If system fails the 24-hour, retest ALL joints by resoaping and repair all faulty joints. Repeat this procedure until the test pressure can be maintained for 24 hours.

6. After passing the above test, operate the vacuum pump. With all vacuum valves closed, the pump and piping system shall be able to maintain a vacuum of 25" Hg for at least one hour.

7. All materials, labor and equipment for testing shall be provided by the installing Contractor.

8. Tests to be witnessed by the Architect/Engineer’s representative, if requested by the Architect/Engineer.

9. After testing, seal the complete system against entry of foreign material until it is turned over to the Owner.

E. All Other Piping:

1. Test piping at 150% of normal operating pressure.

2. Piping shall hold this pressure for one hour with no drop in pressure.

3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.

4. Drain and clean all piping after testing is complete.

5. Test compressed air piping per ASME 31.9 requirements.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.

3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative regarding specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.

B. Air Blow:

1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.

2. Air blow applies to the following systems:

a. Acetylene
b. Carbon Dioxide
c. Nitrogen (use oil free air or nitrogen gas)
d. Argon (use oil free air or nitrogen gas)
e. Instrument Air (use oil free air or nitrogen gas)
f. Distilled Water (use maximum of 50 psig pressure)
g. Chemical Feed
h. Air Compressor Intakes
i. Sulfuric Acid (use oil free air or nitrogen gas)

C. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.

2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.

3. If necessary, remove valves to clean out all foreign material.

D. Fire Service:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:

a. 390 gpm for 4" pipes.
b. 880 gpm for 6" pipes.
c. 1560 gpm for 8" pipes.
d. 2440 gpm for 10" pipes.
e. 3500 gpm for 12" pipes.

3.4 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.

2. Route piping in orderly manner and maintain gradient. Install to conserve building space.

3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.

5. Slope water piping and arrange to drain at low points.

6. Install bell and spigot piping with bells upstream.

7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8” high lettering saying “Non-Potable Water Not for Human Consumption.” Sign shall have black lettering on a yellow background.

10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):

1. All piping in MRI rooms shall be non-ferrous regardless of materials described on Part 2.

D. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

2. Provide clearance for installation of insulation and access to valves and fittings.

3. Provide access doors for concealed valves and fittings.

4. Install valve stems upright or horizontal, not inverted.

5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.

6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

E. Underground Piping:

1. Install buried water piping outside the building with at least 5 feet of cover.Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements

2. Install buried borosilicate glass pipe with the protective polystyrene covering intact. Lay the pipe on bedding and backfill per manufacturer instructions.

3. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24.

4. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.

5. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.

6. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy Kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.

   a. Acceptable Manufacturers: Pipe Line Service Co., Franklin Park, Illinois, Lithcote Corp., Melrose Park, Illinois

7. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.

   a. Acceptable Manufacturer: Republic Steel Corp. "X-Tru-Coat"

8. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.

9. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.

10. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.

11. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

F. Sanitary and Storm Piping:

1. Install all sanitary piping inside the building with a slope of at least the following:

Pipe Size	Minimum Slope
3" and under	- 0.25" per foot
4" and over	- 0.125" per foot

2. All sanitary systems transporting grease laden waste shall be sloped a minimum of 0.25” per foot regardless of size.

3. Install all storm piping inside the building with a slope of at least 0.125" per foot unless noted otherwise.

4. Install horizontal offset at all connections to roof drains to allow for pipe expansion.

5. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 3 feet per second.

6. All sanitary and storm piping shall have at least _____ 42"of cover when leaving the building.

7. Starter fittings with internal baffles are not permitted.

G. Siphonic Storm Piping:

1. Siphonic storm drainage is an engineered piping system. All piping components form part of the hydraulic design calculation that has been engineered to create a siphonic action and make the system function. The Contractor must refer to both the layout drawings and design calculation sheets to identify correct configuration, lengths of pipes, locations of bends, wye branches, and reducers. The Architect/Engineer shall be notified of any changes to the original design. The Contractor shall provide certified drawings from manufacturer if not the basis of design.

2. The piping system shall comprise of swept fittings with 1/4 (90°) bend or 1/8 (45°) bends and 1/8 (45°) wye branches. 90° branches (straight or sanitary tees) are not permitted at any time. Where a right-angle branch is required, it shall be made using a 45° wye branch connecting to a 45° bend or a combination wye and 1/8 bend.

3. Cleanout/access points are not permitted.

4. The horizontal pipe shall be installed with top of pipe (crown) level; there shall be no pitch. Any changes in diameter shall be created with the transition slope at the invert. The drawings shall notate the top of pipe level.

5. Reducers (increasers) shall be of the eccentric type and oriented to ensure the crown of the two adjoining diameters remains level and the diameter transitioning sloped pipe is at the invert.

H. Glass Piping:

1. Glass piping through non-fire rated walls and floors with shall be fitted with pipe sleeves a minimum of 2” greater diameter than the pipe OD. Space between pipe and sleeve shall be packed with fiber glass, glass wool and/or a non-hardening approved caulking material.

2. Glass pipe shall not be installed in direct contact with concrete. Fiber glass insulation or other type of padding as approved by the pipe manufacturer shall be used to insulate between the two materials.

3. Protect glass piping from all weld spatter.

3.5 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.

B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.

D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.

E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.

F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.

G. Provide flanges or unions at all final connections to equipment, traps and valves.

H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.

I. Use full and double lengths of pipe wherever possible.

J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.

K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.

L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 22 05 00 for Excavation, Fill, Backfill and Compaction requirements.

M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45º or 90º angle from the horizontal plane for air lines, and from top, bottom or side for liquids.

N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2” limestone.

3.6 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.

B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.

C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.

D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.

F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.

G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.

H. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.

B. Extend the high side of the soil and waste stacks at least 12" above roof.

C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.

[***OR*****]**

D. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.

E. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.

F. In no case shall the vent through the roof be less than 4" in diameter.

G. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

3.8 BRANCH CONNECTIONS

A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.

B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:

1. Domestic water piping above grade.

E. Further limit use of mechanically formed fittings as follows:

1. Must have at least same pressure rating as the main.
2. Main must be type K or L copper tubing.
3. Permanent marking shall indicate insertion depth and orientation.
4. Branch pipe shall conform to the inner curve of the piping main.
5. Main must be 1" or larger.
6. Branch must be 3/4" or larger.

F. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

G. Forged weld-on fittings are limited as follows:

1. Must have at least same pressure rating as the main.
2. Main must be 2-1/2" or larger.
3. Branch line is at least two pipe sizes under main size.

3.9 JOINING OF PIPE

A. Threaded Joints:

1. Threads shall conform to ANSI B2.1 "Pipe Threads".

2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.

3. Protect plated pipe and valve bodies from wrench marks when making up joints.

4. Apply thread lubricant to male threads as follows:

Vents and Roof Conductors:	Red graphite
All Other Services:	Teflon tape

B. Flanged Joints:

1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.

2. Bolting for services up to 500ºF shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".

3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180º apart are torqued in sequence.

4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.

b. Maximum pressure rating of at least 250 psig.

c. Minimum temperature rating: -10°F.

d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Solder Joints:

1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type.

3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470ºF melting point solder. Remove discs and seals during soldering if they are not suitable for 470ºF.

D. Brazed Joints:

1. Make up joints with silver alloy brazing filler metal conforming to ASTM B260 "Brazing Filler Metal" BAg-1 or BAg-2. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply non-corrosive flux of the type recommended by filler alloy manufacturer, evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly using oxygen-acetylene torch with tip size recommended by fitting manufacturer. Wipe and brush joint clean after alloy has set.

2. Remove discs from solder end valves during brazing.

E. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless mandatory local codes take precedence.

2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.

3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.

4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

5. Single-welded butt joints may be employed with or without the use of backing rings in all sizes. Where backing rings are not used on pumped pressurized systems, the root side of the weld shall either be chipped or ground flush with the piping wall. For services such as vents, overflows, and gravity drains, the backing ring may be eliminated, and the root of the weld need not be chipped or ground. Backing rings shall be of the material being welded.

F. Mechanically Coupled Grooved Joints:

1. Mechanical coupling connections shall mechanically engage, lock and seal the grooved pipe ends in a positive couple. Each coupling shall consist of malleable iron housing clamps, steel bolts and nuts, and sealing gasket designed so internal pressure tends to increase the tightness of the seal.

2. Use grooved mechanical couplings and fasteners only in accessible locations.

3. Final tightening of bolts shall be with a torque wrench for equal tension in all bolts.

G. Mechanical Press Connection:

1. Copper press fitting shall be made in accordance with the manufacturer’s installation instructions.

2. Fully insert tubing into the fitting and mark tubing.

3. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.

4. Joint shall be pressed with a tool approved by the manufacturer.

5. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

H. Mechanical Push-To-Connect:

1. Copper push-to-connect fittings shall be made in accordance with the manufacturer's installation instructions.

2. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

I. Mechanical Joints:

1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.

2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.

J. Push-On Joints - Pressure Pipe:

1. Joints shall be single gasket type conforming to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to 5º. Plain spigot ends shall be suitably beveled for easy entry into bell, centering in gasket and compression of gasket.

2. The joint shall be liquid tight under all pressures from vacuum to 350 psig.

3. Furnish sufficient lubricant for a thin coat on each spigot end. Lubricant shall be non-toxic, impart no taste or odor to conveyed liquid, and have no deleterious effect on the rubber gasket. Lubricant shall be of such consistency that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.

K. Compression Gasket Joints - Sanitary Pipe and Storm Pipe:

1. Joint shall be one-piece double seal compression type gasket made specifically for joining cast iron soil pipe. Gasket shall be neoprene, permitting joint to flex as much as 5 degrees without loss of seal. Gasket shall be extra heavy weight class, conforming to ASTM C-564.

L. Lead and Oakum Joints - Sanitary Pipe and Storm Pipe:

1. Pack joint with oakum made of vegetable fiber, cotton, or hemp. Pour joint with molten lead up to top of hub. Ensure leak-free joints by working joint with inside and outside caulking irons.

M. Glass Pipe Sleeve Type Joints:

1. Make up joints using a mechanical sleeve type, single bolt compression coupling with Teflon seal ring, synthetic rubber compression ring and all stainless steel bolted clamping collar.

2. Pipe and fittings shall have factory-made beaded ends. Field bead ends may be made in complete accord with manufacturer's specifications only when absolutely necessary.

3. Tighten coupling bolts only with a torque wrench to manufacturer's recommendations. Retighten bolts with a torque wrench not less than 24 hours after initial tightening.

N. Concrete Pipe Joints:

1. Tongue and Groove Pipe – Mastic with Geotextile Wrap:

   a. Clean tongue and groove before applying mastic.
   b. Apply mastic to the tongue and groove.
   c. Insert tongue into the groove and seat the joint.
   d. After seating, wipe excess mastic from the inside of the pipe.
   e. Apply and secure geotextile wrap around entire diameter of joint.

2. Modified Bell and Spigot or Tongue and Groove Pipe - Flat Gasket:

   a. Gasket and joint shall comply with ASTM C443.

   b. Apply gasket to the pipe spigot/tongue.

   c. Lower pipe into trench.

   d. Lubricate pipe bell/groove and gasket with vegetable oil lubricant.

   e. Check pipe alignment and grade and seat pipe with pry bar or come-along.

O. Solvent Weld Joints (PVC):

1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.

P. Solvent Weld Joints (CPVC):

1. Make joints with a one-step process. Use CPVC cement conforming to ASTM F493. A primer is not required.

2. If a primer is required by the Authority Having Jurisdiction, then a primer conforming to ASTM F656 shall be used.

Q. Fusion Weld:

1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.

2. Make sure proper heating heads are used for male and female situations.

3. Bevel the leading edge of pipe section with a 45° chamfer.

4. Utilize a fusion welding tool recommended and/or provided by the pipe and fitting manufacturer.

5. Not recommended for temperatures below 40°F.

6. Follow the manufacturer's cold weather installation procedures.

7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.

8. Follow all manufacturer’s installation instructions.

R. Electrically Fused Joints (Acid Waste and Acid Vent):

1. Fused joints shall be made in accordance with manufacturer's installation instructions.

2. All installers shall undergo training provided by the manufacturer or manufacturer's representative.

3. Follow the manufacturer's cold weather installation procedures.

S. Mechanical Joint (Acid Waste and Acid Vent):

1. Mechanical joints shall be made in accordance with the manufacturer's installation instructions.

2. For no-hub/plain end assemblies.

3. Above ground installations only.

T. Elastomeric Gaskets (Sanitary and Storm Pipe):

1. Hub and spigot pipe joints with elastomeric gaskets shall be made in accordance with the manufacturer's installation instructions.

U. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):

1. Gasket shall be heavy weight class, conforming to ASTM C564.

2. The gasket shall have an internal center stop.

3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.

4. Sleeve gaskets shall be installed in accordance with the manufacturer’s installation instructions.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfection of the domestic water piping shall be completed within three (3) weeks prior to building occupancy. Contractor is responsible for disinfecting water piping if used by workers during construction; disinfection during construction does not eliminate the requirement for final disinfection prior to occupancy. Flushing of piping shall be completed within two (2) weeks prior to building occupancy.

B. Provide necessary connections at the start of individual sections of mains for adding chlorine.

C. Before starting work, verify system is complete, flushed and clean.

D. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

E. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

F. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.

G. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.

H. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.

I. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.

J. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

K. Disinfection shall comply with CPC - 609.9: Disinfection of Potable Water Systems

3.11 SERVICE CONNECTIONS

A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION

SECTION 22 10 23
NATURAL GAS AND PROPANE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Natural Gas Piping System.
D. Propane Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

D. All work shall be performed in accordance with the CPC.

E. Design hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

1.3 REFERENCES

A. ANSI/AWS D1.1 - Structural Welding Code.
B. ANSI AGA-LC1 - Standards for Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing.
C. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
D. ASME - Boiler and Pressure Vessel Code - Section 9.
E. ASME B1.20.1 - Pipe Threads, General Purpose.
F. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
G. ASME B16.5 - Pipe Flanges and Flanged Fittings.
H. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
I. ASME B16.11 - Forged Steel Fittings, Socket-Welding and Threaded.
J. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
K. ASME B16.39 - Malleable Iron Threaded Pipe Unions.
L. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
M. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
N. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
O. ASTM A105 - Standard Specification for Carbon Steel Forgings for Piping Applications.
P. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.
Q. ASTM A197 - Standard Specification for Cupola Malleable Iron.
R. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
S. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
T. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
U. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

V. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe.
W. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
X. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
Y. NFPA 54 - National Fuel Gas Code.
Z. CPC California Plumbing Code

1.4 SUBMITTALS

A. Submit product data under provisions of Section 22 05 00 23 05 00. Include data on pipe materials, fittings, valves, and accessories.

B. Test Reports: Provide results of piping system pressure test.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 22 05 00 23 05 00 for the required natural gas piping system electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 NATURAL GAS (0 TO 125 PSI)
PROPANE (0 TO 125 PSI)

A. Design Pressure: 125 psi.
Maximum Design Temperature: 350ºF

B. Piping - 2" and Under:

1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.

2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)

3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.

4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.

C. Piping - 2" and Under:

1. Pipe: Standard weight steel, plain end sanded smooth, ASTM A53.

2. Joints: Mechanical press connection.

3. Fittings, Valves and Unions: ASTM A106 Grade A steel with zinc-nickel coating to reduce corrosion, with embedded HNBR sealing element. ANSI LC 4 approved.

4. Acceptable Manufacturers: Conbraco “Apollo” (Powerpress), Viega (Megapress).

D. Piping – 2” and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: UV resistant, electrically conductive polyethylene, color: black, ASTM E84 25-50 flame and smoke.

3. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connections to threaded pipes and components.

4. Striker Plates: Minimum 16 gauge hardened steel, corrosion resistant, primed and zinc coated. Install to protect tubing from penetrations.

5. Limits: 5 psi or less.

6. Acceptable Manufacturers: TracPipe (Counterstrike), Gastite (Flash Shield).

E. Piping – 2” and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: Polyethylene.

3. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connections to threaded pipes and components.

4. Striker Plates: Minimum 16 gauge hardened steel, corrosion resistant, primed and zinc coated. Install to protect tubing from penetrations.

5. Limits: 5 psi or less. For use only at termination to fixed outlets or equipment, maximum length: 48”. Provide malleable iron, flange mounted, straight or 90 fitting at wall termination with maximum 12” length of tubing on inlet of flange.

6. Acceptable Manufacturers: TracPipe, Gastite, Parker (Parflex), Proflex (1 Yellow CSST).

F. Piping – 2” and Under:

1. Pipe: Corrugated stainless steel tubing, ASTM A240 Series 300 stainless steel, ANSI AGA-LC1.

2. Jacket: UV resistant, electrically conductive polyethylene, color: black, ASTM E84 25-50 flame and smoke.

3. Sleeve: Polyethylene, pre-sleeved from factory with field installed vent tees and water/gas tight heat shrink cuffs on each end.

4. Fittings: Brass with mechanical ends to fit tubing. ASME B1.20.1 threaded ends for connection to threaded pipes and components.

5. Limits: 5 psi or less. Below ground – inside building.

6. Manufacturer: TracPipe (PS-II).

G. Piping - 2-1/2" and Over:

1. Pipe: Standard weight steel, beveled ends, ASTM A53.

2. Joints: Butt welded and flanged.

3. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade I, ANSI B16.9.

4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Flange face seal weld (backweld) is required for slip-on flanges.

H. Piping - All Sizes:

1. Pipe: Polyethylene pipe, ASTM D2513, SDR 11.5.

2. Joints: Fusion welded.

3. Fittings: Socket type, ASTM D2683 or ASTM D2513.

4. Limits: Use only below ground outside of buildings.

I. For Underground Gas Piping - Refer to paragraph “Underground Piping Protection."

J. Shutoff Valves/Throttling Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. BA-13: 2” and under, threaded 600 psi CWP; UL listed for 250# LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, bronze body and chrome plated brass ball, Teflon seats and packing. Apollo #80-100, Nibco #T580-70-UL or #T585-70-UL, Watts #B-6000.

3. PL-1: 2" and under, 125# steam @ 450ºF, 175# CWP @ 180ºF, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.

4. PL-2: 2-1/2" thru 4", 125# steam @ 450ºF, 175# CWP @ 180ºF, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.

5. PL-3: 6" and larger, 125# steam @ 450ºF, 175# CWP, cast iron body, flanged, resilient faced plug, gear and handwheel operator, full port. Walworth #1707F, DeZurik #118, F-RS24.

K. Gas Seismic Valves

1. Provide a valve consisting of a swing check valve arrangement with an acceleration-sensitive triggering mechanism. The trip mechanism shall consist of a steel ball resting on a tapered cup-shaped support. The trip mechanism shall be factory set and sealed. A sight glass shall be provided so that the Open or Closed indicator can be seen, and the trip mechanism status of the valve can be easily determined. The valve assembly shall be certified by the California Sate Architect's Office, approved by the local authority, and meet the requirements of ANSI Z21.70 and ASCE 25-97. Refer to schedule for model number.

L. Check Valves:

1. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. CK-1: 2" and under, 125# steam @ 406ºF, 200# CWP @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #B-5000, Nibco Y-413B.

3. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG970 BUNA, NIBCO W-920-W, Crane.

M. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi CWP @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#751, Sarco #CI-125, Watts #77F-D.

3. ST-4: Cast iron body, screwed ends, screwed cover, 250# steam @ 406°F, 300# CWP @ 150°F. Armstrong #A1SC, Metraflex #SM, Mueller Steam Specialty Co. #11, Sarco #IT.

2.2 NATURAL GAS (126 TO 300 PSI)
PROPANE (126 TO 300 PSI)

A. Design Pressure: 300 psi.
Maximum Design Temperature: 400ºF

B. Piping - 2" and Under:

1. Pipe: Extra strong seamless black steel, plain ends, ASTM A53, Grade B.

2. Joints: Socket welded.

3. Fittings: 3,000# CWP forged steel, socket weld, ASTM A105, Grade II, ANSI B16.11.

4. Unions: 3,000# CWP forged steel, socket weld ground joint, ASTM A105, Grade II.

C. Piping - 2-1/2" and Over:

1. Pipe: Extra strong seamless black steel, beveled ends, ASTM A53, Grade B.

2. Joints: Butt welded and flanged.

3. Fittings: Extra strong seamless steel, butt weld type, ASTM A234, Grade WPB, ANSI B16.9.

4. Flanges: 300# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5. Weld neck type shall have bore to match pipe. Flange face seal weld (backweld) is required for slip-on flanges.

D. For Underground Piping - Refer to paragraph "Underground Piping Protection."

E. Shutoff Valves:

1. PL-11: 1-1/4" and under, 720# CWP, screwed, cast steel, lubricated type, UL labeled. Walworth #1760.

2. PL-12: 1-1/2" and over, 720# CWP, 300# flanged, cast steel, lubricated type, UL labeled. Walworth #1760F.

F. Strainers:

1. ST-5: Cast steel body, socket weld ends, screwed cover, 600# steam @ 850°F, 1440# CWP @ 150°F. Armstrong #B1SW, Mueller Steam Specialty Co. #862, Sarco #CT.

2. ST-6: Cast steel body, 300# flanged ends, bolted cover, 300# steam, 720# CWP. Armstrong #B1FL, Mueller Steam Specialty Co. #762, Sarco #1738.

2.3 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
Gases	1/32"	3/64"	1/16"

B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

C. Use iron body strainers in ferrous piping.

2.4 DRAIN VALVES AND BLOWDOWN VALVES

A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4” male hose thread outlet, cap, and retaining chain.

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. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

D. Connect to all equipment with flanges or unions.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

A. Low Pressure - Up to 1 psi:

1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.

B. High Pressure - Above 1 psi:

1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.

C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.

3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

3.4 INSTALLATION

A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.

B. Install piping to conserve building space, and not interfere with other work.

C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

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. Install thrust blocking and restraints on all buried piping at elbows and other changes in pipe direction.

G. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.

H. Provide valve position indicator on all valves 10’-0” or greater above finish floor and not located above ceiling.

I. Provide clearance for access to valves and fittings.

J. Provide access doors where valves are not exposed.

K. Prepare pipe, fittings, supports, and accessories for finish painting.

L. Install valves with stems upright or horizontal, not inverted.

M. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.

N. Provide shutoff valves to isolate part of systems and vertical risers.

O. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

P. Reducers are generally not shown. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

Q. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.

R. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

S. Refer to Section 23 05 00 for Excavation, Fill, Backfill and Compaction requirements.

T. Underground Piping Protection:

1. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy Kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.

    a. Acceptable Manufacturers: Pipe Line Service Co., Franklin Park, Illinois, Lithcote Corp., Melrose Park, Illinois

2. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.

    a. Acceptable Manufacturer: Republic Steel Corp. "X-Tru-Coat"

3. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.

4. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.

5. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.

6. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

U. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

V. Install underground plastic pipe with an electrically continuous corrosion-resistant tracer wire (minimum AWG 14) or tape per section 22 05 53 23 05 53 to facilitate locating. One end of the tracer wire or tape shall be brought aboveground at a building wall or riser.

W. Install corrugated, stainless steel tubing system according to manufacturer’s written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

X. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer’s written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.

Y. Establish minimum separation of one (1) foot from other services’ piping in accordance with CPC code.

3.5 BONDING AND GROUNDING

A. Each above ground portion of a corrugated stainless steel tubing gas piping systems shall be bonded to the electrical service grounding electrode system. The bonding jumper shall connect to a metallic pipe or fitting between the point of delivery and the first downstream corrugated stainless steel tube fitting. The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent. Gas piping systems that contain one or more segments of corrugated stainless steel tubing shall be bonded in accordance with this section.

B. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

C. Gas piping shall not be used as a grounding conductor or electrode.

D. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems.

E. Install aboveground portions of gas piping systems upstream from equipment shutoff valves, electrically continuous and bonded to a grounding electrode, in accordance with California Electrical Code.

F. Conform to California Electrical Code for electrical connections between wiring and electrically operated control devices.

3.6 PIPE ERECTION AND LAYING

A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.

B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.

C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.

D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.

E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **All fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

F. Use full and double lengths of pipe wherever possible.

G. Cut all pipe to exact measurement and install without springing or forcing.

H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

I. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

3.7 DRAINING AND VENTING

A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.

B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.

C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

3.8 BRANCH CONNECTIONS

A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.

B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

C. Use of forged weld-on fittings is also limited as follows:

1. Must have at least same pressure rating as the main.
2. Header or main must be 2-1/2" or over.
3. Branch line is at least two pipe sizes under header or main size.

D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.

E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

3.9 JOINING OF PIPE

A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints:

1. Steel flanges shall be raised face.

2. Bolting for services up to 500ºF shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".

3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:

   a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.

   b. Maximum pressure rating of at least 250 psig.

   c. Minimum temperature rating: -10°F.

   d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.

C. Welded Joints:

1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.

2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.

3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.

4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.

D. Fusion Weld:

1. Make all field cuts of pipe square and true using a pipe cutter designed for plastic pipe.

2. Make sure proper heating heads are used for male and female situations.

3. Bevel the leading edge of pipe section with a 45° chamfer.

4. Utilize a fusion welding tool recommended and/or provided by the pipe and fitting manufacturer.

5. Not recommended for temperatures below 40°F.

6. Follow the manufacturer's cold weather installation procedures.

7. All installers shall undergo training provided by the manufacturer or manufacturer's representative.

8. Follow all manufacturers’ installation instructions.

3.10 PAINTING EXPOSED PIPE

A. Paint all outdoor exposed natural gas propane piping the color selected by Owner or Architect/Engineer.

3.11 SERVICE CONNECTIONS

A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company.

END OF SECTION

SECTION 22 10 30
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Catch Basins and Manholes.
B. Cleanouts.
C. Traps.
D. Trap Seals and Primers.
E. Floor Drains and Sinks
F. Hub Drains and Standpipes
G. Roof Drains.
H. Backflow Preventers.
I. Strainers.
J. Unions.
K. Balancing Valves.
L. Water Hammer Arresters.
M. Dielectric Fittings (Connections Between Dissimilar Metals).
N. Air Vents.
O. Drain Valves.
P. Relief Valves.
Q. Compressed Air Filters.
R. Compressed Air Condensate Traps.

1.2 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

B. Perform work in accordance with State of California Plumbing Codes and municipality of local area standards.

1.3 REFERENCES

A. ANSI A112.21.1 - Floor Drains.
B. ANSI A112.21.2 - Roof Drains.
C. ASSE 1010 - Water Hammer Arresters.
D. ANSI A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.
E. ANSI A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers.
F. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
G. ANSI 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering.
H. ANSI 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering.
I. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 1.
J. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering.
K. ASSE 1047 - Reduced Pressure Detector Assemblies.
L. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

M. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
N. PDI WH-201 - Water Hammer Arresters.

1.4 SUBMITTALS

A. Submit shop drawings under provisions of Section 22 05 00.

B. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CATCH BASINS

A. Furnish and install all catch basins required for proper site drainage.

B. Unless otherwise specified, the inside diameter of the catch basin be at least 18".

C. Construct catch basin of ASTM C478 precast concrete manhole sections. Set all joints in mortar.

D. Set catch basins on 8" thick concrete pads with diameters 18" larger than the manholes. Reinforce with #4s at 12" OC each way, centered in slab. Install concrete pads on 6" minimum compacted sand base extending to excavation limits.

E. Inlet assembly shall be a two-piece heavy duty cast steel or cast iron frame and grate; curb and gutter style with rectangular grate and storm back, capacity 2.5 cu.ft./sec. or standard round frame and grate with capacity 2.0 cu.ft./sec. or manhole frame with grated top, capacity 1.5 cu.ft./sec., as indicated on drawings; grind or machine grate and frame bearing surfaces.

F. Minimum _____ feet cover over outlet and/or minimum 2 feet sump below outlet.

2.2 MANHOLES

A. Furnish and install all manholes required for proper function and maintenance of the sewer system and as required by the codes having jurisdiction.

B. Unless otherwise specified, the inside diameter of the manhole shall be at least 48".

C. Construct manholes of ASTM C-478 precast concrete manhole sections. The top section shall be eccentrically tapered from a minimum of 24" inside diameter at its top to the diameter of the manhole. Set all joints in mortar.

D. Provide ASTM C443 rubber gasket and ASTM C923 resilient pipe connectors.

E. Set manholes on 8" thick concrete pads with diameters 18" larger than the manhole. Reinforce with #4s at 12" OC each way, centered in slab. Install concrete pads on 6" minimum compacted sand base extending to the excavation limits.

F. Access to manhole shall be by an ASTM A48 grey iron manhole frame with solid lid. Set cover at grade. Letter lid "SANITARY" or "STORM" as appropriate.

G. Provide ASTM A48 grey cast iron manhole steps with load and pullout ratings per OSHA standards on 16" centers from top to bottom of the manhole.

H. After installing inlets and outlets, provide hand formed concrete channels between inlet and outlet pipes.

I. Manholes in city property (streets, etc.) must conform to city requirements.

2.3 CLEANOUTS

A. Provide cleanouts as shown and specified on the drawings as well as required by code.

B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.

C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.

D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.4 YARD CLEANOUTS

A. Provide yard cleanouts as shown and specified on the drawings as well as required by code.

B. Cleanout shall be same size as pipe up to 6" and 6" for larger pipes.

2.5 TRAPS

A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:

1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.

2. Insulated at accessible lavatories.

3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.

4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.

B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.

C. Each trap shall be completely filled with water at the end of construction but before building space turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2” minimum layer of mineral oil.

2.6 TRAP SEALS AND PRIMERS

A. Provide trap seals as specified on the drawings.

B. Provide trap primers as shown and specified on the drawings.

2.7 FLOOR DRAINS AND SINKS

A. Floor drains and sinks shall be in the form of a receptor with grate/strainer set flush with the surrounding floor.

B. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.8 HUB DRAINS AND STANDPIPES

A. A hub drain shall be in the form of a hub or pipe without a grate/strainer extending through the floor for receiving indirect waste. A hub drain has a flood level rim above the finished floor.

B. Provide hub drains as shown and specified on the drawings as well as required by code.

2.9 ROOF DRAINS

A. Provide roof drains as shown and specified on the drawings as well as required by code.

2.10 SIPHONIC ROOF DRAINS

A. Provide a complete siphonic rainwater drainage system designed, supplied, installed, and tested in full compliance with ASME A112.6.9. The design of the siphonic system shall be based on full-bore flow conditions.

B. Acceptable Manufacturers: Mifab, Zurn, Jay R Smith.

2.11 BACKFLOW PREVENTERS

A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

2.12 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
air	1/32"	3/64"	1/16"
water	3/64"	1/16"	1/8"
lube, hydraulic, No. 6 fuel and waste oils	3/16"	3/16"	3/16"

B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.13 UNIONS

A. Copper pipe - wrought copper fitting - ground joint.

B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.

C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

2.14 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:

1. Carrying case with handle.

2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.

3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.

4. Coordinate with the Mechanical Contractor if a meter kit is also required in Section 23 21 00. It is not our intent to require two identical kits, rather it will be acceptable to provide only one kit to the owner which can be used with both plumbing and hydronic piping systems.

D. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design “Accusetter”, Preso “B+”, Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold “Quickset”, Gerand “Balvalve Venturi” or Nibco Globe Style balancing valve.

E. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso, Armstrong, Griswold, Gerand, or Nibco balancing valve.

F. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.15 WATER HAMMER ARRESTERS

A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100ºF and 300ºF and maximum 250 psig working pressure.

C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12” long at fixtures and minimum 24” long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

2.16 DIELECTRIC FITTINGS (CONNECTIONS BETWEEN DISSIMILAR METALS)

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron, steel, and stainless steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.17 AIR VENTS

A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.

B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.18 DRAIN VALVES

A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4” male hose thread outlet and cap.

2.19 RELIEF VALVES

A. RV-3: (Compressed Air) Spring loaded disc type, cast iron or steel body, stainless steel disc, side outlet and lifting lever, 250# CWP. Acceptable Manufacturers: Consolidated Div. of Dresser Ind. Series 1900, Kunkle #463, Keckley Type 41.

B. RV-4: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210ºF temperature. Capacities ASME certified and labeled. Acceptable Manufacturers: Cash Series FV, Watts #40, #120, #N240, #340.

2.20 COMPRESSED AIR FILTERS

A. Filters shall have a stainless steel sleeve, micro-glass media with epoxy coating, elastomeric filter to housing seal and sealed end caps.

B. Filters shall be capable of removing the following:

1. All solids 3 microns and larger.
2. Liquids up to 25,000 ppm by weight.
3. 99% of water droplets.
4. 40% of oil aerosols.

C. Provide a differential pressure alarm for each filter. Range shall be adjustable from 10 to 35 psi differential at 100 psig.

D. Acceptable Manufacturer: Hankison.

2.21 COMPRESSED AIR CONDENSATE TRAPS

A. Furnish and install traps of the type and capacity shown on the drawings.

B. Traps shall be mechanically actuated with stainless steel construction, and 10-300 psig working pressure.

C. Acceptable Manufacturer: Hankison Series 505.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Coordinate construction to receive drains at required invert elevations.

B. Install all items per manufacturer's instructions.

C. Water Hammer Arresters and Air Chambers:

1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.

2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.

3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

4. Install air chambers at each fixture not protected by a water hammer arrester.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 100 feet apart in 6” and larger pipes inside the building.

2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.

3. Extend cleanouts to the floor with long sweep elbows.

4. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.

5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

6. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12” above the finished floor.

E. Yard Cleanouts:

1. Install cleanouts on maximum 90 foot centers (including riser) for pipes 8" and smaller.

2. Extend cleanout to grade. Encase cleanout in 5" thick concrete pad extending 6" beyond cleanout, set low enough not to interfere with lawn mowers.

F. Trap Seals and Primers:

1. Install trap guard trap primer on drains not receiving continuous discharge and subject to drying out.

2. Connect trap primer to an active water line 1-1/2” in size or less and which will produce a 3 10 PSI pressure drop upon fixture operation downstream of the trap primer.

G. Floor Drains and Floor Sinks:

1. Drains in upper floors shall have a flashing of EPDM or similar membrane sheet. The sheet shall be at least 36" X 36" square with the drain in the center. Clamp membrane in auxiliary clamping ring of floor drain. Membrane is not required if upper floor construction is single pour, cast-in-place concrete.

2. Use alternate sealing method when installing drains in existing floor slabs.

3. Coordinate sloping requirements with the architectural plans and specifications.

4. Top of floor drain and sinks grate/strainer shall not extend above the finished floor elevation.

5. Top of floor drain and sink grate/strainer shall not extend above the finished floor elevation. Grate/strainer shall be installed flush with surrounding finished floor. Should the Plumbing Contractor believe this presents a conflict with code, the issue should be evaluated before installation of the floor drain or sink begins. Proceeding with installing a floor drain or sink raised above the finished floor without prior approval will result in the Contractor being required to remove the drain or sink in question and reinstall it at the approved elevation.

H. Hub Drains and Standpipes

1. The top of a hub drain/standpipe shall extend above the finished floor elevation. Refer to drawings for dimensions above the finished floor.

2. Access shall be provided to drains and standpipes for rodding.

I. Roof Drains:

1. Roof drains shall have bearing pans.

2. Provide auxiliary support steel under drains as required to prevent movement of the drain.

3. All roof drains shall have underdeck clamps.

4. Drains in built-up roofing systems shall have a 36" x 36", 3 lb density lead sheet flashing.

J. Siphonic Roof Drains:

1. Failure to install pipework exactly as designed and supplied may adversely affect the siphonic action. The installer shall immediately report any issue that may prevent the pipework from being installed exactly as designed.

2. The horizontal pipework shall be installed level without any pitch gradient. This is to ensure speedy priming process that creates the siphonic action.

K. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.

2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.

3. Install unit between 12" and 60" above finish floor.

L. Balancing Valves:

1. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All plumbing fixtures.

1.2 REFERENCES

A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
C. ANSI A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
D. ANSI A112.19.2M - Vitreous China Plumbing Fixtures.
E. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
F. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
G. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
H. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
I. AHRI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.
J. ASSE 1002 - Water Closet Flush Tank Ball Cocks.
K. Americans with Disabilities Act (ADA), Title III.
L. The Energy Policy Act (EPAct) of 2005.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.

B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.

PART 2 - PRODUCTS

2.1 DSA FIXTURE REQUIREMENTS

A. Plumbing fixtures and accessories provided in a toilet room or bathing room are required to comply with CBC Section 11B-213.2 and shall comply with CBC Section 11B-213.3.

B. Effective March 1, 2017, all single-user toilet facilities shall be identified as Gender-Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.2.6.3. No pictogram, text, or braille is required on the symbol. If tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are “ALL-GENDER RESTROOM”, “RESTROOM” or “UNISEX RESTROOM”. DSA BU 17-01.

C. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.

D. Clearance around accessible water closets and in toilet compartments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.4.1.

E. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

F. Fixture controls shall comply with CBC Sections 11B-601.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.9.5 for children's water closets, 11B-605.4 for urinals, 11B-606.4 for lavatories and sinks, 11B-607.5 for bathtubs, 11B-608.5 for showers, and 11B-611.3 for washing machines and clothes dryers.

G. Accessible sinks shall be 6-1/2" deep maximum. Sinks shall be mounted with the front of the higher of the rim and counter surface 34" maximum above the finish floor or ground.

H. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. CBC Section 11B-606.

2.2 MATERIALS

A. Wall Hung Fixture Carriers:

1. Material: All Metal, ASME/ANSI A112.6.1M.

2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.

3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.

B. All fixtures shall be as scheduled on the drawings.

C. All china shall be from the same manufacturer where possible.

D. All lavatory and sink trim shall be from the same manufacturer where possible.

E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.

3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.

4. Install components level and plumb.

5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.

6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.

7. Refer to Plumbing Material List architectural drawings for fixture mounting heights.

8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8” high lettering saying “Non-Potable Water Not for Human Consumption.” Sign shall have black lettering on a yellow background.

B. Wall-Mounted Fixture Requirements:

1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.

C. Floor-Mounted Fixture Requirements:

1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:

1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.

2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.

3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.

4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

E. ADA Accessible Exposed Sink and Lavatory Trim:

1. All exposed sink and lavatory traps, piping and angle stops installed at accessible sink and lavatory locations shall include offset style drain tailpiece, p-trap installed near and parallel with back wall, and insulation kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

3.2 ADJUSTING AND CLEANING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

SECTION 23 05 00
BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. CCR California Code of Regulation
B. CBC California Building Code
C. CFC California Fire Code
D. CEC California Electric Code
E. CMC California Mechanical Code
F. CPC California Plumbing Code
G. California Title 24 - Building Energy Efficiency Standards
H. SCAQMD Southern California Air Quality Management Division

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.

B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.

C. Scope of Work:

1. Heating Work shall include, but is not necessarily limited to:

a. Furnish and install heating hydronic boilers and accessories.

b. Furnish and install steam heating boiler, condensate return equipment, and accessories.

c. Furnish and install steam-to-water heat exchanger with connection to steam system.

d. Furnish and install a complete heating water system including pumps, piping, insulation, air control equipment, terminal heating equipment, and specialties. Make final connections to all coils, including those furnished by others.

e. Furnish and install a complete steam distribution system including piping, insulation, terminal heating equipment, traps, and specialties. Make final connections to all coils, including those furnished by others.

f. Furnish and install a complete reheat water system including pumps, piping, insulation, air control equipment, specialties, and connections to terminal heating coils.

g. Furnish and install gas piping system including all meter requirements.

h. Furnish and install humidifiers, piping, and accessories.

i. Furnish and install chillers and cooling towers.

j. Furnish and install a complete condenser water system including pumps, piping, insulation, and specialties.

k. Furnish and install a complete chilled water system including pumps, piping, insulation, air control equipment, terminal cooling equipment, and specialties. Make final connections to all coils, including those furnished by others.

l. Furnish and install refrigerant piping, accessories, and final charge of refrigerant.

m. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.

n. Furnish and install Modify existing medical gas system including all piping, valves, alarms, and testing. Furnish and install all items on the Medical Gas material list and medical gas equipment Schedules. Refer to Division 22 60 00 for requirements.

o. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

p. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

q. Complete all applicable tests, certifications, forms, and matrices listed in the Illinois Department of Public Health (IDPH) Final Occupancy Checklist Certifications for Request of Inspection.

2. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:

a. Furnish and install built-up air handling units complete with louvers, dampers, filters, coils, fans, motors, housing, and vibration isolation.

b. Furnish and install package indoor air handling units complete with dampers, filters, coils, fans, and motors.

c. Furnish and install package rooftop air handling units complete with curbs.

d. Furnish and install air-cooled condensing units and curbs.

e. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.

f. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.

g. Furnish and install all terminal air boxes and reheat coils.

h. Furnish and install combustion air louver, damper, and ductwork.

i. Furnish and install complete fume hood exhaust systems including fans, ductwork, and fittings.

j. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.

k. Furnish and install mechanical room ventilation systems including louvers, ductwork, insulation, and fans.

l. Furnish and install gas flues, stacks, and breechings.

m. Furnish and install all temperature control systems.

n. Furnish and install all fire dampers.

o. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

p. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

q. Complete all applicable tests, certifications, forms, and matrices listed in the Illinois Department of Public Health (IDPH) Final Occupancy Checklist Certifications for Request of Inspection.

3. Temperature Control Work shall include, but is not necessarily limited to:

a. Furnish and install a complete temperature control system as specified in Section 23 09 00.

b. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.

c. Furnish automatic control valves and dampers for installation by others.

d. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 23 05 50.

e. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.

f. The temperature controls will be provided by the Owner, separate from this work. This Contractor shall install all devices so noted in Section 23 09 00.

4. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:

a. Furnish complete testing, adjusting, and balancing as specified in Section 23 05 93, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.

b. Complete all applicable tests, certifications, forms, and matrices listed in the Illinois Department of Public Health (IDPH) Final Occupancy Checklist Certifications for Request of Inspection.

1.4 OWNER FURNISHED PRODUCTS

A. The Owner will supply the following items for installation and/or connection by This Contractor:

B. The following items shall be relocated, installed and/or connected by This Contractor:

C. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.

D. This Contractor shall make all mechanical system connections shown on the drawings **or** as required for fully functional units.

E. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

B. Schedule overtime for the following work:

C. Itemize all work and list associated hours and pay scale for each item.

1.6 ALTERNATES

1.7 UNIT PRICES

1.8 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

1. "Mechanical Contractors" refers to the following:

a. Heating Contractor.
b. Air Conditioning and Ventilating Contractor.
c. Temperature Control Contractor.
d. Testing, Adjusting, and Balancing Contractor.

2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.

3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.

5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.

   a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements, California Code of Regulation Title 24, Article E725.

5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:

    a. Light fixtures.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical busduct.
    d. Sheet metal.
    e. Electrical cable trays, including access space.
    f. Sprinkler piping and other piping.
    g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:

    a. Boiler Feed Pumps.
    b. Burners.
    c. Chillers.
    d. Computer Room Air Conditioning Units.
    e. Condensate Return Stations.
    f. Condensing Units.
    g. Makeup Air Units.
    h. Electric Humidifiers.
    i. Gas Trains.
    j. Package Air Handling Units.
    k. Packaged Rooftop Units.

2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

4. Temperature Control Contractor's Responsibility:

    a. Wiring of all devices needed to make the Temperature Control System functional.

    b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor Contractor.

    c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor Contractor when so noted on the Electrical Drawings.

3. Provides motor control and temperature control wiring, where so noted on the drawings.

4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.

5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.

6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.9 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

   a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

   a. Scale of drawings:

      1) General plans: 1/4 Inch = 1 '-0" (minimum).

      2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

      3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

      4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

      5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

    c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.10 QUALITY ASSURANCE

A. Contractor’s Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor’s own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor’s risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.

2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Los Angeles Codes, Laws, Ordinances and other regulations having jurisdiction.

2. Conform to all State Codes.

3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.

6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriters' Laboratories, Inc. and approved by FM Global.

E. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.

3. Scaling of the drawings is not sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either on the drawings or in the specifications, it shall be included in this contract.

7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.

8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.

    a. Any item listed as furnished shall also be installed, unless otherwise noted.

    b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor’s use of these documents.

1.11 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	**Submittal Item**
23 05 00	Owner Training Agenda
23 05 03	Fire Seal Systems
23 05 15	Variable Frequency Drives
23 05 29	Hangers and Supports
23 05 48	Vibration Isolation Equipment
23 05 50	Seismic Restraint Systems
23 05 53	HVAC Identification
23 05 93	Testing, Adjusting, and Balancing
23 07 19	HVAC Pipe Insulation

Referenced Specification Section	Submittal Item
23 09 00	Controls
23 21 00	Hydronic Piping Systems and Valves
23 21 23	HVAC Pumps
23 40 00	Filters and Filter Systems
23 52 16	Boilers
23 74 16.13	Packaged Rooftop Air Conditioning Units - Above 25T
23 81 26	Split System Air Conditioning Units
23 81 45	Variable Refrigerant Flow Heat Pumps

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor's name and address
   d. Division of work (e.g., plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors' names and addresses
   e. Supplier and manufacturer's names and addresses
   f. Division of work (e.g., plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor's review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor's review shall include, but not be limited to, verification of the following:

      1) Only approved manufacturers are used.
      2) Addenda items have been incorporated.
      3) Catalog numbers and options match those specified.
      4) Performance data matches that specified.
      5) Electrical characteristics and loads match those specified.
      6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7) Dimensions and service clearances are suitable for the intended location.
      8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

   d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

   e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

   b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor’s responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer’s approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. Submittal file name: 23 XX XX.description.YYYYMMDD
b. Transmittal file name: 23 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. The Contractor shall submit ten (10) paper copies of each shop drawing.

3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.12 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

3. Itemize the cost for each of the following:

a. Overhead and profit.
b. Bonds.
c. Insurance.
d. General Requirements: Itemize all requirements.

4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:

a. Each piece of equipment requiring shop drawings (e.g., each air handling unit, pump, exhaust fan, etc.). Use the equipment nomenclature (AHU-1, P-1, EF-1, etc.) on the Schedule of Values.
b. Each type of small unitary equipment (e.g., FCUs, UHs, CABs, etc.). Multiple units of the same type can be listed together, provided quantities are also listed so unit costs can be determined.
c. Each piping system (chilled water, heating water, steam, condensate, etc.). In addition, for larger projects, break down the material and labor for each piping system based on geography (building, floor, and/or wing).
d. Each duct system (supply, return, relief, outside air, etc.) listed separately for each unit they serve (AHU-1 supply air ductwork, AHU-1 return air ductwork, etc.).
e. Pipe insulation with separate material and labor line items for each piping system listed above.

f. Duct insulation with separate material and labor line items for each duct system listed above.
g. Temperature controls broken down into material and labor for the following:
    1) Engineering
    2) Controllers, devices, sensors, etc.
    3) Control valves
    4) Control dampers
    5) Conduit
    6) Wiring
    7) Programming
    8) Commissioning
h. Site utilities (5’ beyond building)
i. Seismic design
j. Air balancing
k. Water balancing
l. Commissioning
m. Record drawings
n. Punchlist and closeout

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.13 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.14 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:

1. Air Cooled Condensers
2. Base Mounted Pumps
3. Boilers, Burners and Boiler Trim
4. Computer Room Units
5. Condensing Units
6. Cooling Towers
7. Gas Fired Makeup Air Units
8. Fire Seal Systems
9. Fluid Coolers
10. Seismic Restraints and Equipment Bracing
11. Water Chillers

B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.

C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.15 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.16 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.17 WARRANTY

A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.18 INSURANCE

A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.19 CONTINGENCY

A. The Mechanical Contractors shall include in the Base Bid a contingency of one percent (1%) to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.20 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fits in the allocated space.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.

D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.

F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Covering exterior walls, interior partitions and chases.
2. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:

a. Pipe insulation is installed and fully sealed.
b. Pipe and duct wall penetrations are sealed.
c. Pipe identification and valve tags are installed.
d. Main, branch and flexible ducts are installed.
e. Diffusers, registers and grilles are installed and connected to ductwork.
f. Terminal air box reheat coil piping or wiring is complete.
g. Terminal air box control wiring is complete and all control boxes are closed.

2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor is required to review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review.

3. Upon Contractor certification that the project is complete and ready for a final observation, the Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

4. It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer's additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

C. Before final payment is authorized, this Contractor must submit the following:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up or reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representatives.

4. Inspection by State Boiler Inspector.

5. Start-up reports on all equipment requiring a factory installation inspection or start-up.

6. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; receipt by Architect/Engineer required prior to final payment approval.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer’s review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer’s comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. O&M file name: O&M.div23.contractor.YYYYMMDD
b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title “Operation and Maintenance Instructions”, title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, 2 paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.

3. Binder Labels: Label the front and spine of each binder with “Operation and Maintenance Instructions”, title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Refer to Section 23 09 00 for additional requirements for Temperature Control submittals.

5. Copy of final approved test and balance reports.

6. Copies of all factory inspections and/or equipment startup reports.

7. Copies of warranties.

8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

9. Dimensional drawings of equipment.

10. Capacities and utility consumption of equipment.

11. Detailed parts lists with lists of suppliers.

12. Operating procedures for each system.

13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

14. Repair procedures for major components.

15. List of lubricants in all equipment and recommended frequency of lubrication.

16. Instruction books, cards, and manuals furnished with the equipment.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Explanation of all air handling systems.
3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
4. Maintenance of equipment.
5. Smoke control systems.
6. Stairwell pressurization systems.
7. Start-up procedures for all major equipment.
8. Explanation of seasonal system changes.
9. Description of emergency system operation.

E. The Architect/Engineer shall be notified of the time and place instructions will be given to the Owner's representatives so he or his representative can attend if desired.

F. Minimum hours of instruction for each item shall be:

1. Air Handling System(s) - 2 hours.

2. Computer Room System(s) - 2 hours.

G. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two four weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

H. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.

2. If the Contractor does not have staff that can adequately provide the required instructions he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

A. The mechanical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.

C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.

E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.

B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.

C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.

D. Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.

E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.

F. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

A. This Contractor shall paint the following items:

1. All piping in mechanical room
2. Piping exposed in kitchen

B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.

C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor.

D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer his color preference and furnish this color.

F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.

H. Paint all outdoor exposed natural gas propane piping the color selected by Owner or Architect/Engineer.

I. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.

3. Color of paint shall be as follows:

a. All piping in mechanical room:

1) Chilled Water: Blue pipe/black letters
2) Condenser Water: Green pipe/black letters
3) Heating Water: Orange pipe/black letters
4) Natural Gas: Yellow pipe/black letters

b. Piping exposed in kitchen:

1) All Piping: White

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.

C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.

D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner’s designated representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.11 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

a. Minimizing the amount of dust generated.
b. Reducing solvent fumes and VOC emissions.
c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
d. Protect stored on-site and installed absorptive materials from moisture damage.

2. Request that the Owner designate an IAQ representative.

3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.

4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.

5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.

6. Request copies of and follow all of the Owner's IAQ and infection control policies.

7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.

8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.

9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

10. If permanently installed air handlers are used to serve both construction and occupied areas, all return grilles throughout construction areas shall be sealed to prevent air from construction areas being supplied to occupied areas.

11. If permanently installed air handlers are used during construction to serve only construction areas and do not supply air to adjacent occupied areas, MERV 8 filtration media shall be used to protect each return air grille or opening. The intent of this will be to prevent construction dust and debris from entering any return or supply air ductwork in the facility. All filtration media shall be replaced immediately prior to occupancy.

12. Construction areas shall be maintained at a negative pressure at all times during construction. When areas are under construction, HEPA filtered exhaust fan(s) shall be installed in sufficient quantities as required to maintain construction areas at sufficient negative pressure as called for in the Owner's Infection Control Risk Assessment (ICRA). HEPA filtered exhaust fan discharge shall be ducted either outdoors or back into designated hospital areas as called for in the Owner's ICRA.

13. For each area under construction, the Contractor shall install a negative pressure indicator equivalent to Lamiflow Model L-102F as manufactured by Lamiflow Technologies. Contractor shall regularly monitor and record the negative pressure condition of the construction areas as called for in the Owner's ICRA.

3.12 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.

B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.

C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.

D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.

E. The following steps shall be taken during testing, adjusting, and balancing of each air system:

1. All construction activities in all spaces served by the air system shall stop.

2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.

3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.

4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.

F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
4. All pumps and boilers operating and balanced.
5. All temperature control systems operating, programmed and calibrated.
6. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * *

SECTION 23 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials.
B. UL 723 - Surface Burning Characteristics of Building Materials
C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
F. Intertek / Warnock Hersey - Directory of Listed Products
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
I. The Building Officials and Code Administrators National Building Code
J. 1994 1997 Uniform Building Code
K. Wisconsin Administrative Code
L. 2000 2003 2006 2009 2012 2015 International Building Code
M. NFPA 5000 – Building Construction Safety Code
N. CBC California Building Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Section 23 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

    a. Floor penetrations located outside wall cavities.
    b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
    c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
    d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq. ft at both ambient temperature and 400°F for smoke barriers.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

3. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)

7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Dow Corning Corp.
10. Fire Trak Corp.
11. International Protective Coating Corp.

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
   F Rating = Floor/Wall Rating
   T Rating = Floor/Wall Rating
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
   F Rating = Wall Rating
   T Rating = 0
   L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999

Penetrating Item	UL System No.
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Walls) = 0 or Wall Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 23 05 05
HVAC DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanical demolition.
B. Cutting and Patching.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.

B. Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, fixtures, piping, ducts, systems, etc., from the removed area.

C. Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, fixtures, pipes, ducts, systems, etc.

D. Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.

E. Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.

F. This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.

G. Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.2 PREPARATION

A. Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

C. Existing Heating System: Maintain existing system in service until new system is complete and ready for service. Drain system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before partially or completely draining system. Minimize outage duration.

D. Existing Medical Gas System: Maintain existing system in service until new system is complete and ready for service. Modify existing system only to make switchovers and connections. Obtain permission from the Owner at least 48 hours before system modification. Minimize outage duration. Certify system same day as new connections are made.

3.3 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Demolish and extend existing mechanical work under provisions of Division 2 and this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned ducts and piping to source of supply and/or main lines.

D. Remove exposed abandoned pipes and ducts, including abandoned pipes and ducts above accessible ceilings. Cut ducts flush with walls and floors, cap duct that remains, and patch surfaces. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.

E. Disconnect and remove mechanical devices and equipment serving equipment that has been removed.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.

H. Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 6” of the last branch. End caps shall be 3” pressure class and seal class “A”.

I. Extend existing installations using materials and methods compatible with existing installations, or as specified.

J. Properly reclaim and dispose of all refrigerant in demolished equipment and as required for extension of existing equipment.

3.4 CUTTING AND PATCHING

A. This Contractor is responsible for all penetrations of existing construction required to complete the work of this project. Refer to Section 23 05 29 for additional requirements.

B. Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

C. Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.

D. Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.

E. Floor slab is post-tensioned. All penetrations shall be x-rayed prior to cutting and/or drilling to avoid any tension cables or utilities encased in floor construction.

F. Floor slabs may contain conduit systems. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This includes x-ray or similar non-destructive means.

G. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.5 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.

C. MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

3.6 SPECIAL REQUIREMENTS

A. Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.

B. Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Architect/Engineer before proceeding.

END OF SECTION

SECTION 23 05 29
HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hangers, Supports, and Associated Anchors.
B. Equipment Bases and Supports.
C. Sleeves and Seals.
D. Flashing and Sealing of Equipment and Pipe Stacks.
E. Cutting of Openings.
F. Escutcheon Plates and Trim.

1.2 REFERENCES

A. ANSI/ASME B31.1 - Power Piping.
B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
E. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00. Include plastic pipe manufacturers' support spacing requirements.

1.4 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

A. Refer to Section 23 05 50 for additional requirements for seismic restraints.

2.2 HANGER RODS

A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

Column #1: Steel pipe.

Column #2: Copper, plastic and fiberglass reinforced pipe.

B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.

C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

1.

2.3 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).

2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.

a. Insulation Couplings:

1) Insulation Coupling: Molded thermoplastic, -65ºF to 275ºF, sizes up to 4-1/8” OD, and receive insulation thickness up to 1”. Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60°F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

2) Horizontal Strut Mounted Insulated Pipe:

a) Acceptable Manufacturers: Klo-Shure or equal.

3) Vertical:

a) Acceptable Manufacturers: Klo-Shure Titan or equal.

B. Vertical Supports:

1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at fixed takeoff locations.

Acceptable Products:

Cooper/B-Line - Fig B3373 Series
Erico - 510 Series
Nibco/Tolco - Fig. 82

2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over mounts.

   Acceptable Products: Mason RBA, RCA, or BR.

3. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.

4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts

C. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp within their temperature limits of -65°F to +275°F.

3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.

   Acceptable Products:

Anvil -	Fig. 160, 161, 162, 163, 164, 165
Cooper/B-Line -	Fig. 3160, 3161, 3162, 3163, 3164, 3165
Erico -	Model 630, 631, 632, 633, 634, 635
Nibco/Tolco -	Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation insert and shield sections may be used.

   Acceptable Products:

Cooper/B-Line -	Fig. B3380 through B3384
Pipe Shields -	A1000, A2000

6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:
Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

b. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

c. Continuous Channel with Clevis Type:
Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:
Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

d. Adjustable Swivel Ring Type:
Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4” in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer’s installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.

b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

a. Clamp Type:
Service: Bare Metal Pipe
Rigid Plastic Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

1) Clamps in direct contact with copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, Erico Cushion Clamp or Cooper Vibra-Clamp.

2) Pipes subject to expansion and contraction shall have clamps oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

b. Roller Type:
Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

D. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

a. Steel Structure Clamps

1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not permitted for use with bar-joists):

Acceptable Products:	
Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300
Nibco/Tolco	68

2) Scissor Type Beam Clamps (For use with bar-joists and wide flange):

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

b. Concrete

1) Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

2) Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

3) Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

4) Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

c. Steel Structure Welding:

1) Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and protecting walls and ceilings from smoke damage.

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Refer to Section 23 05 50 for additional requirements for concrete bases in seismic applications.

2. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

3. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a “dirt-trap”.

4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6”x6”, W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.

5. Equipment requiring bases is as follows:

    a. Air Compressor
    b. Air Handling Unit
    c. Boiler
    d. Boiler Feed Pump/Tank
    e. Chemical Feed Equipment
    f. Chiller
    g. Expansion Tank
    h. Condensate Return Station
    i. Day Tank
    j. Fans
    k. Furnace
    l. Steam Generator (Humidifier)
    m. Heat Exchanger
    n. Pump
    o. Tank

C. Equipment Roof Support (Curbs and Rails):

1. Rooftop equipment such as packaged air handling units, roof hoods and rooftop exhaust fans shall be provided with curbs by the unit manufacturer.

2. Where not furnished with rooftop equipment, provide prefabricated curbs or rails as follows:

    a. 12" high above the top surface of the roof (not the roof structure).
    b. 14 or 18 gauge galvanized sheet metal, as required for the equipment weight.
    c. Internal reinforcing.
    d. Pressure treated wood nailer.
    e. 18 gauge counter flashing completely covering nailer.
    f. Factory insulated with rigid fiberglass.

3. Match units to the building roof with either a raised cant to match roof insulation (for built-up roofs), or with no cant (for single-ply roofs).

4. Where legs of equipment rest on rails, provide 1/4" bent plates 18” long.

5. Acceptable Manufacturers: Thy, Pate, United, Roof Products Systems or Portals Plus.

6. Equipment requiring curbs or rails is as follows:

a. Condensing Units

D. Roof Pipe Supports:

1. Provide pre-fabricated roof pipe supports for all piping installed on the roof.

2. Support shall guide and align pipe while permitting longitudinal expansion.

3. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.

4. Support shall be UV, corrosion and freeze/thaw resistant.

5. Support shall include orange paint, reflective safety orange accents or similar markings for increased visibility.

6. The strut system shall have galvanized aluminum 302 stainless steel 316 stainless steel PVC coated powder coated zinc trivalent chromium finish.

7. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load), Miro Industries 1.5, 3-R, 4-R or 5-R (to match pipe).

E. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.

2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

F. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.

2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.

3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.

B. Coordinate all openings with other Contractors.

C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.

D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.6 ROOF PENETRATIONS

A. Seal pipes with surface temperature below 150ºF penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.

B. Break insulation only at the clamp for pipes between 60ºF and 150ºF. Seal outdoor insulation edges watertight.

2.7 SLEEVES AND LINTELS

A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.

C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.

E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.

F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.

G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.

H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.

I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

J. Wall Seals ("Link-Seals"):

1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.

2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120ºF, sleeves may be thermoplastic with integral water seal and textured surface.

3. Sleeves shall be at least 2 pipe sizes larger than the pipes.

4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.

5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40ºF to 250ºF
T	High/Low Temperature	Silicone	-67ºF to 400ºF
T	Fire Seals (1 hour)	Silicone	-67ºF to 400ºF
FS	Fire Seals (3 hours)	Silicone	-67ºF to 400ºF
OS	Oil Resistant/Stainless	Nitrile	-40°F to 210°F

6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.8 ESCUTCHEON PLATES AND TRIM

A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.

C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.9 PIPE PENETRATIONS

A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.10 PIPE ANCHORS

A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.11 FINISH

A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.

2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.

3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with sheet metal contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer’s recommendations. Method of securing base to roof shall be compatible with roofing materials.

2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.

3. Set all concrete inserts in place before pouring concrete.

4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.

5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.

6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.

4. Piping shall not introduce strains or distortion to connected equipment.

5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.

6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.

7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.

8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:

1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3’ spacing between loads.

2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:

a. The hanger is attached within 6” from a web/chord joint.

b. Additional L2x2x1/4 web reinforcement is installed per manufacturer’s requirements.

3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.

4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.

E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.

F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2’-0” on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2’-0” spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.

H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	Pipe Material	Maximum Spacing
1.	Steel and Fiberglass (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"

Pipe Material	Maximum Spacing
2" & larger	12'-0"

3. Hard Drawn Copper & Brass (Liquid Service):

3/4" and under	5'-0"
1"	6'-0"
1-1/4"	7'-0"
1-1/2"	8'-0"
2"	8'-0"
2-1/2"	9'-0"
3"	10'-0"
4"	12'-0"
6"	12'-0"

4. Hard Drawn Copper & Brass (Vapor Service):

3/4" & under	7'-0"
1"	8'-0"
1-1/4"	9'-0"
1-1/2"	10'-0"
2"	11'-0"
2-1/2" & larger	12'-0"

5. Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:

   a. Continuous channel with hangers maximum 8’-0” OC.

6. Rigid Plastic Pipe:

   a. Hangers shall be spaced based on the piping system manufacturers’ instructions or, if no system instructions are available, space hangers at 4’-0” maximum centers.

7. Installation of hangers shall conform to MSS SP-58, 69, and 89.

END OF SECTION

SECTION 23 05 48
HVAC VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Bases.
B. Vibration Isolation.
C. Flexible Connectors.

1.2 SUBMITTALS

A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.

B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.

C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.

D. Isolator submittals shall include:

1. Equipment served
2. Type of Isolator
3. Load in Pounds per Isolator
4. Recommended Maximum Load for Isolator
5. Spring Constants of Isolators (for Spring Isolators)
6. Load vs. Deflection Curves (for Neoprene Isolators)
7. Specified Deflection
8. Deflection to Solid (at least 150% of calculated deflection)
9. Loaded (Operating) Deflection
10. Free Height
11. Loaded Height
12. Kx/Ky (horizontal to vertical stiffness ratio – for spring isolators)
13. Materials and Coatings
14. Spring Diameters

E. Make separate calculations for each isolator on equipment where the load is not equally distributed.

F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

G. Submit certification that equipment, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

H. Submit calculations by a licensed Structural Engineer substantiating that equipment mountings and foundations, and their seismic restraints, can meet the required external forces "G" load for all rigidly and resiliently supported equipment without failure and permanent displacement. Submit similar calculations for life safety equipment restraints for "G" loading.

I. Contractor shall provide seismic bracing calculations stamped by a licensed California Structural Engineer for all suspended utilities.

1. Contractor to submit shop drawings showing the following:

a. All seismic bracing locations and type of restraint being used.

b. Maximum seismic loads shall be indicated on the shop drawings for each brace location.

c. Manufacturer’s seismic restraint layout on contractor shop drawings to be stamped by a licensed California Structural Engineer for all suspended utilities.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENT

A. Vibration isolation for this project is subject to seismic restraint requirements of Section 23 05 50.

B. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

C. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection [e.g., 3" for 2" calculated deflection]. The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.

D. The lateral to vertical stiffness ratio (Kx/Ky) of spring isolators shall be between 0.8 and 2.0.

E. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.

F. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.

G. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

H. Provide motor slide rails for belt-driven equipment per Section 23 05 13.

I. All isolators, except M1, shall have provision for leveling.

2.2 MOUNTINGS

A. Type M1:

1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35”.

2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.

3. Acceptable Manufacturers: Mason "Super W", Kinetics "NGS", Amber/Booth “SPNR”, Vibration Eliminator Co. “400N”.

B. Type M2:

1. Double deflection neoprene with minimum static deflection of 0.15" at calculated load and 0.35" at maximum rated load.

2. All metal shall be neoprene covered. Mounting shall have friction pads both top and bottom.

3. All units shall have bolt holes and be bolted down.

4. Use steel rails above the mountings to compensate for the overhang of equipment such as small vent sets and close coupled pumps.

5. Acceptable Manufacturers: Mason Industries "ND" or "DNR", Amber/Booth "RVD", Kinetics "RD", Vibration Mountings and Controls "RD", Vibration Eliminator Co. “T22” or “T44”.

C. Type M3:

1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.

2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.

3. All mountings shall have leveling bolts.

4. Acceptable Manufacturers: Mason "SLFH", Kinetics "FDS", Amber/Booth "SW-3, 4”, 5”or 6", Vibration Eliminator Co. “OST”.

2.3 HANGERS

A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.

2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.

3. Provide hangers with end connections as required for hanging ductwork or piping.

4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration Eliminator Co. “ALH”.

B. Type H2:

1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.

2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the grommet and short circuiting the spring.

4. Provide end connections for hanging ductwork or piping.

5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex “RSH”, Vibration Eliminator Co. “SNC”.

2.4 BASES

A. Type B1:

1. Rectangular structural steel bases.

2. All perimeter members shall be beams or channels with minimum depth of 10% of the longest base dimension or 14" maximum if rigidity is acceptable to the equipment manufacturer.

3. Use height saving brackets, unless noted otherwise.

4. Acceptable Manufacturers: Mason "WF", Kinetics “SBB”, Aeroflex, Vibration Eliminator Co. “AF”.

2.5 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC1:

1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.

2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.

3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.

4. Connectors up to 2" size may have threaded ends.

5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.

6. All connectors shall be rated for a minimum working pressure of 150 psi at 200ºF.

7. Acceptable Manufacturer: Metraflex "Double Cable-Sphere", Minnesota Flex Corp., Mercer “200 Series”, Twin City Hose “MS2”.

2.6 VIBRATION ISOLATION CURBS

A. Spring Isolated Curbs:

1. Provide factory fabricated vibration isolated curb consisting of an upper floating section resting on a rigid rectangular steel tube structure containing adjustable steel vibration isolation springs.

2. Vibration Isolation:

a. Isolators shall consist of free standing, unhoused laterally stable steel springs.

b. Springs shall be zinc electroplated.

c. Springs shall rest on a minimum of 1/4” neoprene pad.

d. Springs shall provide a minimum of 2” deflection calculated based on final assembled loads.

3. Provide continuous wood nailing strip and counter flashing along entire perimeter of the curb.

4. Provide continuous air and water seal, such as an EPDM bellows, around the entire curb.

5. Curb assembly shall withstand 125#/sf lateral wind loading against the supported equipment.

6. The curb shall be designed with lateral restraint to meet seismic requirements specified in Section 23 05 50.

7. Coordinate internal structural cross framing with ductwork and piping routed in the curb.

8. Acceptable Manufacturers: Mason Industries, Inc. – Type RSC; Vibration Elimination Company – BERC; ThyCurb – Vibro Curb II; and Kinetics – SSR.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Install all products per manufacturer’s recommendations.

B. Provide vibration isolation as indicated on the drawings and as described herein.

C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.

D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.

E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.

F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

3.2 PIPE ISOLATION

A. The first three hangers from vibration-isolated equipment shall be type H1.

B. For base mounted pumps without resilient mountings, the first five hangers shall be Type H1.

C. Where piping is floor-supported, use M2 instead of H1 and M3 instead of H2.

D. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.

E. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220ºF, and the fluid handled is compatible with neoprene and EPDM.

F. Use Type FC2 for all other services. FC2 shall be installed parallel with equipment shafts.

G. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.

H. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.

I. Support piping to prevent extension of flexible connectors.

3.3 VIBRATION ISOLATION OF DUCTWORK

A. The first three hangers on all fan systems shall be Type H1 with at least 0.20” minimum static deflection.

3.4 VIBRATION ISOLATION SCHEDULE

EQUIPMENT DESIGNATION	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION	FLEXIBLE CONNECTIONS
Base Mounted Pump(s)	NA	NA	NA	FC-1
Base Mounted Pump(s)	B3	M3	0.75” 1.5”	FC-1
Boilers	NA	NA	NA	FC-1
Packaged HVAC Unit (<10 HP)	NA	M3 or H2 or H3	0.75”	Per Section 23 33 00
Packaged HVAC Unit (>15 HP, <4” static pressure)	NA	M3 or H2 or H3	Refer to ASHRAE Table	Per Section 23 33 00

Note 1: AHU internal fan isolation shall be determined by AHU manufacturer. Isolation selected shall be a minimum of 98% efficient at scheduled CFM and static pressure.

END OF SECTION

SECTION 23 05 50
SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Seismic Requirements.

1.2 QUALITY ASSURANCE

A. General:

1. The contractor shall retain a specialty consultant or equipment manufacturer to develop a seismic restraint and support system and perform seismic calculations in accordance with these specifications, state, and local codes.

2. Items used for seismic restraint of equipment and systems shall be specifically manufactured for seismic restraint.

3. These requirements are beyond those listed in Section 23 05 29 of these specifications. Where a conflict arises between the seismic requirements of this section and any other section, the Architect/Engineer shall be immediately notified for direction to proceed.

B. Manufacturer:

1. System Supports/Restraints: Company specializing in the manufacture of products specified in this Section.

2. Equipment: Each company providing equipment that must meet seismic requirements shall provide certification included in project submittals the equipment supplied for the project meets or exceeds the seismic requirements of the project.

C. Testing Agency: An independent testing agency, acceptable to Authorities Having Jurisdiction, with experience and capability to conduct the testing indicated.

D. Installer: Company specializing in performing the work of this Section.

E. Suppliers: Following is a partial list of manufacturer/supplier contact information for seismic restraints:

1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
2. Unistrut Corporation http://www.unistrut.us/
3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
4. Mason Industries, Inc. www.mason-ind.com.
5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
6. Tolco (909) 737-5599, www.tolco.com
7. ISAT 877.523.6060, www.isatsb.com
8. Vibro-Acoustics (416) 291-7371 , https://virs.vibro-acoustics.com/

1.3 REFERENCES

A. California Building Code (CBC)
B. California Division of State Architect (DSA) Interpretation of Regulations

C. ASHRAE - A Practical Guide to Seismic Restraint.
D. Technical Manual 5-809-10, NAVFAC P-355, Air Force Manual 88-3, Chapter 13.
E. ASCE 7-02, Chapter 9.
F. ASCE 7-05, Chapter 13.
G. ASCE 7-10, Chapter 13.
H. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
I. NFPA 13 - Installation of Sprinkler Systems.
J. NFPA 14 - Standpipe and Hose Systems.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 05 00.

B. Submittal to Code Official

1. Contractor shall submit copies of the seismic shop drawings to the governing code authority for approval.

C. Shop Drawings:

1. Calculations, restraint selections, and installation details shall be designed and sealed by a Professional Structural Engineer licensed in the state where the project is located experienced in seismic restraint design and installation.

2. Coordination Drawings: Plans and sections drawn to scale, coordinating seismic bracing of mechanical components with other systems and equipment in the vicinity, including other seismic restraints.

3. Manufacturer’s Certifications: Professional Structural Engineer licensed in the state where the project is located shall review and approve manufacturer’s certifications of compliance.

4. System Supports/Restraints - Submit for each condition requiring seismic bracing:

a. Calculations for each seismic brace and detail utilized on the project.

b. Plan drawings showing locations and types of seismic braces on contractor fabrication/installation drawings.

c. Cross-reference between details and plan drawings to indicate exactly which brace is being installed at each location. Details provided are to clearly indicate attachments to structure, correctly representing the fastening requirements of bracing.

d. Clear indication of brace design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Equipment - Submit for each piece of equipment supplied:

a. Certification that the equipment supplied for the project meets or exceeds the seismic requirements specified.

b. Specific details of seismic design features of equipment and maximum seismic loads imparted to the structural support.

c. Engineering calculations and details for equipment anchorage and support structure.

D. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

1.5 TESTING AND INSPECTION

A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the California Building Code.

B. The Owner Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.

C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.

D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.7 DESIGN REQUIREMENTS

A. This project is subject to the seismic bracing requirements of the California Building Code 2019 edition.

B. Forces shall be calculated with the above requirements and Equation 16-67, 68, & 69 in section 1621.1.4 of IBC 2000, unless exempted by 1621.1.1 9.6.1.3-1, -2, and -3 of ASCE 7-02, unless exempted by 9.6.1 13.3-1, -2, and -3 of ASCE 7-05, unless exempted by 13.1.413.3-1, -2, and -3 of ASCE 7-10, unless exempted by 13.1.4. Equipment shall meet California Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

C. All seismic anchorage and bracing shall comply with FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.

1.8 COORDINATION

A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.

B. Coordinate concrete bases with building structural system.

1.9 WARRANTY

A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions

1. Stay in Place:

a. All systems and equipment shall be anchored and restrained such that the anchoring system is intended not to fail and equipment and/or system components will not fall.

2. Remain Operational:

a. Requirements for “Stay in Place” listed above shall be met.

b. The following systems and associated equipment are intended not to fail externally or internally and are intended to remain operational.

1) Air Handling
2) Boiler

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; refer to submittal requirements.

2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer’s submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.

3. 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.

4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.

5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.

6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.

D. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.3 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.

B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:

1. Pumps
2. Tanks

2.4 MATERIALS

A. Use the following materials for restraints:

1. Indoor Dry Locations: Steel, zinc plated.
2. Outdoors and Damp Locations: Galvanized steel.
3. Corrosive Locations: Stainless steel.

2.5 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.

B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.

C. Concrete Inserts: Steel-channel type.

D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.

E. Welding Lugs: Comply with MSS SP-69, Type 57.

F. Beam Clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.

G. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.6 SEISMIC BRACING COMPONENTS

A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.

1. Materials for Channel: ASTM A 1011, GR 33.

2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.

3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.

4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.

B. Channel-Type Bracing Assemblies: Slotted steel channel, with adjustable hinged steel brackets and bolts.

C. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.

B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.

C. All seismic restraint systems shall be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.

D. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.

E. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.

F. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.

G. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer’s attention prior to specific equipment selection.

H. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.

I. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or California Code Council approved seismic anchors for installation in concrete.

J. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.

K. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.

L. Do not install cables over sharp corners.

M. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.

N. Provide reinforced clevis bolts when required.

O. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.

P. Post-Installed anchors shall be provided to meet seismic requirements.

Q. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.

R. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.

S. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.

T. Do not brace a system to two different structures such as a wall and a ceiling.

U. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.

V. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.

W. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.

X. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

SECTION 23 05 53
HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Identification of products installed under Division 23.

1.2 REFERENCES

A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
B. ASTM B-1, B-3, and B-8 for copper conductors.
C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 – 2kV Cables.
D. CGA Pamphlet C-9, Standard Color-Marking of Compressed Gas Cylinders for Medical Use.
E. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00. Include list of items identified, wording, letter sizes, and color coding.

B. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or insulation	Marker Length	Size of Letters
Up to and including 1-1/4”	8”	1/2”
1-1/2” to 2”	8”	3/4”
2-1/2” to 6”	12”	1-1/4”
8” to 10”	24”	2-1/2”
Over 10”	32”	3-1/2”

Plastic tags may be used for outside diameters under 3/4".

B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.

C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.

D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.

E. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

I. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The minimum at any point shall not be less than 90% of the specified average thickness in compliance with UL 83.

3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical tests shall be in accordance with UL 1581.

K. Ductwork Markers:

1. Ductwork systems containing hazardous materials shall be provided with minimum 2”x4” ANSI Z535.2 biohazard warning labels with custom labeling describing hazard. Refer to table in Part 3 for system and label description.

2. Vinyl Markers: Colored vinyl with permanent pressure sensitive adhesive backing suitable for indoor and outdoor application.

L. Maintenance Access Doors:

1. Doors and roof hatches used to access equipment serving hazardous ductwork systems shall be provided with a minimum 4”x6" ANSI Z5353.2 biohazard warning label. Label shall read “WARNING – BIOHAZARD. ONLY AUTHORIZED PERSONNEL BEYOND THIS POINT”.

2. Coordinate location of warning label with Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Valves:

1. All valves (except shutoff valves at equipment) shall have numbered tags.

2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.

3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.

5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.

6. Number all tags and show the service of the pipe.

7. Provide one Plexiglas framed valve directory listing all valves, with respective tag numbers, uses and locations. Mount directory in location chosen by the Architect/Engineer.

B. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.

2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

3. Stencil Painted Pipe Markers:

   a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
   b. Apply primer on non-insulated pipes before painting.
   c. Use background and letter colors as scheduled later in this section.

4. Apply markers and arrows in the following locations where clearly visible:

   a. At each valve.
   b. On both sides of walls that pipes penetrate.
   c. At least every 20 feet along all pipes.
   d. On each riser and each leg of each "T" joint.
   e. At least once in every room and each story traversed.

5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

C. Ductwork Markers:

1. Apply ductwork markers on ductwork systems containing hazardous materials in the following locations where clearly visible:

   a. On both sides of walls that ducts penetrate.
   b. At least every 20 feet along all ducts.
   c. On each riser and each leg of each branch connection.
   d. At least once in every room and each story traversed.
   e. At all ductwork access doors.

f. At all fans and equipment serving ductwork system. Markers shall be clearly visible from the normal maintenance access path to the equipment. Coordinate placement location with Owner.

D. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.

2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.

3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method or material is used:

Pipe Service	Lettering Color	Background Color
HEATING WATER SUPPLY	Black	Yellow
HEATING WATER RETURN	Black	Yellow
CONDENSATE DRAIN	Black	Yellow
NATURAL GAS	Black	Yellow
REFRIGERANT LIQUID	Black	Yellow
REFRIGERANT SUCTION	Black	Yellow
REFRIGERANT HOT GAS	Black	Yellow

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjusting, and balancing of air systems.
B. Testing, adjusting, and balancing of boiler systems.
C. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.

B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

A. AABC - National Standards for Total System Balance, 2002.
B. ADC – Test Code for Grilles, Registers, and Diffusers.
C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.
D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.
E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.
G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.
H. TABB – International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

B. Electronic Copies:

1. Submit a certified copy of test reports to the Architect/Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.

3. All text shall be searchable.

4. Bookmarks shall be used. All bookmark titles shall be an active link to the index page and index tabs.

C. Paper Copies:

1. Submit four (4) certified copies of test reports to the Architect/Engineer for approval in soft cover, 3-hole binder manuals, with cover identification. Include index page and indexing tabs.

1.5 REPORT FORMS

A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.

B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

B. Project will be constructed in phases. Provide balancing report after each phase is complete.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.

B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.

C. Recorded data shall represent actual measured or observed conditions.

D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.

G. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.

H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

A. Before beginning work, verify that systems are complete and operable. Ensure the following:

1. General Equipment Requirements:

   a. Equipment is safe to operate and in normal condition.
   b. Equipment with moving parts is properly lubricated.
   c. Temperature control systems are complete and operable.
   d. Proper thermal overload protection is in place for electrical equipment.
   e. Direction of rotation of all fans and pumps is correct.
   f. Access doors are closed and end caps are in place.

2. Duct System Requirements:

   a. All filters are clean and in place. If required, install temporary media.
   b. Duct systems are clean and free of debris.
   c. Fire/smoke and manual volume dampers are in place, functional and open.
   d. Air outlets are installed and connected.
   e. Duct system leakage has been minimized.

3. Pipe System Requirements:

   a. Coil fins have been cleaned and combed.
   b. Hydronic systems have been cleaned, filled, and vented.
   c. Strainer screens are clean and in place.
   d. Shutoff, throttling and balancing valves are open.

B. Report any defects or deficiencies to Architect/Engineer.

C. Promptly report items that are abnormal or prevent proper balancing.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.

B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

A. ± 10% of scheduled values:

1. Adjust air inlets and outlets to ± 10% of scheduled values.

2. Adjust piping systems to ± 10% of design values.

B. ± 5% of scheduled values:

1. Adjust fume exhaust systems to ± 5% of scheduled values.

2. Adjust supply and exhaust air-handling systems for space pressurization to ± 5% of scheduled values, and to provide proper pressurization.

C. + 5% of scheduled values

1. Adjust outdoor air intakes to within + 5% of scheduled values.

2. Adjust exhaust air through energy recovery equipment to within +5% of scheduled values.

D. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

3.5 ADJUSTING

A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.

B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.

D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.

E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SYSTEM PERFORMANCE REPORT

A. After the conclusion of balancing operations, utilize the building DDC system or install portable data loggers to simultaneously record temperatures and humidity during summer and winter conditions for a seven-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5ºF wet bulb temperature of maximum summer design condition and within 10ºF dry bulb temperature of minimum winter design condition.

B. Design Conditions:

1. Summer: 92 ºF DB 76 ºF WB
2. Winter: 38 ºF DB

C. Architect/Engineer will direct all test locations.

D. Report of test results shall include original recording and three reproductions.

3.7 SUBMISSION OF REPORTS

A. Fill in test results on appropriate forms.

B. Complete all applicable tests, certifications, forms, and matrices listed in the Illinois Department of Public Health (IDPH) Final Occupancy Checklist Certifications for Request of Inspection.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 VERIFICATION OF EXISTING SYSTEMS

A. Perform a pre-balance of systems serving the area of construction prior to the start of any other work. Do not make adjustments to the systems. If the systems are not operating at maximum capacity, temporarily drive system to maximum and take readings for the system. Return the system to its original state when measurements are complete.

1. Air Handling Unit

a. General Requirements:
   1) Existing Equipment Tag (if available).
   2) Location.
   3) Manufacturer, model, arrangement, class, discharge.
   4) Fan RPM.
b. Flow Rate:
   1) Supply flow rate (cfm)
   2) Return flow rate (cfm)
   3) Outside flow rate (cfm)
   4) Exhaust flow rate (cfm)
c. Pressure Drop and Pressure:
   1) Filter pressure drop.
   2) Total static pressure. (Indicate if across fan or external to unit).
   3) Inlet pressure.
   4) Discharge pressure.

2. Exhaust Fan

a. Drawing symbol.

b. Location.
c. Manufacturer and model.
d. Flow rate (cfm).
e. Total static pressure. (Indicate measurement locations).
f. Inlet pressure.
g. Discharge pressure.
h. Fan RPM.

3. Air Terminal (Inlet or Outlet):

a. Room number/location.
b. Terminal type and size.
c. Velocity.
d. Flow rate (cfm)
e. Percent of design flow rate.

4. Air Terminal Unit (Terminal Air Box) Data:

a. General Requirements:
1) Drawing symbol.
2) Location.
3) Manufacturer and model.
4) Size.
5) Type: constant, variable, single, dual duct.
b. Flow Rate:
1) Cooling maximum flow rate (cfm).
2) Heating maximum flow rate (cfm).
3) Minimum flow rate (cfm).
4) Water flow rate (gpm).
c. Temperature:
1) Entering air temperature.
2) Leaving air temperature (in heating mode).
3) Entering water temperature.
4) Leaving water temperature.
d. Pressure Drop and Pressure:
1) Inlet static pressure during testing.
2) Coil air pressure drop.
3) Water pressure drop.

B. Report findings to Architect/Engineer on standard forms. Provide four (4) copies of report.

4.2 GENERAL REQUIREMENTS

A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (IMEG Corp.).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.3 AIR SYSTEMS

A. Duct Leakage Test:

1. Air system and fan.
2. Leakage class.
3. Test pressure.
4. Construction pressure.
5. Flow rate (cfm): specified and actual.
6. Leakage (refer to Section 23 31 00 in the specifications): specified and actual.
7. Statement that fire dampers, reheat coils and other accessories were included in the test.
8. Pass or Fail.
9. Test performed by.
10. Test witnessed by.

B. Air Moving Equipment:

1. General Requirements:
   a. Drawing symbol.
   b. Location.
   c. Manufacturer, model, arrangement, class, discharge.
   d. Fan RPM.
   e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
   f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
   a. Supply flow rate (cfm): specified and actual.
   b. Return flow rate (cfm): specified and actual.
   c. Outside flow rate (cfm): specified and actual.
   d. Exhaust flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
   a. Filter pressure drop: specified and actual.
   b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
   c. Inlet pressure.
   d. Discharge pressure.

C. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

D. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

E. Duct Traverse:

1. System zone/branch/location.
2. Duct size.
3. Free area.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Duct static pressure.
7. Air temperature.
8. Air correction factor.

F. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

G. Air Terminal Unit (Terminal Air Box) Data:

1. General Requirements:
    a. Drawing symbol.
    b. Location.
    c. Manufacturer and model.
    d. Size.
    e. Type: constant, variable, single, dual duct.
2. Flow Rate:
    a. Cooling maximum flow rate (cfm): specified and actual.
    b. Heating maximum flow rate (cfm): specified and actual.
    c. Minimum flow rate (cfm): specified and actual.
    d. Water flow rate (gpm): specified and actual.
3. Temperature:
    a. Entering air temperature: specified and actual.
    b. Leaving air temperature (in heating mode): specified and actual.
    c. Entering water temperature: specified and actual.
    d. Leaving water temperature: specified and actual.

4. Pressure Drop and Pressure:
    a. Inlet static pressure during testing (maximum and minimum).
    b. Coil air pressure drop: specified and actual.
    c. Water pressure drop: specified and actual.

H. Air Flow Measuring Station:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Size.
6. Flow rate (cfm): specified and actual.
7. Pressure drop: specified and actual.

4.4 HEATING SYSTEMS

A. Hot Water Boiler:

1. General Requirements:
    a. Drawing symbol.
    b. Service.
    c. Location.
    d. Manufacturer, model, and identification number.
    e. Control setting: specified and actual.
2. Temperature:
    a. Entering water temperature: specified and actual.
    b. Leaving water temperature: specified and actual.
3. Flow Rate:
    a. Flow rate (gpm): specified and actual.
4. Pressure Drop and Pressure:
    a. Pressure Drop: specified and actual.
5. Energy:
    a. Rating (Btuh).
    b. Measured output (Btuh).

END OF SECTION

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation.
B. Insulation Jackets.

1.2 QUALITY ASSURANCE

A. Applicator: Company specializing in piping insulation application with five years minimum experience.

B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).

C. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

2. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.3 REFERENCES

A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
B. ANSI/ASTM C195 - Mineral Fiber Thermal Insulation Cement.
C. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
D. ANSI/ASTM C534 - Elastomeric Foam Insulation.
E. ANSI/ASTM C547 - Mineral Fiber Preformed Pipe Insulation.
F. ANSI/ASTM C552 - Cellular Glass Block and Pipe Thermal Insulation.
G. ASTM C449 - Mineral Fiber Hydraulic-setting Thermal Insulating and Finishing Cement.
H. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
I. ASTM C578 - Preformed Cellular Polystyrene Thermal Insulation.
J. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
K. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
L. ASTM E84 - Surface Burning Characteristics of Building Materials.
M. NFPA 255 - Surface Burning Characteristics of Building Materials.
N. UL 723 - Surface Burning Characteristics of Building Materials.
O. California Title 24 - Building Energy Efficiency Standards

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include product description, list of materials and thickness for each service, and locations.

PART 2 - PRODUCTS

2.1 INSULATION

A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75ºF; non-combustible. All purpose, white Kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

B. Type B: EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1” thick per layer where multiple layers are specified.

C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75ºF; moisture resistant, non-combustible; suitable for -100ºF to +900ºF. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white Kraft jacket for above grade installations.

2.2 JACKET COVERINGS

A. Aluminum Jackets: ASTM C1729; 0.016" thick (thicker where required by ASTM C1729); stucco embossed finish with Z edge seams and aluminum bands for outdoor use. Where colored jacket covers are called for, provide factory-applied hard film acrylic paint in color selected by Architect.

2.3 REMOVABLE INSULATION JACKETS

A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.

B. Inner and outer covering shall be constructed from a minimum 16.5 oz./yd^2 PTFE fiberglass composite and suitable for insulating surface temperatures up to 550ºF.

C. Interstitial insulation blanket shall be minimum 1-1/2” thick and shall consist of either:

1. Silica and glass-fiber insulation felts and blankets – minimum 6 lb./ft^3 density.
2. E-type glass-fiber felts and blankets – minimum 6 lb./ft^3 density.

D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand minimum 550ºF surface temperatures without degradation. The use of hog rings, staples, and wires for closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of preventing the insulation from shifting and shall not be used.

E. No raw cut jacket edges shall be exposed.

F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and minimum 1” slide buckles.

G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro) that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.

H. Acceptable Manufacturers: Firwin Corp, Lewco Specialty Products, ThermaXX Jackets LLC or approved equivalent.

PART 3 - EXECUTION

3.1 PREPARATION

A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

B. Patch and repair torn insulation. Paint to match adjacent insulation surface.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.

2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.

3. On all insulated piping, provide at each support an insulation insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F, with a minimum compressive strength of 50 psi. Polyisocyanurate insulation with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3” and below, minimum 60 psi for pipe sizes 4” and above, and operate below 300°F. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.

4. Neatly finish insulation at supports, protrusions, and interruptions.

5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3”	12" long x 18 gauge
b.	4"	12" long x 16 gauge

7. All piping and insulation that does not meet 25/50 that is in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

2. On piping operating below 60ºF in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.

C. Insulated Piping Operating Between 60°F and 140°F:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.

D. Insulated Piping Operating Above 140°F:

1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves, the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the stem that is above the bonnet and valve operator exposed.

2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate valve bonnets, F&T traps, strainers, line sets, and the like).

E. Refrigerant Piping:

1. On refrigerant piping (25°F and above) and **not** required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360°, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.

F. Exposed Piping:

1. Locate and cover seams in least visible locations.

2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.

2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.

3. Apply insulation with laps on top of pipe.

4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60ºF, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170ºF.

C. Type C Insulation:

1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar manner.

2. Insulate fittings with prefabricated fittings.

3.4 JACKET COVER INSTALLATION

A. Metal Covering:

1. Provide vapor barrier as specified for insulation type. Cover with aluminum stainless steel jacket covering with seams located on the bottom of horizontal piping. Include fittings, joints and valves.

2. Seal all interior and exterior butt joints with metal draw bands and sealant. Seal all exterior joints watertight.

3. Interior joints do not need to be sealed.

4. Use metal covering on the following pipes:

a. All exterior piping.

b. All exposed piping in finished spaces.
c. All exposed piping in areas noted on drawings.
d. All Type E, F, G and H insulation.

5. Use colored aluminum jacket covers on the following pipes:

a. All exterior piping.

3.5 SCHEDULE

Refer to attached insulation schedule.

END OF SECTION

HEATING for Use With: ASHRAE 90.1-2010 | ASHRAE 90.1-2013 | ASHRAE 90.1-2016 | IECC -2018															
	Insulation Thickness per Pipe Size														
Piping System	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Saturated Steam, Condensate Return, and Boiler Feedwater (Up to 29 psig, 250°F)	A 2-1/2"			A 2-1/2"			A 2-1/2"			A 3"			A 3"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (30 to 134 psig, 350°F)	A 4-1/2"			A 5"			A 5"			A 5"			A 5"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (135 to 250 psig, 450°F)	A 4-1/2"			A 5"			A 5"			A 5"			A 5"		
Below Grade, above 10" pipe size			D 4"			D 4"			D 4"			D 5"			D 5"
Chilled Water Supply & Return (40°F-60°F Supply Water Temp)															
located in air conditioned spaces	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)		B 1/2"	J 1/2" *		B 1/2"	J 1/2" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *
located in modular chiller enclosure		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
located inside air handling unit airstream		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
Cooling Coil Condensate Drains below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (105°-140°F Supply Water Temp)	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (141°-200°F Supply Water Temp)	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 2"		J 1" *	A 2"		J 1" *	A 2"		J 1" *
Condenser Water Supply & Return (Indoor)	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *
located in modular chiller enclosure		B 3/4"			B 3/4"			B 3/4"			B 3/4"			B 3/4"	
Condenser Water Supply & Return (Outdoor)	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"
Geothermal/Loop Water Supply & Return (Indoor)															
located in air conditioned spaces	A	B	J	A	B	J	A	B	J	A	B	J	A	B	J

HEATING for Use With: ASHRAE 90.1-2010 | ASHRAE 90.1-2013 | ASHRAE 90.1-2016 | IECC -2018															
	Insulation Thickness per Pipe Size														
Piping System	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
	1/2"	1/2"	1/2" *	1/2"	1/2"	1/2" *	1"	1"	1" *	1"	1"	1" *	1"	1"	1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Heat Recovery Water Supply & Return 105°F ≤ 140°F	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *
Heat Recovery Water Supply & Return 40°F ≤ 60°F	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Glycol Water Supply & Return (<40°F)		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *		B 1-1/2"	J 1" *
Engine Exhaust Piping															
From engine to muffler	E 4"			E 4"			E 4"			E 4"			E 4"		
From muffler to discharge	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"
Drain piping from muffler to floor drain	E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"	
Underground Heating Water Supply & Return (105°-140°F Supply Water Temp)	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Heating Water Supply & Return (141°-200°F Supply Water Temp)	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Chilled Water Supply & Return	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Refrigeration Lines	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
VRF Refrigerant Pipe Insulation	Refer to Section 23 81 45														
Mini-Split System Refrigerant Pipe Insulation	Refer to Section 23 81 26														
Refrig. Hot Gas Lines	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Refrig. Suction Lines (25°F & Above)	B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +		
Refrig. Suction Lines (40°F & Above)	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Low Temp. Refrigeration Suction Lines (25°F to 0°F)	C 1-1/2"		J 1-1/2" *	C 2"		J 2" *	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *
Low Temp. Refrigeration Suction Lines (-1°F to -25°F)	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *	C 3"		J 3" *	C 3"		J 3" *
Low Temp. Refrigeration Suction Lines (-26°F to -75°F)	C 2-1/2"		J 2-1/2" *	C 3-1/2"		J 3-1/2" *	C 3-1/2"		J 3-1/2" *	C 4"		J 4" *	C 4"		J 4" *

HEATING for Use With: ASHRAE 90.1-2010 | ASHRAE 90.1-2013 | ASHRAE 90.1-2016 | IECC -2018					
	Insulation Thickness per Pipe Size				
Piping System	<1"	1” to < 1-1/2"	1-1/2" to < 4"	4” to < 8"	8" <
Low Temp. Refrigeration Suction Lines (-76°F to -125°F)	C 3" J 3” *	C 4" J 4" *	C 4" J 4" *	C 5" J 5" *	C 5" J 5" *
Insulation Inserts at hangers	Type C or E or J* - match pipe insulation thickness				
Medical Air Compressor Intake	A 2"	A 2"	A 2"	A 2"	A 2"
Medical Vacuum System Exhaust (within 10’ of outside wall/roof penetration)	A 1"	A 1"	A 1"	A 1"	A 1"
SPARE					
SPARE					
SPARE					
SPARE					

KEY NOTES FOR CONTRACTORS:

* Type J not allowed in return air plenum (not 25/50 rated)

+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1"

** Two (2) 2" layers with staggered seams

HEATING for Use With: California Title 24 Table 120.3-A															
	Insulation Thickness per Pipe Size														
Piping System	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Saturated Steam, Condensate Return, and Boiler Feedwater (Up to 29 psig, 250°F)	A 2-1/2"			A 2-1/2"			A 2-1/2"			A 3"			A 3"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (30 to 134 psig, 350°F)	A 3"			A 4"			A 4.5"			A 4.5"			A 4.5"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (135 to 250 psig, 450°F)	A 4-1/2"			A 5"			A 5"			A 5"			A 5"		
Below Grade, above 10" pipe size			D 4"			D 4"			D 4"			D 5"			D 5"
Chilled Water Supply & Return (40°F-60°F Supply Water Temp)															
located in air conditioned spaces	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)		B 1/2"	J 1/2" *		B 1/2"	J 1/2" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *
located in modular chiller enclosure		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
located inside air handling unit airstream		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
Cooling Coil Condensate Drains below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (105°-140°F Supply Water Temp)	A 1"	B 1"	J 1" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (141°-200°F Supply Water Temp)	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *	A 2"		J 2" *	A 2"		J 2" *	A 2"		J 2" *
Condenser Water Supply & Return (Indoor)	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *
located in modular chiller enclosure		B 3/4"			B 3/4"			B 3/4"			B 3/4"			B 3/4"	
Condenser Water Supply & Return (Outdoor)	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"
Geothermal/Loop Water Supply & Return (Indoor)															
located in air conditioned spaces	A	B	J	A	B	J	A	B	J	A	B	J	A	B	J

HEATING for Use With: California Title 24 Table 120.3-A															
Piping System	Insulation Thickness per Pipe Size														
	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
	1/2"	1/2"	1/2" *	1/2"	1/2"	1/2" *	1"	1"	1" *	1"	1"	1" *	1"	1"	1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Heat Recovery Water Supply & Return 105°F ≤ 140°F	A 1"	B 1"	J 1" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *	A 1-1/2"		J 1-1/2" *
Heat Recovery Water Supply & Return 40°F ≤ 60°F	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Glycol Water Supply & Return (<40°F)		B 1"	J 1" *		B 1-1/2" +	J 1-1/2" *		B 1-1/2" +	J 1-1/2" *		B 1-1/2" +	J 1-1/2" *		B 1-1/2" +	J 1-1/2" *
Engine Exhaust Piping															
From engine to muffler	E 4"			E 4"			E 4"			E 4"			E 4"		
From muffler to discharge	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"
Drain piping from muffler to floor drain	E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"	
Underground Heating Water Supply & Return (105°-140°F Supply Water Temp)	C 1"		J 1"	C 1-1/2"		J 1-1/2"	C 1-1/2"		J 1-1/2"	C 1-1/2"		J 1-1/2"	C 1-1/2"		J 1-1/2"
Underground Heating Water Supply & Return (141°-200°F Supply Water Temp)	C 1-1/2"		J 1"	C 1-1/2"		J 2"	C 2"		J 2"	C 2"		J 2"	C 2"		J 2"
Underground Chilled Water Supply & Return	C 1/2"		J 1/2"	C 1/2"		J 1/2"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Refrigeration Lines	C 1/2"		J 1/2"	C 1/2"		J 1/2"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
VRF Refrigerant Pipe Insulation	Refer to Section 23 81 45														
Mini-Split System Refrigerant Pipe Insulation	Refer to Section 23 81 26														
Refrig. Hot Gas Lines	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Refrig. Suction Lines (25°F & Above)	B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +		
Refrig. Suction Lines (40°F & Above)	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Low Temp. Refrigeration Suction Lines (25°F to 0°F)	C 1-1/2"		J 1-1/2" *	C 2"		J 2" *	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *
Low Temp. Refrigeration Suction Lines (-1°F to -25°F)	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *	C 3"		J 3" *	C 3"		J 3" *
Low Temp. Refrigeration Suction Lines (-26°F to -75°F)	C 2-1/2"		J 2-1/2" *	C 3-1/2"		J 3-1/2" *	C 3-1/2"		J 3-1/2" *	C 4"		J 4" *	C 4"		J 4" *

HEATING for Use With: California Title 24 Table 120.3-A					
	Insulation Thickness per Pipe Size				
Piping System	<1"	1” to < 1-1/2"	1-1/2" to < 4"	4” to < 8"	8" <
Low Temp. Refrigeration Suction Lines (-76°F to -125°F)	C 3" J 3” *	C 4" J 4" *	C 4" J 4" *	C 5" J 5" *	C 5" J 5" *
Insulation Inserts at hangers	Type C or E or J* - match pipe insulation thickness				
Medical Air Compressor Intake	A 2"	A 2"	A 2"	A 2"	A 2"
Medical Vacuum System Exhaust (within 10’ of outside wall/roof penetration)	A 1"	A 1"	A 1"	A 1"	A 1"
SPARE					
SPARE					
SPARE					
SPARE					

KEY NOTES FOR CONTRACTORS:

* Type J not allowed in return air plenum (not 25/50 rated)

\+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1"

** Two (2) 2" layers with staggered seams

HEATING for Use With: IECC -2012 | IECC -2015															
	Insulation Thickness per Pipe Size														
Piping System	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
Saturated Steam, Condensate Return, and Boiler Feedwater (Up to 29 psig, 250°F)	A 2-1/2"			A 2-1/2"			A 2-1/2"			A 3"			A 3"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (30 to 134 psig, 350°F)	A 3"			A 4"			A 4.5"			A 4.5"			A 4.5"		
Below Grade			D 4"			D 4"			D 4"			D 5"			D 5"
Saturated Steam, Condensate Return (135 to 250 psig, 450°F)	A 4-1/2"			A 5"			A 5"			A 5"			A 5"		
Below Grade, above 10" pipe size			D 4"			D 4"			D 4"			D 5"			D 5"
Chilled Water Supply & Return (40°F-60°F Supply Water Temp)															
located in air conditioned spaces	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)		B 1/2"	J 1/2" *		B 1/2"	J 1/2" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *
located in modular chiller enclosure		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
located inside air handling unit airstream		B 1/2"			B 1/2"			B 1"			B 1"			B 1"	
Cooling Coil Condensate Drains below 55°F		B 1/2"			B 1/2"			B 1/2"			B 1/2"			B 1/2"	
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (105°-140°F Supply Water Temp)	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *
Heating Water Supply & Return; Reheat Water Supply & Return; Heating/Chilled Water Supply and Return (141°-200°F Supply Water Temp)	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 2"		J 1" *	A 2"		J 1" *	A 2"		J 1" *
Condenser Water Supply & Return (Indoor)	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *	A 1"	B 3/4"	J 3/4" *
located in modular chiller enclosure		B 3/4"			B 3/4"			B 3/4"			B 3/4"			B 3/4"	
Condenser Water Supply & Return (Outdoor)	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"	A 1"	B 3/4"	J 1"
Geothermal/Loop Water Supply & Return (Indoor)															
located in air conditioned spaces	A	B	J	A	B	J	A	B	J	A	B	J	A	B	J

HEATING for Use With: IECC -2012 | IECC -2015															
	Insulation Thickness per Pipe Size														
Piping System	<1"			1" to < 1-1/2"			1-1/2" to < 4"			4" to < 8"			8" <		
	1/2"	1/2"	1/2" *	1/2"	1/2"	1/2" *	1"	1"	1" *	1"	1"	1" *	1"	1"	1" *
located in non-air conditioned spaces (mechanical rooms; exterior; attic, etc.)	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Heat Recovery Water Supply & Return 105°F ≤ 140°F	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *	A 1-1/2"		J 1" *
Heat Recovery Water Supply & Return 40°F ≤ 60°F	A 1/2"	B 1/2"	J 1/2" *	A 1/2"	B 1/2"	J 1/2" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *	A 1"	B 1"	J 1" *
Glycol Water Supply & Return (<40°F)		B 1/2"	J 1/2" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *		B 1"	J 1" *
Engine Exhaust Piping															
From engine to muffler	E 4"			E 4"			E 4"			E 4"			E 4"		
From muffler to discharge	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"	E 4"	F 4" **	G/2" & H/2"
Drain piping from muffler to floor drain	E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"		E 3"	F 3"	
Underground Heating Water Supply & Return (105°-140°F Supply Water Temp)	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Heating Water Supply & Return (141°-200°F Supply Water Temp)	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Chilled Water Supply & Return	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
Underground Refrigeration Lines	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"	C 1"		J 1"
VRF Refrigerant Pipe Insulation	Refer to Section 23 81 45														
Mini-Split System Refrigerant Pipe Insulation	Refer to Section 23 81 26														
Refrig. Hot Gas Lines	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Refrig. Suction Lines (25°F & Above)	B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +			B 1-1/2" +		
Refrig. Suction Lines (40°F & Above)	B 1/2"			B 1/2"			B 1"			B 1"			B 1"		
Low Temp. Refrigeration Suction Lines (25°F to 0°F)	C 1-1/2"		J 1-1/2" *	C 2"		J 2" *	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *
Low Temp. Refrigeration Suction Lines (-1°F to -25°F)	C 2"		J 2" *	C 2-1/2"		J 2-1/2" *	C 2-1/2"		J 2-1/2" *	C 3"		J 3" *	C 3"		J 3" *
Low Temp. Refrigeration Suction Lines (-26°F to -75°F)	C 2-1/2"		J 2-1/2" *	C 3-1/2"		J 3-1/2" *	C 3-1/2"		J 3-1/2" *	C 4"		J 4" *	C 4"		J 4" *

HEATING for Use With: IECC -2012 | IECC -2015					
	Insulation Thickness per Pipe Size				
Piping System	<1"	1” to < 1-1/2"	1-1/2" to < 4"	4” to < 8"	8" <
Low Temp. Refrigeration Suction Lines (-76°F to -125°F)	C 3" J 3” *	C 4" J 4" *	C 4" J 4" *	C 5" J 5" *	C 5" J 5" *
Insulation Inserts at hangers	Type C or E or J* - match pipe insulation thickness				
Medical Air Compressor Intake	A 2"	A 2"	A 2"	A 2"	A 2"
Medical Vacuum System Exhaust (within 10’ of outside wall/roof penetration)	A 1"	A 1"	A 1"	A 1"	A 1"
SPARE					
SPARE					
SPARE					
SPARE					

KEY NOTES FOR CONTRACTORS:

* Type J not allowed in return air plenum (not 25/50 rated)

+ Type B < 1" thickness shall be installed using multiple layers of 3/4" or 1"

** Two (2) 2" layers with staggered seams

SECTION 23 09 00
CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Complete System of Automatic Controls.
B. Control Devices, Components, Wiring and Material.
C. Instructions for Owners.
D. Remodeling.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.

B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.

C. Technician: Minimum five years' experience installing commercial temperature control systems.

D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 100 miles of the job site.

E. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under this section. Materials and installation to confirm to Class 1 or 2, California Administrative Code Title 24, Article E725, and as restricted under the Division 26 Electrical of these specifications.

1.3 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
C. ANSI/ASHRAE Standard 135-2001: BACnet® – A Data Communication Protocol for Building Automation and Control Networks, including all amendments.
D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
E. ANSI/NFPA 70 - National Electrical Code.
F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
G. ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.
H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.
I. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
J. ANSI/ASTM B32 - Solder Metal.
K. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.
L. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

1.4 SUBMITTALS

A. Equipment Coordination:

1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.

2. Control valve selections shall be based on flow rates shown in approved shop drawings.

3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.

2. Cross-reference **all** control components and point names in a single table located at the beginning of the submittal with the **identical** nomenclature used in this section.

3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.

4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.

5. Diagrams shall include:

a. Wiring diagrams and layouts for each control panel showing all termination numbers.

b. 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 all interface wiring to the control system.

c. Identification of all control components connected to emergency power.

d. Schematic diagrams for all field sensors and controllers.

e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.

f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.

g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.

h. All installation details and any other details required to demonstrate that the system will function properly.

i. All interface requirements with other systems.

6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.

7. Sequences: Submit 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. **The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.**

8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.

9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:

a. Damper Identification Tag.
b. Location.
c. Damper Type.
d. Damper Size.
e. Duct Size.
f. Arrangement.
g. Blade Type.
h. Velocity.
i. Pressure Drop.
j. Fail Position.
k. Actuator Identification Tag.
l. Actuator Type.
m. Mounting.

10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:

a. Valve Identification Tag.

b. Location.
c. Valve Type.
d. Valve Size.
e. Pipe Size.
f. Configuration.
g. Flow Characteristics.
h. Capacity.
i. Valve C_V.
j. Design Pressure Drop.
k. Pressure Drop at Design Flow.
l. Fail Position.
m. Close-off Pressure.
n. Valve and Actuator Model Number and Type.

11. Indoor modular air handling units (Section 23 73 13) and mixed flow return air fans (Section 23 34 13) provided under this project will have piezometer type sensors mounted at fan inlets by fan manufacturer. Fan manufacturer will provide fan specific flow coefficients and equations that can be used to calculate fan airflow based on measured pressure differential at fan inlet. TCC shall provide the following:

    a. Quantity of pressure transducers so that each individual fan is served by a dedicated pressure transducer. Each pressure transducer shall have a range that is selected based on scheduled maximum airflow for each fan. TCC shall submit a schedule that shows the following calculations for each fan/pressure transducer:

        1) Pressure drop at maximum scheduled airflow for each fan using fan manufacturer's flow coefficient.

        2) Recommended transducer range.

    b. Pneumatic tubing as required to interconnect all piezometer type sensors and pressure transducer. **Note:** Where UV lamps are installed upstream of supply fan inlets, only copper tubing shall be used.

    c. Fasteners and supports as required to securely attached tubing, pressure transducers, conduits, wiring, and the like for a complete installation.

12. Airflow Measuring Station Schedule:

    a. The manufacturer's authorized representative shall prepare the airflow measuring station submittal, or review and approve in writing the submittal prepared by the TCC prior to submission to the Architect/Engineer and prior to installation. The representative shall review air handling equipment submittals and duct fabrication drawings to ensure that all AFMS locations meet the appropriate parameters to achieve proper installation and the specified accuracy. Comply with all manufacturer's installation requirements including straight up and downstream duct lengths. Install airflow straighteners if required by the manufacturer based on installation constraints. The Architect/Engineer shall be notified for approval of any deviations.

    b. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.

c. Submit installation, operation, and maintenance documentation.

13. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies 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 drawings 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.

14. Provide PICS files indicating the BACnet® functionality and configuration of each device.

15. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements if problems are found during BTL testing is required.

16. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.

17. Software: A list of operating system software, operator interface software, color graphic software, and third-party software.

18. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.

19. Clearly identify work by others in the submittal.

20. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.

2. Provide three complete sets of manuals.

3. Each O&M manual shall include:

a. Table of contents with indexed tabs dividing information as outlined below.

b. Definitions: List of all abbreviations and technical terms with definitions.

c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.

d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.

e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.

f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.

g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.

h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.

i. Original Software: Complete original issue CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

j. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.

k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.

D. Training Manual:

1. Provide a course outline and training manuals for each training class.

E. Record Documents:

1. Submit record documentation per Section 23 05 00.

2. Provide a complete set of “as-built” drawings and application software on CDs. Provide drawings as AutoCAD™ or Visio™ compatible files. Provide two copies of the “as-built” drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.

3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.

4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.

5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the A/E verifying completion and proper operation of all points.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.6 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Control Valves.
B. Flow Switches.
C. Temperature Sensor Sockets.
D. Gauge Taps.
E. Automatic Dampers.
F. Flow Meters.

1.7 AGENCY AND CODE APPROVALS

A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.

1. UL-916; Energy Management Systems.
2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “Signal Equipment.”
3. EMC Directive 89/336/EEC (European CE Mark).
4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.8 ACRONYMS

A. Acronyms used in this specification are as follows:

1.	B-AAC	BACnet Advanced Application Controller
2.	B-ASC	BACnet Application Specific Controller
3.	BTL	BACnet Testing Laboratories
4.	DDC	Direct Digital Controls
5.	FMCS	Facility Management and Control System
6.	GUI	Graphic User Interface
7.	IBC	Interoperable BACnet Controller
8.	IDC	Interoperable Digital Controller
9.	LAN	Local Area Network
10.	NAC	Network Area Controller
11.	ODBC	Open DataBase Connectivity
12.	OOT	Object Oriented Technology
13.	OPC	Open Connectivity via Open Standards
14.	PICS	Product Interoperability Compliance Statement
15.	PMI	Power Measurement Interface
16.	POT	Portable Operator’s Terminal
17.	TCC	Temperature Control Contractor
18.	TCS	Temperature Control System
19.	WAN	Wide Area Network

20. WBI Web Browser Interface

1.9 SUMMARY

A. Extend Existing System:

1. Extend the existing FMCS for this project.

2. All controllers and accessories shall interface with the existing FMCS.

B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.

C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.

D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

1.10 SYSTEM DESCRIPTION

A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.

B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Owner's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.

C. Provide materials and labor necessary to connect factory supplied control components.

D. Provide central and remote hardware, software, and interconnecting wire and conduit.

E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.

F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

G. For each operator workstation provided, furnish one legal copy of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be readily available in the market. Contractor shall convey to the Owner all software tools and their legal licenses at project closeout.

1.11 SOFTWARE LICENSE AGREEMENT

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID (**"orgid"**) of all software licenses. Owner shall be free to direct the modification of the **"orgid"** in any software license, regardless of supplier.

1.12 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.13 WARRANTY

A. Refer to Section 23 05 00 for warranty requirements.

B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.

C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

1.14 WARRANTY ACCESS

A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Acceptable Manufacturers	**BACnet Protocol**	**LonTalk Protocol**
Alerton	●	
Automated Logic: WebCTRL	●	
Delta Controls: ORCA	●	
Honeywell	●	●
Johnson Controls: Metasys Extended Architecture	●	●
KMC	●	

Acceptable Manufacturers	BACnet Protocol	LonTalk Protocol
Siemens Building Technologies: APOGEE	●	
Schneider Electric – EcoStruxure Building Operation	●	●
Trane Summit	●	●
Distech Controls	●	●

2.2 SYSTEM ARCHITECTURE

A. General:

1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

B. Open, Interoperable, Integrated Architectures:

1. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data are not acceptable.

2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.

3. Hierarchical or “flat” topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer’s internal intranet network.

a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE Standard 802.3.
2. Cable; 100 Base-T, UTP-8 wire, Category 6.

3. Minimum throughput; 100 Mbps.

C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high-power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.

D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and “safed” off in an appropriate manner.

E. There shall be no power wiring more than 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer’s wiring practices.

2.4 REMOTE NETWORK ACCESS

A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer’s intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.5 BACNET FMCS

A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device’s compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).

C. Interoperable BACnet Controller (IBC):

1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system’s compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.

2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:

a. BACnet Building Controller(s) (B-BC).
b. BACnet Advanced Application Controller(s) (B-ACC).
c. BACnet Application Specific Controller(s) (B-ASC).

3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.

4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.

5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.

6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:

   a. BACnet Device; MAC address, name, type and instance number.
   b. BACnet Objects; name, type and instance number.

7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.

D. Object Libraries

1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.

4. All control objects shall conform to the control objects specified in the BACnet specification.

5. The library shall include applications or objects for the following functions, at a minimum:

   a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.

b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic “point-and-click” selection. This object must be “linkable” to any or all scheduling objects for effective event control.

c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.

d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building’s “flywheel” effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.

e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user’s screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.

6. The library shall include control objects for the following functions:

a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.

b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.

c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.

d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.

e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.

f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.

g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.

h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.

i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.

j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an “on” state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.

k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphic shell of this container.

7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:

a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.

b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.

c. For BACnet devices, provide the following objects:

1) Analog In.
2) Analog Out.
3) Analog Value.
4) Binary.
5) Binary In.
6) Binary Out.
7) Binary Value.
8) Multi-State In.
9) Multi-State Out.
10) Multi-State Value.
11) Schedule Export.
12) Calendar Export.
13) Trend Export.
14) Device.

d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.

e. For BACnet devices, provide the following support at a minimum:

1) Segmentation.
2) Segmented Request.
3) Segmented Response.
4) Application Services.
5) Read Property.
6) Read Property Multiple.
7) Write Property.
8) Write Property Multiple.
9) Confirmed Event Notification.

10) Unconfirmed Event Notification.
11) Acknowledge Alarm.
12) Get Alarm Summary.
13) Who-has.
14) I-have.
15) Who-is.
16) I-am.
17) Subscribe COV.
18) Confirmed COV notification.
19) Unconfirmed COV notification.
20) Media Types.
21) Ethernet.
22) BACnet IP Annex J.
23) MSTP.
24) BACnet Broadcast Management Device (BBMD) function.
25) Routing.

2.6 TERMINAL AIR BOX (TAB) CONTROLLERS

A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.

B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.

C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.

D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator’s terminal connected to the specific controller.

E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.

F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

2.7 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)

A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall have, at a minimum, the following configurable properties:

1. Designating the log as interval or deviation.

2. For interval logs, configure the object for time of day, day of week and the sample collection interval.

3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.

5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so configured) or a standard Web browser.

C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

D. All log data shall be available to the user in ALL the following data formats:

1. HTML.
2. XML.
3. Plain text.
4. Comma or tab separated values.

E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties:

1. Archive on time of day.
2. Archive on user-defined number of data stores in the log (buffer size).
3. Archive when log has reached its user-defined capacity of data stores.
4. Provide ability to clear logs once archived.

2.8 AUDIT LOG

A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:

1. Time and date.
2. User ID.
3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

2.9 DATABASE BACKUP AND STORAGE

A. The NAC shall automatically backup its database on a user-defined time interval.

B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of the most recently saved database shall depend on the user-defined database save interval.

C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as XML format is supported.

2.10 GRAPHIC USER INTERFACE SOFTWARE

A. Operating System:

1. Provide computer with the most current Microsoft-based operating system with which the GUI has proven compatibility.

B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location and the selected object identification.

C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.

D. Real-Time Displays: The GUI shall support the following graphic features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a graphic background, the GUI shall support the use of scanned pictures.

2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.

3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.

4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be accomplished graphically.

    a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard entry from the operator.

    b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be made by selecting the object and the appropriate command from a pop-up menu. No text entry shall be required.

6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a graphic slider to adjust the value. No text entry shall be required.

E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable the operator to perform the following tasks with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects.
3. Tune control loops by adjusting control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select alarm points and define the alarm state.
7. Select points to be trended and initiate the recording of values automatically.
8. View any trend as a graph.

F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available using hypertext. All system documentation and help files shall be in HTML format.

G. Security: Each operator shall be required to log on to that system with a user name and password to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall be able to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security data in an encrypted format.

H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Annunciate the failure of any device to the operator.

I. Alarm Console:

1. The system shall have a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the alarm.

2. When the alarm console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable. The use of the alarm console can be enabled or disabled by the system administrator.

2.11 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Firefox™, or Chrome. Systems requiring additional software to enable a standard Web browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.

B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, are not permitted.

C. The Web browser client shall provide:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, display a blank web page. Implement security using Java authentication and encryption techniques to prevent unauthorized access.

2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client. The web browser interface shall support all animated graphic objects supported by the GUI.

3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.

4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics storage on the client machine.

5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

   a. Modify common application objects, such as schedules, calendars, and setpoints, graphically.

      1) Schedule times shall be adjustable using a graphic slider, without requiring any keyboard entry from the operator.

      2) Holidays shall be set using a graphic calendar, without requiring any keyboard entry from the operator.

   b. Commands to start and stop binary objects shall be made by right-clicking the selected object and selecting the appropriate command from a pop-up menu. No text entry shall be required.

   c. View logs and charts.

   d. View and acknowledge alarms.

   e. Setup and execute SQL queries on log and archive information

7. The system shall be able to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just his/her defined home page. From the home page, links to other views or pages in the system shall be possible, if allowed by the system administrator.

8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

2.12 VARIABLE FREQUENCY DRIVES

A. The following variable frequency drives shall be furnished and installed by the TCC:

   1. Air handling units

B. Refer to Section 26 29 23 Variable Frequency Drives for additional information.

C. Power connection between VFD and motor shall be by EC. Coordinate feeder and raceway installation with EE.

2.13 CONTROL INSTRUMENTATION

A. Temperature Sensors:

1. IT/ Data Room Temperature Sensor:

a. Sensor Only: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, no setpoint adjustment or override button.

b. Sensor with Setpoint Adjustment: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a single warmer/cooler or red/blue visual scale), no override button.

c. Sensor with Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.

d. Sensor with Setpoint Adjustment and Override: Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

a. Thermistor or RTD type. Pneumatic transmitters with transducers are not acceptable.

3. Water Temperature Sensor:

a. Install in immersion wells. Separate thermometers as specified elsewhere, also of the immersion well type, shall be installed within 2 feet of each temperature sensor.

B. Humidity Measuring Devices:

1. Humidity Sensors:

a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be ± 2% of reading.

C. Enthalpy Sensors. Duct-mounted enthalpy sensor shall include solid state temperature and humidity sensors with electronics that shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling.

PART 3 - PRODUCTS

3.1 GENERAL INSTALLATION

A. VFDs:

1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.

2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.

3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.

4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.

5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

3.2 CONDUIT AND BOXES INSTALLATION

A. Conduit and Box Installation: Refer to Electrical Section 26 05 33 for execution and installation.

B. Conduit and Box Identification (color and labeling) installation. Refer to Electrical Section 26 05 53 for raceway and box identification installation.

C. Outlet Box Schedule: Thermostat/temperature sensor:

1. Dry Interior Locations: Provide 4” square galvanized steel with raised cover to fit flush with finished wall line. When located in concrete block walls, provide square edge title cover of sufficient depth to extend out to face of block or masonry boxes.

2. Other Conditions: Refer to Electrical Section 26 05 33 for requirements.

3.3 WIRE AND CABLE INSTALLATION

A. Wire and Cable Installation: Refer to Electrical Section 26 05 13 for execution and installation.

B. Field Quality Control:

1. Inspect wire and cable for physical damage and proper connection.

2. Torque test conductor connections and terminations to manufacturer’s recommended values.

3. Perform continuity test on all conductors.

4. Protection of cable from foreign materials:

a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

C. Installation Schedule:

1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be made with flexible conduit rated for the environment.

3.4 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.

F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.

H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

END OF SECTION

SECTION 23 21 00
HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Pipe Fittings.
B. Valves.
C. Heating Water Piping System.

1.2 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.

B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 REFERENCES

A. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
B. ANSI/AWS D1.1 - Structural Welding Code.
C. ANSI/AWWA C104/A21.4 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
D. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.
E. ANSI/AWWA C111/A21.11 - Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
F. ANSI/AWWA C150/A21.50 - Thickness Design of Ductile Iron Pipe.
G. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
H. ANSI/AWWA C153/A21.51 - Ductile Iron Compact Fittings, Centrifugally Cast for Water or Other Liquids.
I. ASME - Boiler and Pressure Vessel Code.
J. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
K. ASME B16.3 - Malleable Iron Threaded Fittings Class 150 and 300.
L. ASME B16.4 - Cast Iron Threaded Fittings, Class 125 and 250.
M. ASME B16.5 - Pipe Flanges and Flanged Fittings.
N. ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
O. ASME B16.12 - Cast Iron Threaded Drainage Fittings.
P. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings
Q. ASME B16.21 - Nonmetallic Flat Gaskets for Pipes Flanges.
R. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
S. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
T. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
U. ASME B18.2.1 - Square and Hex Bolts and Screws, Inch Series.
V. ASME B18.2.2 - Square and Hex Nuts, Inch Series.
W. ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
X. ASME B31.9 - Building Services Piping.
Y. ASME Section 9 - Welding and Brazing Qualifications.
Z. ASTM A126 - Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings.
AA. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
BB. ASTM A181 - Forgings, Carbon Steel for General Purpose Piping.

CC. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
DD. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
EE. ASTM A536 - Standard Specification for Ductile Iron Castings
FF. ASTM A733 - Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
GG. ASTM B32 - Standard Specification for Solder Metal.
HH. ASTM B88 - Seamless Copper Water Tube.
II. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube.
JJ. ASTM D1599 - Standard Test Method for Short-Time Hydraulic Failure Pressure of Plastic Tubing and Fittings.
KK. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
LL. ASTM D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass Pipe and tube.
MM. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate loading.
NN. ASTM D2513 – Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
OO. ASTM D2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
PP. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
QQ. ASTM D2992 – Standard Practice for Obtaining Hydrostatic Design Basis for Fiberglass pipe and fittings.
RR. ASTM D2996 - Standard Specification for Filament Wound Fiberglass Pipe.
SS. ASTM D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
TT. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
UU. ASTM D4024 - Standard Reinforced Thermosetting Resin Flanges.
VV. ASTM D5685 - Standard for Fiberglass Pressure Pipe Fittings.
WW. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
XX. ASTM E413-87 - Classification for Rating Sound Insulation
YY. ASTM F2389 – Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems.
ZZ. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories. Include manufacturers' support spacing requirements for plastic piping.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.

B. Deliver and store valves in shipping containers with labeling in place.

1.6 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 HEATING WATER

A. Design Pressure: 125 psig.
Maximum Design Temperature: 225ºF. (230ºF for grooved couplings)

B. Piping - 2" and Under:

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53; Type E, F, or S; Grade B.

2. Joints: Screwed.

3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4; or Class 150 malleable iron, ASTM A197, ASME B16.3.

4. Unions: Class 150 malleable iron, ANSI B16.39, ground joint with copper or copper alloy-to-iron seat.

C. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.

2. Joints: Butt-welded or flanged.

3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.

4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24” and B16.47 above 24”. ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.

D. Piping - 2-1/2" and Over All Sizes:

1. Pipe: Standard weight black steel, grooved ends, ASTM A53, Type E or S, Grade B.

2. Joints: Grooved type, with Grade E EPDM molded pressure-responsive gaskets suited for 32°F to 230°F per ASTM D2000.

3. Fittings: ASTM A536 Grade 65-45-12 ductile or A47 malleable iron, grooved type.

4. Flanges: Grooved end, flanged adapter.

E. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Gate Valves:

   a. GA-1: 2" and under, 125 psi S @ 353ºF, 300 psi WOG @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131.

   b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, NIBCO F-617-O.

3. Ball Valves:

   a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

      NOTES:

      1) Provide extended shaft for all valves in insulated piping.

      2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

   b. BA-1A: 2-1/2" and 3", 125 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

      NOTES:

      1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

      2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

4. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 225°F continuous and 250°F intermittent at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# CWP, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 225, Watts #DBF-03-121-1G, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

3) Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic #300, Nibco GD4765.

F. Throttling Valves:

1. For pipe systems where mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Globe Valves:

a. GL-1: 3" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, or NIBCO #T-235.

b. GL-2: 4" thru 10", 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, or NIBCO #F-718.

3. Ball Valves:

   a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-216BR-R, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

      NOTE: Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

4. Butterfly Valves:

   a. BF-4:

      1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20ºF to 225°F continuous and 250ºF intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size. Victaulic #300, Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, NIBCO LD2000 Series, Milwaukee CL series, Hammond 5200 series.

      2) 8" thru 12", 175# CWP, elastomers for 20ºF to 225ºF at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #300, Milwaukee CL series, Hammond 5200 series.

   b. BF-5:

      1) 14" through 24", 150 psi CWP, elastomers rated for 20ºF to 225°F continuous and 250ºF intermittent at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or nickel plated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 150 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system). Weatherproof gear operator. Cv of at least 12,000 in 16" size.

Victaulic #709, Center Line Series 200, Keystone #AR2, Watts DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #W706, Milwaukee CL series, Hammond 5200 series.

G. Check Valves:

1. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. CK-1: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.

3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

H. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122-A.

3. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 353°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.2 HEATING WATER

A. Design Pressure: 125 psig.
Maximum Design Temperature: 225ºF.

B. Piping - All Sizes:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Piping All Size (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, NIBCO Press System Fittings and Valves, Mueller Streamline PRS.

D. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Gate Valves:

a. GA-1: 2" and under, 125 psi S @ 353ºF, 300 psi WOG @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131.

b. GA-5: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, solder bronze. Crane #1334, Stockham #B108, Walworth #4SJ, Watts #B-3101, NIBCO #S-111.

3. Ball Valves:

a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

E. Throttling Valves:

1. For pipe systems where mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Globe Valves:

a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.

b. GL-5: 2" and under, 125 psi saturated steam, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T, Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.

3. Ball Valves:

a. BA-9: 2" and under, 125 psi saturated steam, 600 psi WOG, standard port, screwed (solder ends are acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body and ball of copper alloy containing less than 15% zinc, chrome plated or stainless steel ball, Teflon seats and seals with memory stop. Apollo #70-120, Stockham #S-216BR-R, Milwaukee #BA-100, Watts #B-6000, Hammond #8501, Nibco #580-70.

NOTE: Provide solid extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

F. Check Valves:

1. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. CK-1: 2" and under, 125 psi S @ 406ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, NIBCO #T-413.

3. CK-4: 2" and under, 200 psi WOG @ 150ºF, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, NIBCO #S-413.

G. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. ST-1: Bronze body, screwed ends, screwed cover, 125 psi S @ 353°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

2.3 HEATING WATER

A. Design Pressure: 125 psig.
Maximum Design Temperature: 225ºF. (230ºF for mechanical couplings)

B. Piping - 2" and Under:

1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

3. Fittings: Wrought copper solder joint, ASME B16.22.

C. Piping - 2” and Under (Contractor’s Option):

1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, NIBCO Press System Fittings and Valves, Mueller Streamline PRS.

D. Piping - 2-1/2" and Over:

1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.

2. Joints: Butt-welded or flanged.

3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.

4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24” and B16.47 above 24”. ASME B16.1 for flanges mating with flat face equipment flanges. Flange face seal weld (backweld) is required for slip-on flanges.

E. Piping - 2-1/2" and Over All Sizes (Contractor Option)

1. Pipe: Standard weight black steel, grooved ends, ASTM A53, Type E or S, Grade B.

2. Joints: Grooved type, with Grade E EPDM molded pressure-responsive gaskets suited for 32°F to 230°F per ASTM D2000.

3. Fittings: ASTM A536 Grade 65-45-12 ductile or A47 malleable iron, grooved type.

4. Flanges: Grooved end, flanged adapter.

F. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Gate Valves:

a. GA-1: 2" and under, 125 psi S @ 353ºF, 300 psi WOG @ 150ºF, screwed, bronze, rising stem, screwed bonnet. Crane #431, Hammond #IB641, Stockham #B122, Walworth #56, Milwaukee #1150, Watts #B-3210, NIBCO #T-131.

b. GA-2: 2-1/2" thru 12", 125 psi S @ 353°F, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted, OS&Y. Crane #465-1/2, Hammond, Stockham #G623, Walworth, Milwaukee #F2885, Watts #F-503, NIBCO F-617-O.

c. GA-5: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, solder bronze. Crane #1334, Stockham #B108, Walworth #4SJ, Watts #B-3101, NIBCO #S-111.

3. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

4. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

3) Mechanically coupled grooved end valves are acceptable if they have the features listed above. Victaulic #300, Nibco GD4765.

b. BF-5:

1) 14" through 24", 150 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or nickel plated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 150 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system). Weatherproof gear operator. Cv of at least 12,000 in 16" size. Victaulic #709, Center Line Series 200, Keystone #AR2, Watts DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #W761, Milwaukee CL series, Hammond 5200 series.

G. Throttling Valves:

1. For pipe systems where mechanical press connections are allowed, throttling valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Globe Valves:

a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.

b. GL-2: 2-1/2" thru 10", 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.

c. GL-5: 2" and under, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T, Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.

3. Butterfly Valves:

a. BF-4:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size. Victaulic #300, Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, NIBCO N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20ºF to 225ºF at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, NIBCO N200 Series or LD2000 Series, Victaulic #300, Milwaukee CL series, Hammond 5200 series.

b. BF-5:

1) 14" through 24", 150 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or nickel plated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 150 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system). Weatherproof gear operator. Cv of at least 12,000 in 16" size. Victaulic #709, Center Line Series 200, Keystone #AR2, Watts DBF-03-121-1G, NIBCO LD2000 Series, Victaulic #W761, Milwaukee CL series, Hammond 5200 series.

H. Check Valves:

1. For pipe systems where mechanical press connections are allowed, check valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. CK-1: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.

3. CK-4: 2" and under, 200 psi WOG @ 150ºF, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, or NIBCO #S-413.

4. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

I. Strainers:

1. For pipe systems where mechanical press connections are allowed, strainers with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

3. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.4 HEATING WATER

A. Design Pressure: 150 psi at 180ºF
Design Pressure: 100 psi at 180ºF

B. Piping – 3/4” to 14” diameter:

1. Pipe: Multilayer extruded PP-RCT polypropylene with fiberglass layer; SDR=7.3[11]. ASTM F2389.

2. Joints: Polypropylene socket fused, electrofusion or flanged.

3. Fittings: Polypropylene PP-RCT; PP-RCT/Brass (for connection to brass or iron threaded valves)

4. Limitations: Shall not be used in a plenum unless listed ≤25/50 per ASTM E84/UL723.

C. Acceptable Manufacturers: Niron FG Clima; Aquatherm MF

D. Shutoff Valves:

1. Provide valves by the pipe manufacturer as part of a complete system.

2. Ball Valves:

a. BA-1: 3" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed ends, bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft with operating handle of low thermal conductivity material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in piping conveying fluids over 120°F, compressed air piping, gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

3. Butterfly Valves:

a. BF-1:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20°F to 225°F at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, Nibco N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

E. Throttling Valves:

1. Globe Valves:

a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.

b. GL-2: 2-1/2" thru 10", 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.

2. Butterfly Valves:

a. BF-4:

1) 2-1/2" thru 6", 175 psi WOG, elastomers rated for 20ºF to 250ºF at 125 psig, fully lugged or grooved end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), infinite position locking operator with memory stop up to 6" size. Cv of at least 1580 in 6" size. Victaulic #300, Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, NIBCO N200 Series or LD2000 Series, Milwaukee CL series, Hammond 5200 series.

2) 8" thru 12", 175# WOG, elastomers for 20ºF to 225ºF at 130 psi, fully lugged end, ductile or cast iron body (not in contact with fluid), bronze, EPDM coated ductile iron or aluminum-bronze disc, EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to the centerline of the valve body (to permit pipe extension without draining system), weatherproof gear operator. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1G, NIBCO N200 Series or LD2000 Series, Victaulic #300, Milwaukee CL series, Hammond 5200 series.

F. Check Valves:

1. Provide Check Valves by the Pipe Manufacturer as part of a complete system.

2. CK-1: 2" and under, 125 psi S @ 353ºF, 200 psi WOG @ 150ºF, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.

3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.

G. Strainers:

1. Provide Strainers by the Pipe Manufacturer as part of a complete system.

2. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

3. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.5 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53, Schedule 40 galvanized.

1. Fittings: Galvanized cast iron screwed drainage type, ASME B16.12.

2. Joints: Screwed.

3. Service: Not allowed on boiler drains and overflow.

B. Steel Pipe: ASTM A53. [for boiler drains only]

1. Pipe: Standard weight black steel, threaded and coupled, ASTM A53.

2. Joints: Screwed.

3. Fittings: Class 125 cast iron, ASTM A126, ASME B16.4.

C. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.

1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.

2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.

D. Piping 4” and Under (Contractor’s Option):

1. Tubing: Type M (or thicker) drawn temper seamless copper tube, ASTM B88.

2. Joints: Mechanical press connection.

3. Fittings: Copper, ANSI B-16.22, with embedded EPDM O-ring, NSF-61.

4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, NIBCO Press System Fittings and Valves, Mueller Streamline PRS.

E. Piping Under 1-1/4” Size:

1. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding are acceptable.

F. Shutoff Valves:

1. For pipe systems where mechanical press connections are allowed, shutoff valves with mechanical press connections are acceptable subject to the requirements in the paragraphs below.

2. Ball Valves:

a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

b. BA-1A: 2-1/2" and 3", 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi standard port, carbon steel body stainless steel ball and trim, Teflon seats and seals. Apollo #88A-100, Nibco #F510-CS/66, Milwaukee #F90.

NOTES:

1) Provide extended shaft for all valves in insulated piping.

2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2.6 AIR VENTS

A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.7 AUTOMATIC AIR VENTS

A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, Taco, or Watts.

B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8” minimum outlet. B&G #107, Armstrong, Spirotherm, Taco, or Watts.

2.8 STRAINERS

A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 8"	10” and Up
Air and Gases	1/32”	3/64”	1/16”
Water and Glycol/Water	1/32”	1/16"	1/8"

B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.

C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.9 MAKE-UP WATER ACCESSORIES

A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.

2. Pressure reducing valve. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225°F maximum temperature.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Thrush, Watts.

B. Relief Valve:

1. For water fill lines to hydronic systems.

2. Cast iron or bronze body, 1/2" or 3/4” screwed connections, 125 psig working pressure, 225°F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.

3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Taco, Watts.

C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.

2. Provide an air gap fitting and piping to drain.

3. If not indicated on the drawings, unit shall be same size as pipe.

4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

2.10 SAFETY RELIEF VALVES

A. SRV-1 (Hydronic Heating Systems): Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250ºF. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled. Acceptable Manufacturers: Kunkle # 537, B&G, Conbraco, McDonnell & Miller, or Watts.

2.11 TRIPLE DUTY VALVE

A. Type TD-1: 2" and above, 175 psi working pressure, flanged, cast iron, non-slam check valve, calibrated throttling, shutoff capabilities, angle or straight pattern. Pressure drop with design flow at 100% open shall not exceed 10 feet. Size to match pipe (not pump outlet) size, but reduce size by not more than one (1) if needed to provide at least 3 feet of differential pressure across the flow measuring taps at scheduled flow rate. Acceptable Manufacturers: Armstrong, Bell & Gossett, Taco, Wheatley, Victaulic.

B. Triple duty valves may replace the combination of shutoff valve, balancing valve, and check valve on constant volume systems. Triple duty valves are not permitted on variable volume systems.

2.12 SUCTION DIFFUSER

A. Furnish and install on base mounted pumps with inlet size same as pipe size shown on the drawing.

B. In no case shall pressure drop exceed 3.0 psi.

C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to blowdown connection. Provide 16 mesh bronze startup strainer. The startup strainer shall be removed after the system has been started, cleaned, and is operating under normal conditions, but before the system is turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.

D. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Patterson, Taco, Wheatley, Victaulic.

2.13 SELF-CONTAINED CONTROL VALVES

A. Thermostatic hot water control valves, self-contained bellows, nickel-plated body with EPDM disc, stainless steel spindle, and lifetime lubricated packing gland. Gland shall be replaceable with valve in operation.

B. Size for maximum pressure drop of 1 psi.

C. Configuration SCCV-1: Mount sensor and operator on valve body. Provide tamper-proof cover.

D. Configuration SCCV-2: Mount operator on valve body with remote sensor and capillary connection. Provide tamper-proof cover.

E. Configuration SCCV-3: Mount actuator on valve body with remote sensor, remote operator and capillary connections.

F. Acceptable Manufacturers: Danfoss, Type RA, Bell & Gossett, Honeywell Braukmann, Sterling, Rittling.

2.14 BALANCING VALVE

A. Rated for 125 psi working pressure and 250ºF operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure across a valve). Graph shall extend below the specified minimum flow.

C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:

1. Carrying case with handle.

2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.

3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff valves, vent valves, and probes for insertion into pressure and temperature plugs.

D. Valves in copper piping shall be brass or bronze.

1. Quarter-Turn Ball Valve Style:

a. Bell & Gossett "Circuit Setter Plus",

2. Quarter-Turn Venturi Style:

a. Presso “B+”
b. Griswold “Quickset”
c. Gerand “BALVALVE Venturi”
d. HCI “Terminator B”
e. Nexus Valve “UltraXB Orturi”
f. MI Hydronic Engineering “Accusetter”

3. Multi-Turn Style:

a. Tour&Anderson (STAD)
b. Armstrong "CBV"
c. Victaulic 785
d. Macon STVL/STV
e. MEPCO MBV
f. Wheatly GS
g. NIBCO 1710

E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction. Option to balancing valves noted above are flow sensors specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style:

a. Bell & Gossett "Circuit Setter Plus"

2. Quarter-Turn Venturi Style:

a. Presso “B+”
b. Gerand “BALVALVE Venturi”
c. HCI “Terminator B”
d. Nexus Valve “UltraXB Orturi”
e. IMI Hydronic Engineering “Accusetter”

3. Multi-Turn Style:

a. TA Hydronics “786-789”
b. Armstrong "CBV"
c. Victaulic 787

d. Macon STVL/STV
e. MEPCO MBV
f. Wheatly GSNIBCO 1710 (T1710L)

F. Balancing valves in ferrous piping over 2" size shall have flanged or grooved ends and steel or cast iron construction. Option to balancing valves noted above are flow sensor specified in Section 23 09 00 with a specified throttling valve.

1. Quarter-Turn Ball Valve Style:

a. B&G “Circuit Setter”

2. Quarter-Turn Venturi Style:

a. Presso “B+”,
b. Taco “Accu-flo”,
c. HCI “Terminator G”
d. Nexus Valve “Nextrol NXFB”,
e. IMI Hydronic Engineering “Accusetter”,

3. Multi-Turn Style:

a. Armstrong "CVB-II",
b. Tour&Anderson (STAF, STAG),
c. Victaulic 788/789
d. Macon STVA
e. MEPCO MBV
f. NIBCO 737

G. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on manufacturer's standard meters.

2.15 AUTOMATIC FLOW CONTROL VALVES (AUTOMATIC BALANCING VALVES)

A. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within ± 10% of the specified GPM over at least 95 percent of the control range.

B. Pump Head Requirements:

1. The permanent pressure loss added to the pump head shall not exceed 7 feet.

C. Each valve shall have two P/T ports.

D. Five-year product warranty and first year cartridge exchange, up to 10 percent.

E. The internal wear surfaces of the valve cartridge shall be stainless steel or polyphenylsulfone orifice with an elastomeric diaphragm.

F. The internal flow cartridge shall be permanently marked with the GPM and spring range.

G. Valve body shall be brass on all valves 2” and under and ductile iron on all valves 2-1/2” and larger.

H. All valves shall be factory leak tested at 100 psi air under water.

I. A differential pressure test kit shall be supplied to verify flow and measure over-heading. The kit shall consist of a 4-1/2” diaphragm gauge equipped with 10 foot hoses and P/T adapters all housed in a vinyl case. Calibration shall be 0-35 PSID for 2-32 PSI spring range or 0-65 PSID for 5-60 PSI range.

J. Acceptable Manufacturers: Griswold, Autoflow, Versa Flow, Nexus, B&G, Victaulic, Hays Fluid Controls.

K. Complete integral piping package, which integrate shutoff valves, automatic flow control valves, vents, strainers and drains, are acceptable.

2.16 COMBINATION PIPING PACKAGES

A. Combination piping packages are allowed in lieu of individual components specified for hydronic coils and devices containing hydronic coils. Combination piping packages shall include shutoff valves, wye strainers, 1/4 turn strainer blow down valves with hose thread and cap, manual balancing valves with memory stop, test plugs, manual air vents, and unions. Automatic flow control devices are not allowed. Configuration of combination pieces shall match layouts on the drawings. Each component of the combination piping packages shall meet these specifications for the individual components being combined.

B. Acceptable Manufacturers: FDI Flowset, Griswold, Hays Fluid Controls, HCI Terminator, Nexus Coil Pak, NIBCO, Victaulic.

2.17 EXPANSION TANK

A. Compression Type:

1. Tank shall be welded steel, guaranteed air-tight and leakproof, ASME construction, stamped for 125 psig working pressure.

2. Furnish with air control fitting and drain valve.

3. 375ºF maximum operating temperature.

4. Furnish bronze 3/4" gauge glass, tested for at least 200 psi, hand wheel automatic valves with rubber washer for glass and 1/4" drain cock.

5. Acceptable Manufacturers: Bell & Gossett, Adamson, Taco, Armstrong, Ace Buehler, Wessels, Wheatley, Amtrol, Patterson, Grundfos.

B. Bladder Type:

1. Tank shall be welded steel, ASME construction and stamped.

2. Tank shall be complete with heavy-duty replaceable butyl bladder, charging valve, lifting ring, drain tapping, and system connection.

3. 125 psig working pressure and 240ºF maximum operating temperature.

4. Acceptable Manufacturers: Thrush, Taco, Bell & Gossett, Armstrong, Watts, Wessels, Wheatley, Amtrol, Patterson, Grundfos.

2.18 CONNECTIONS BETWEEN DISSIMILAR METALS

A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.

B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.

C. Aluminum, iron, steel, brass, copper, bronze, galvanized steel, and stainless steel are commonly used and require isolation from each other with the following exceptions:

1. Iron and steel connected to each other.

2. Brass, copper, and bronze connected to each other.

3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze items occur together, they shall be connected with brass nipples. Brass or bronze valves and specialties cannot be used as a dielectric separation between pipe materials.

D. Dielectric protection is required at connections to equipment of a material different than the piping.

E. Screwed Joints (acceptable up to 2" size):

1. Dielectric waterway rated for 300 psi CWP and 225°F.

2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 647, Grinnell Series 407, Matco-Norca.

F. Flanged Joints (any size):

1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.

2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.

3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.

4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.

5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.

6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

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. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.

D. Connect to all equipment with flanges or unions.

E. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

A. Heating Water:

1. Test pipes underground or in chases and walls before piping is concealed.

2. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.

3. Test the pipe with water at 100 psig pressure. Hold pressure for at least two hours.

4. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.

3.3 CLEANING PIPING

A. Assembly:

1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.

3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.

4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.

2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.

3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.

4. After each system has been cleaned and thoroughly flushed of pretreatment chemicals, it shall be immediately refilled with water and treated with chemical treatment as specified in Section 23 25 00. The system shall not be allowed to sit empty for any length of time.

5. When system water is clear, remove, clean and replace all strainers.

6. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.

7. Chemical cleaning applies to the following systems:

a. Heating Water

3.4 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.

2. Install piping to conserve building space, and not interfere with other work.

3. Group piping whenever practical at common elevations.

4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.

6. Install bell and spigot pipe with bells upstream.

7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.

8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle from the horizontal plane to the top of piping.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.

C. Valves/Fittings and Accessories:

1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.

2. Provide valve position indicator on all valves 10’-0” or greater above finish floor and not located above ceiling.

3. Provide clearance for installation of insulation, and access to valves and fittings.

4. Provide access doors where valves are not exposed.

5. Where a manual balance valve is shown to be installed in series with a service (isolation) valve, separate balance and service (isolation) valves shall be installed.

6. Prepare pipe, fittings, supports, and accessories for finish painting.

7. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.

8. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.

9. Provide flanges or unions at all final connections to equipment, traps and valves.

10. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

3.5 JOINING OF PIPE

A. Threaded Joints:

1. Ream pipe ends and remove all burrs and chips.
2. Protect plated pipe and valve bodies from wrench marks when making up joints.
3. Apply Teflon tape to male threads.

B. Flanged Joints:

1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.

2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.

3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.

4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:

   a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.

   b. Maximum pressure rating of at least 250 psig.

   c. Minimum temperature rating: -10°F.

   d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.

   e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.

C. Solder Joints:

1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.

2. Flux shall be non-acid type conforming to ASTM B813.

3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470ºF melting point solder. Remove composition discs and all seals during soldering if not suitable for 470ºF.

END OF SECTION

SECTION 23 21 23
HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. All pumps except where integral with a manufactured piece of equipment.
B. Pump controls where self-contained.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.

C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.

D. Submit motor data indicating compliance with Section 23 05 13.

E. Submit certification that pumps, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

A. Statically and dynamically balance rotating parts.

B. Construction shall permit complete servicing without breaking piping or motor connections.

C. Pumps shall operate at 1750 rpm unless specified otherwise.

D. Pump connections shall be flanged, whenever available.

E. Heating pumps shall be suitable for 225ºF water.

F. Motors shall comply with Section 23 05 13.

G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 BASE MOUNTED END SUCTION PUMPS

A. Type: Centrifugal, single stage.

B. Casing: Cast iron, single suction, rated for greater of 150 psior 1.25 times actual working discharge pressure, flanged suction and discharge with gauge ports.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.

E. Bearings: Grease lubricated roller or ball bearings with grease fittings. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.

F. Drive: Flexible coupling with OSHA approved guard.

G. Seals: Mechanical type with internal flushing rated for -20 to 225ºF with Buna elastomer, carbon primary ring, and ceramic stationary ring.

H. Baseplate: Heat treated cast iron or reinforced heavy steel.

I. Acceptable Manufacturers: Bell & Gossett, Taco, Aurora, Armstrong, Grundfos/Peerless/PACO, Patterson, Weinman/Crane.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.

2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18” clearance for removal of suction diffuser.

3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.

4. For pumps not powered by a VFD, trim impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor and Architect/Engineer.

5. Install on vibration isolators as scheduled on drawings.

B. Base-Mounted Pumps:

1. Base-mounted pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Architect/Engineer, manufacturer shall provide a factory trained representative to field align the shafts.

2. Unless otherwise shown on the drawings, mount all base mounted pumps on 4" high concrete pads and anchor frames to pads with cast-in-place anchors.

3. All base-mounted pumps shall be grouted-in. Follow manufacturer's instructions for grouting.

END OF SECTION

SECTION 23 31 00
DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Galvanized Ductwork
B. Carbon Steel Ductwork
C. Ductwork Reinforcement
D. Ductwork Sealants
E. Rectangular Ductwork
F. Leakage Testing
G. Ductwork Penetrations
H. Duct Cleaning

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.
B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.
D. ASHRAE - Handbook 2012 Systems and Equipment; Chapter 19 - Duct Construction.
E. ASHRAE - Handbook 2013 Fundamentals; Chapter 21 - Duct Design.
F. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
G. ASTM A90 - Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
H. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.
I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
K. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
L. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
M. ASTM E413-87 - Classification for Rating Sound Insulation.
N. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.
O. AWS D9.1M/D9.1 - Sheet Metal Welding Code.
P. NADCA ACR 2002 - Assessment, Cleaning, and Restoration of HVAC Systems.
Q. NADCA Standard 05 1997 - Requirements for the Installation of Service Openings in HVAC Systems.
R. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
S. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
T. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.
U. SCAQMD Rule 1168 – South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications.
V. SMACNA – Air Duct Leakage Test Manual – 1985 Edition.
W. SMACNA - HVAC Duct Construction Standards - 2005 Edition.
X. SMACNA - Phenolic Duct Construction Standard 022.
Y. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.
Z. UL 181 - Factory-Made Air Ducts and Air Connectors.
AA. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors
BB. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.

CC. UL 1978 - Standard for Grease Ducts.
DD. UL 2221 - Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies.
EE. CMC California Mechanical Code
FF. CBC California Building Code

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00.

B. Submit duct fabrication standards in compliance with SMACNA and these specifications. Clearly indicate metal gauges, reinforcement, and joining methods intended for use for each pressure classification. Furnish details of all common duct fittings and joint connections to be used on this project.

C. The Architect/Engineer may require field verification of sheet metal gauges and reinforcing to verify compliance with these specifications. At the request of the Architect/Engineer, the contractor shall remove a sample of the duct for verification. The contractor shall repair as needed.

D. Duct Layout Drawings: Submit detailed duct layout drawings at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.

2. Differentiate ducts that are wrapped. Include insulation thickness, type of insulation, and acoustical lagging.

3. Room names and numbers, ceiling types, and ceiling heights.

4. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

5. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of ventilation drawings for contractor’s use if the contractor signs and returns the “Electronic File Transfer” waiver. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Refer also to Section 23 05 00.

1.4 DEFINITIONS

A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.

B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

1.5 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

B. Duct drawings shall be at 1/4" minimum scale complete with the following information:

1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.

2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.

3. Location and size of all duct access doors.

4. Room names and numbers, ceiling types, and ceiling heights.

5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

C. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.

3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.

4. Ductwork reinforcement shall be of galvanized steel.

5. Ductwork supports shall be of galvanized or painted steel.

6. Strap hanger shall be a minimum of 1 inch, 18 gauge galvanized steel attached to the bottom of ducts with spacing as required by SMACNA at 8'-0" OC and as required by CMC/UMC and SMACNA guidelines.

7. Aircraft cable and slip cable hangers are acceptable for ducts up to 18"ø. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.

8. All fasteners shall be galvanized or cadmium plated.

2.2 DUCTWORK REINFORCEMENT

A. General Requirements:

1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.

a. Ducts must be over 18” wide.

b. Duct dimensions must be increased 2” in one dimension (h or w) for each row of tie rods installed.

c. Tie rods must not exceed 1/2” diameter.

d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.3 DUCTWORK SEALANTS

A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

B. Two-part joint sealers shall consist of a minimum 3” wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30°F to +175°F and 2000-hour minimum UV resistance per ASTM G-53.

C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.

D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

2. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

E. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.4 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.

2. Transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.

2. Snap lock seams are not permitted.

3. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:

a. Type 1:

1) **Description**: Single wall type with 22-gauge (0.029”) or heavier vanes, 3-1/4" blade spacing, and 4” to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra-long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.

2) **Usage**: Limited to 3,000 fpm and vane lengths 36” and under.

b. Type 2:

1) **Description**: Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.

2) **Usage**: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48” long.

c. Type 3 (acoustical - where acoustical lagging is located or as noted on drawings):

1) **Description**: Same as Type 2, except filled with fiberglass and with slotted or perforated inner curve. Minimum insertion loss of 9 dB at 250 Hz and 6 dB at 1 KHz.

2) **Usage**: No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48” long.

d. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.

e. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.

f. Omitting every other vane is prohibited.

4. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.

5. Rectangular branch and tee connections in ducts over 1” pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1” pressure class.

6. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

7. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1” or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.

8. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.

9. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.

10. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6” in length.

11. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    a. Apply sealant to all inside corners. Holes at corners are not acceptable.

    b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer’s approval before any fabrication begins.

12. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.

    a. Apply sealant to all inside corners. Holes at corners are not acceptable.

    b. Flanges shall be 24-gauge minimum (not 26 gauge).

c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide openings in ducts for thermometers and controllers.

B. Locate ducts with space around equipment for normal operation and maintenance.

C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.

D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with Level "B" "C" of the SMACNA Duct Cleanliness for New Construction Guidelines.

E. Repair all duct insulation and liner tears.

F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.

H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.

I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.

K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 23 05 50 for seismic requirements.

L. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California Building Codes.

M. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

N. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

O. Kitchen Grease and Dishwasher Ductwork:

1. All kitchen grease and dishwasher ductwork shall be installed with a continuous slope and grease tight welds on all seams and joints.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	**MATERIAL**	**PRESSURE CLASS**	**SEAL CLASS †**	**INSULATION** (Refer to Section 23 07 13 for insulation types) ±
Constant Volume from Fan to Outlet	Galvanized Sheet Metal - Rectangular	+2”	A	1-1/2" thick Type A (R=4.5) or 1" thick Type C (R=3.6) 2" thick Type A (R=6.0) or 2" thick Type C (R=7.1)
Constant Volume from Fan to Outlet	Galvanized Sheet Metal – Spiral Seam Round or Snap-lock Seam Round	+2”	A	1-1/2" thick Type A (R=4.5) or 1" thick Type G(R=4.3) 2" thick Type A (R=6.0) or 2" thick Type G (R=7.1)
Return Duct	Galvanized Sheet Metal	-2"	A	None None 1" thick Type C (R=3.6)
Constant Volume from Fan to Outlet	Phenolic Non-Fibrous Closed Cell - Indoor	+3”	A	None
Return Duct	Phenolic Non-Fibrous Closed Cell - Indoor	-3”	A	None
Exterior Return Duct	Phenolic Non-Fibrous Closed Cell – Outdoor.	-3”	A	None
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual ± Type A insulation (Flexible Fiberglass Wrap) R-values noted are based on installed values (25% compression). Note 1: Apply aluminum based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant. Note 2: Apply aluminum based adhesive sealant tape on TAB boxes (all seams and joints of the box and duct connections) serving dedicated outside air supply (DOAS) system.				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.

2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.

3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.

4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer’s data sheet specifies other application methods or requirements.

B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.

C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

3.4 TESTING

A. Duct - 2" WG or Less (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.

2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.

3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.

4. Seal ducts to bring the air leakage into compliance.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:

1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.

2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.

3. All joints shall be felt by hand, and all discernible leaks shall be sealed.

4. Totaling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.

5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.

6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.

8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.

9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

3.5 DUCTWORK PENETRATIONS

A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.

B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.

C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install trim strip to cover vacant space and raw construction edges of all openings in finished rooms. Install escutcheon ring at all round duct openings in finished rooms. Trim strips and rings shall be same material and finish as exposed duct.

END OF SECTION

SECTION 23 40 00
AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Filters and Filter Media.

B. Side Access Filter Housings.

C. Activated Carbon Filters.

D. Filter Frames.

E. Filter Gauges.

1.2 QUALITY ASSURANCE

A. Filter media shall be tested under ANSI/UL 900 and labeled.

B. Provide all filters and filter banks by one manufacturer.

C. Air filters shall be State Fire Marshal approved and of a listed type. Preformed filters having combustible framing shall be tested as a complete assembly. Air filters in all occupancies shall be Class 2 or better (as shown in the State Fire Marshal listing). Air filters shall be accessible for cleaning or replacement.

1.3 REFERENCES

A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.

B. ANSI/UL 900 - Test Performance of Air Filter Units.

C. ASHRAE 26 - Guideline for Field Testing of General Ventilation Devices and Systems for Removal Efficiency In-Situ by Particle Size and Resistance to Flow.

D. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

E. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include data on media, performance, assembly, and frames.

1.5 EXTRA STOCK

A. Provide a total of three (3) sets of filters for all units.

1. Provide clean filters in all units at time of installation.
2. Provide clean filters in all units at project final completion after all interior finishes are complete.
3. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

PART 2 - PRODUCTS

2.1 PRE-FILTERS: MERV 8 (MEDIUM EFFICIENCY) - DISPOSABLE

A. MERV 8 per ASHRAE 52.2.

B. Quantity and size of filters per the Packaged Rooftop Air Conditioning Unit Manufacture.

C. Manufacturers:

1. Camfil
2. Flanders
3. American Air Filter

2.2 FINAL FILTERS: MERV 16 (>95% EFFICIENT) BAG FILTER

A. Disposable type with high density, fine fiberglass media with reinforced backing and galvanized steel face frame.

B. Self-supporting bags without sag under airflow reduced to 25% of the maximum design flow.

C. Individual pleats shall have sealed link stitching to maintain their shape.

D. Maximum depth of 24". At least 17.5 square feet of media per square foot of face area.

E. MERV 16 per ASHRAE 52.2. Maximum 0.85" WG initial resistance at 500 fpm face velocity.

F. Quantity and size of filters per the Packaged Rooftop Air Conditioning Unit Manufacture.

G. Manufacturers:

1. Camfil
2. Flanders
3. American Air Filter

2.3 FILTER GAUGES

A. Inclined Manometer: One-piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, 0-2" WG range, 3% of full scale accuracy.

B. Accessories: Static pressure tips with integral compression fittings, 1/4" plastic tubing, 2- or 3-way vent valves, indicating fluid.

C. Manufacturers:

1. Dwyer "Mark II"
2. Meriam Instrument.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all products per manufacturers' instructions.

B. Seal filter media to prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan systems without filters.

D. Install static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and calibrate. Every filter bank, including packaged units, shall have a filter gauge.

E. Install four (4) high efficiency filter test holes, two upstream and two downstream, at all high efficiency filter banks in air handling units and ductwork (85% efficiency and higher). Coordinate location of test holes with Owner.

END OF SECTION

SECTION 23 51 00
STACKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Gas Vents.

1.2 REFERENCES

A. ANSI Z181.1 (UL 959) - Medium Heat Appliance Factory Built Chimneys.
B. ANSI Z21.66 - Electrically Operated Automatic Vent Damper Devices for Use with Gas-Fired Appliances.
C. ANSI Z223.1 (NFPA 54) - The National Fuel Gas Code.
D. ANSI/ASTM C64 - Refractories for Incinerators and Boilers.
E. ANSI/UL 103 - Standard for Factory Built Chimneys for Residential Type and Building Heating Appliances.
F. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
G. UL 378 - Standard for Draft Equipment
H. UL 441 - Standard for Gas Vents.
I. UL 641 - Standard for Type L Low-Temperature Venting Systems.

1.3 SUBMITTALS

A. Submit shop drawings per Section 23 05 00. Include general construction, dimensions, weights, support and layout of breechings. Where factory built units are used submit layout drawings indicating plan view and elevations.

B. Submit product data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights.

C. Submit engineering report and manufacturer's certificate that refractory lined metal stacks meet specified requirements.

D. Submit manufacturer's installation instructions.

E. Submit certification that all breechings, chimneys, stacks, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 DEFINITIONS

A. Smoke Pipe: Round, single wall vent connector.

B. Vent: Conveys flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

1.5 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

B. Design stacks for wind loading of 110 mph and seismic loads for zone in California.

C. Design stacks over 5 feet above roof under direct supervision of Professional Engineer experienced in design of this Work and licensed at project location in State of California.

PART 2 - PRODUCTS

2.1 CLASS B GAS VENTS

A. Galvanized steel outer pipe. Aluminum liner pipe. 0.25"insulating air space between pipes. Type B listed by UL.

B. Inside diameter of the liner shall be as shown on the drawings.

C. Extend up 2'-0" above the nearest obstruction within 20'-0" and terminate with a rain and bird proof cap.

D. Install tall cone flashing and storm collar at roof.

E. Maintain 1" clearance to all enclosures.

F. Acceptable Manufacturers: AMPCO, DuraVent, Hart & Cooley, Heat Fab, Metal-Fab, Schebler, Selkirk/Metalbestos, Van-Packer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prior to putting boilers into operation, Contractor shall provide full penetration welds for the entire length of each pipe section for all inner and outer shell seams to prevent leakage of flue gases. Riveted, tack, or spot-welded seams are not permitted.

B. Install all products in accordance with manufacturer's instructions.

C. Install in accordance with recommendations of ASHRAE - Handbook, Chapter "Chimney, Gas Vent, and Fireplace Systems", NFPA 211, and ANSI Z223.1 (NFPA 54).

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Guide vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for duct support configuration and size. Provide expansion compensation approved by the manufacturer.

E. Level and plumb chimneys and stacks. Provide 3/4" condensate drain at base of all stacks over 12" diameter. Pipe condensate to nearest floor drain.

F. Clean stacks during installation, removing dust and debris.

G. Provide slip joints permitting removal of appliances without removal or dismantling of breechings, chimneys, or stacks.

END OF SECTION

SECTION 23 52 16
CONDENSING BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boilers.
B. Controls and Boiler Trim.
C. Hot Water Connections.
D. Fuel Burning System and Connection.
E. Vent Connection.
F. Boiler Vent Flue.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with at least three years documented experience.

B. Provide factory authorized start-up service by manufacturer's agent.

C. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 for construction of boilers.

D. Boiler Units: AGA certified, UL listed and ASME certified.

E. Installation shall meet the requirements of ASME CSD-1 NFPA 85, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.

F. Conform to ASHRAE 90.1.

1.3 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.
B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.
C. ANSI/AGA Z223.1 - National Fuel Gas Code.
D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
E. ANSI/ASME SEC 4 - Boiler and Pressure Vessels Code - Rules for Construction of Heating Boilers.
F. ANSI/ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
G. ANSI/NFPA 70 - National Electrical Code.
H. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.
I. NFPA 85 - Boiler and Combustion Systems Hazard Code.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 23 05 00.

B. Submit product data indicating general assembly, components, controls, safety controls, and electrical power/controls wiring diagrams, and service connections.

C. Submit manufacturer's installation instructions.

D. Submit reports indicating condition and operation at start-up.

E. Submit reports indicating specified performance and efficiency is met or exceeded.

F. Submit certification that all boilers, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

[***OR*****]**

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

PART 2 - PRODUCTS

2.1 BOILERS

A. Provide factory assembled, factory fire-tested, self-contained unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Hot water, condensing type boiler with integral forced draft or pulse combustion burner, burner controls, boiler trim, insulation and jacket.

C. ASME allowable working pressure of 150 psig water.

D. Provide two lifting eyes on top of boiler.

E. Unit casing shall be a minimum of 16 gauge steel. Factory paint boiler, base, and other components with hard finish enamel.

F. Porcelain enameled or stainless steel exhaust manifold with gravity drain and reservoir for condensate elimination.

G. Single Fuel Acceptable Manufacturers: Thermal Solutions (Apex); Thermal Solutions (Arctic); Raypak (Xfrye); Buderus/Bosch (SSB).

H. Single Fuel Acceptable Manufacturers:Thermal Solutions (EVCA); Raypak (Xtherm).

I. Single Fuel Acceptable Manufacturers: Fulton (Endura); Aerco International, Inc. (Benchmark); Riverside Hydronics M3; Cleaver Brooks (Clear Fire); Viessman (Vitocrossal); Lochinvar (Crest); Riello (RTC).

J. Dual-Fuel Acceptable Manufacturers: Fulton Vantage DF; Riello RTC Buderus/Bosch (SSB Commercial), Aerco (MFC).

2.2 BOILER FLUE

A. The boiler manufacturer shall furnish review and approve vent size, type, and routing of all vent flue piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use with category III and IV appliances with operating temperatures of up to 480°F.

B. Refer to Section 23 51 00 for materials.

2.3 HOT WATER BOILER TRIM

A. Provide ASME safety relief valve set at 125 psi or boiler maximum allowable working pressure.

B. Provide low water cut-off with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.

C. Provide operating temperature controller to control burner operation to maintain boiler water temperature, as determined by a remote 4-20 mA signal from building DDC system or boiler controller.

D. Limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.

E. Provide all trim required to meet ASME CSD-1 NFPA 85. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.4 FUEL BURNING SYSTEM - SINGLE FUEL

A. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14” W.C. inlet pressure. Maintain fuel-air ratios automatically.

B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor.

C. Include on unit complete gas train including gas safety shutoff valve conforming to CSD-1 requirements. Vent all gas valves to outdoors separately.

D. Burner to be modulating with a minimum turndown ratio of 20:1 5:1 3:1.

2.5 FUEL BURNING SYSTEM - DUAL FUEL

A. General - Combination Gas-Oil Burner: Burner for gas and light oil to be built as single unit. Gas burner and oil burner complete with gas pressure regulator. Oil burner must be able to fire without the use of natural gas.

B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor. Burner shall be capable of operating at 14" to 42"W.C. inlet pressure. Maintain fuel-air ratios automatically.

C. Oil Burner: Low pressure [fuel atomizing] [air atomizing] forced draft type with electric ignition. Provide with oil drip pan and oil pump. Oil burner piping shall include oil pressure regulating devices, oil metering controls, solenoid shut off valves, oil strainer and instrumentation, integrally mounted on unit and adequate to permit performance adjustment.

D. Include on unit complete gas train including gas safety shutoff valve conforming to CSD-1 requirements. Vent all gas valves to outdoors separately.

E. Burner to be modulating with a minimum natural gas [propane] turndown ratio of [10:1] [5:1] [3:1].

2.6 CONTROL PANEL

A. The boiler system control panel shall include contacts for a trouble alarm to the DDC system.

B. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition or main flame failure. Interlock to shut down burner upon combustion air pressure drop.

C. Manual-automatic selector switch to permit automatic firing in accordance with load demand, or manual control of firing rate at fixed temperature.

D. Panel to include indicating lights to show fault conditions of low water level, flame failure, fuel pressure, exhaust temperature, water temperature, or combustion air pressure. Mount indicating lights and switches in hinged drop-panel for access to wiring.

E. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Mechanical Temperature Controls Contractor. A switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation.

F. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read "BOILER EMERGENCY SHUTOFF". Square D XAL K174 or as approved by Architect/Engineer.

G. For multiple boiler systems, furnish a boiler management system consisting of controller(s) capable of stopping, starting, and modulating all boilers to maintain maximum efficiency of the boiler plant. The boiler management system shall include all alarms, control points, and setpoints specified.

H. Manufacturer shall provide a BACnet interface with the building automation system in accordance with ASHRAE/ANSI Standard 135. This may be accomplished through a system integration panel or “gateway”. Integration panels shall be provided as part of the boiler package. Wiring between the boiler control panel(s) and the integration panel shall be the responsibility of the manufacturer

2.7 PERFORMANCE

A. Minimum gas-fired efficiency, verified by factory tests, shall be 86% at 100% output with 150°F return water and 88% at 25% output with 130°F return water.

B. Rated for return temperatures as low as 40°F and supply temperatures as high as 190°F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install in accordance with manufacturer's instructions.

2. Provide for connection to electrical service.

3. Provide connection of gas service in accordance with ANSI/AGA Z223.1.

4. Provide connection of fuel oil supply and return piping connections. Hydraulically separate fuel supply system from boiler fuel pumping system.

5. Pipe safety relief valve and condensate trap to nearest floor drain glycol feed system. Route condensate pipe to acid resistant floor drain.

6. Install heating water circulation pump as recommended by the manufacturer.

B. Combustion Inlet and Venting:

1. Provide complete sealed combustion inlet and venting system.

2. Slope all horizontal runs of exhaust vent towards the boilers at a slope of 1” per 4’.

C. Service Clearance:

1. Install the boilers with a minimum of three feet clear space behind them for installation of piping and services. Verify exact maintenance clearances required by the manufacturer prior to installation.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under factory authorized supervision.

B. Provide field representative for starting unit and training operator.

C. Provide combustion test and submit report. Test shall include boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O_2), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent combustion efficiency, and heat output.

D. Dual fuel boilers shall be fired on natural gas and fuel oil. Contractor shall provide the supply of fuel oil necessary for the firing test. Provide a minimum of two hours of operation for each boiler on fuel oil prior to system turn over. Upon completion of the test, provide cleaning of the combustion chamber, breeching, and flue and then re-fire and test again on natural gas. Ensure the manufacturer's published operational efficiency is achieved. Document the results in the manufacturer's startup report.

END OF SECTION

SECTION 23 74 16.13
PACKAGED ROOFTOP AIR CONDITIONING UNITS
ABOVE 25 TON

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged Rooftop Unit.
B. Unit Controls.
C. Roof Mounting Frame and Base.
D. Economizers.
E. Power Exhaust.
F. Ultraviolet Germicidal Irradiation (UVGI).

1.2 QUALITY ASSURANCE

A. All insulation inside the unit and in the air stream must comply with the requirement of NFPA 90A (maximum flame spread of 25 and maximum smoke developed of 50).

B. All units must be UL or ETL listed and must contain UL labeled components.

C. Fans shall be tested and rated in cabinet in accordance with AMCA Standard 210. All fan assemblies shall be dynamically balanced in cabinet at final assembly.

D. Conform to ASHRAE 90.1 IECC California Energy Code Title 24.

E. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

A. AHRI 210 - Unitary Air Conditioning Equipment.
B. AHRI 240 - Air Source Unitary Heat Pump Equipment.
C. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
D. ASHRAE 37 - Methods of Testing for Rating Unitary Air Conditioning and Heat Pump Equipment.
E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
F. NFPA 70 - National Electrical Code.
G. NFPA 90A - Installation of Air Conditioning and Ventilating System.
H. UL - Underwriters' Laboratory.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Indicate electrical service and duct connections on shop drawings or product data.

C. Submit manufacturer's installation instructions.

D. Submit electrical power/controls wiring diagrams and product data indicating general assembly, components, safety controls, and service connections.

E. Provide 8 octave maximum sound power levels at unit discharge and return connection.

F. Submit certification that the packaged rooftop air conditioning units, accessories, and components will withstand seismic forces defined in Section 23 05 50. Include the following:

1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

[* * * * * OR * * * * *]

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, installation instructions, maintenance and repair data, and parts listing.

1.7 WARRANTY

A. Provide five (5) year manufacturer’s warranty for compressors. **[SPECIFIER: Alternate 10-year warranty has been removed from master specifications. Normal market does not offer 10-year compressor manufacturer warranty on packaged RTUs. Anything beyond standard 5-year warranty is covered by the manufacturer’s representative or the Contractor. If you want 10-year warranty, revise to 10-year and revise “manufacturer’s warranty” to either “warranty” or “Contractor warranty”.]**

B. Provide five (5) ten (10) year manufacturer’s warranty for heat exchanger.

C. Provide three (3) five (5) year manufacturer’s warranty for controls and electrical components (thermostats, VFD, etc.).

1.8 MAINTENANCE SERVICE

A. Contractor shall furnish complete service and maintenance of packaged roof top units for one year from Date of Substantial Completion.

B. Provide maintenance service with a two-month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of four (quarterly) filter replacements, minimum of one fan belt replacement, and controls checkout, seasonal adjustments, and recalibrations.

D. Submit copy of service call work order or report and include description of work performed to Owner and Architect/Engineer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Trane
B. York
C. Daikin
D. Carrier
E. Valent
F. Aaon

2.2 MANUFACTURED UNITS

A. Provide roof-mounted units having gas burner, electric heating elements, and electric refrigeration.

B. Unit shall be self-contained, packaged, factory assembled, pre-wired and tested, consisting of cabinet and frame, supply fan, return fan, exhaust fan, heat exchanger and burner, electric heating elements, controls, air filters, refrigerant cooling coil and compressor, condenser coil, condenser fan, and a full refrigerant charge.

C. Unit shall be furnished with non-fused disconnect switch, short fuse protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.

2.3 FABRICATION

A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fasteners locking door handle type with piano hinges. Access doors shall be provided at each section (e.g., filter section, supply fan section, etc.). All exterior access panels must be permanently labeled on the outside indicating what is behind the panel. Structural members shall be minimum 18 gauge, with access doors or removable panels of minimum 20 gauge.

B. Outside Air Intakes: The outside air intakes shall be located a minimum of 15 inches above the roof mounting curb to minimize the effect of heat pickup from the roof during the natural cooling cycle and the effects of snow on the roof during winter operation. Each air intake shall be furnished with rain eliminators.

C. Insulation: Minimum of 1”25mm thick aluminum foil faced glass fiber on all sections. All sections shall be double wall, foam injected casings.

D. Heat Exchangers: Aluminized Stainless steel, of welded construction.

E. Air Filters: One inch thick glass fiber disposable media in metal frames. Two inch thick glass fiber disposable media in metal frames.

F. Roof Mounting Curb: Minimum 12 inches 24 inches high, minimum 14 gauge galvanized steel, one-piece construction, insulated, all welded, wood nailer.

2.4 FANS/MOTORS

A. Fans:

1. Supply Fans: Airfoil DWDI centrifugal; SWSI plenum or vane axial fan.

2. Return: Airfoil DWDI centrifugal; SWSI plenum or vane axial fan.

3. Exhaust Fans: Airfoil DWDI centrifugal; SWSI plenum or vane axial fan.

4. All fans shall be aluminum or composite construction with fan shaft: turned, ground and polished steel; keyed to wheel hub.

5. Fan and motor assemblies shall be resiliently mounted

6. Direct drive motor or with V-belt drive and rubber isolated hinge mounted motor.

7. All fan bearings must be capable of being lubricated by easily accessible grease fittings.

8. All fans must be statically and dynamically balanced.

B. Motors:

1. Motors shall be open drip-proof with grease lubricated bearings.

2. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

3. No equipment shall be selected or operate above 90% of its motor nameplate rating.

4. Motor shall have 1.15 service factor.

5. ECM motors may be provided.

C. Belt Drive Fans:

1. Belt drive fans must be within ± 10% of scheduled RPM.

2. Belt drive fans shall have slide rails, adjusting screws, anchor bolts, and bedplates.

3. Drives shall be V-belt type with adjustable pitch sheaves for units 20 HP and below. On units over 20 HP, use fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

4. Units used with variable speed drives shall have fixed sheaves. This Contractor shall provide replacement sheaves and belts as required to allow final air balancing.

2.5 EVAPORATOR COIL

A. Provide copper tube with aluminum copper fin coil assembly.

B. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044oz per ft^2 of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8" per foot.

C. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

D. Provide insulation on liquid refrigerant and suction piping between compressor and evaporator coil where not protected by drain pans. Insulation shall be elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 1" thick per layer where multiple layers are specified.

2.6 COMPRESSOR

A. Provide hermetic or semi-hermetic compressors (quantity as scheduled on drawings), 3600 rev/min maximum, resiliently mounted with positive lubrication, crankcase heater for operation down to 0°F, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

B. Five minute timed off circuit shall delay compressor start.

C. Provide capacity control by providing digital scrolls or providing inverter duty compressors.

D. For heat pump units, provide reversing valve, suction line accumulator, discharge muffler, flow control check valve, and solid-state defrost control utilizing thermistors.

E. The use of hydrochlorofluorocarbon (HCFC) or chlorofluorocarbon (CFC)based refrigerants is prohibited.

2.7 CONDENSER

A. Provide copper tube aluminum fin coil assembly with sub-cooling rows.

B. Provide direct drive low noise blade design propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be aluminum or composite material.

C. Provide refrigerant pressure switches outdoor thermostat to cycle condenser fans.

D. Provide hail guards on all condenser coils.

E. Liquid and discharge isolation valves with staged and digital scrolls.

F. Fan motors shall be an ECM type motor for proportional control. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

2.8 MIXING SECTION

A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to closed position. Relief dampers may be gravity balanced.

B. Gaskets: Provide tight fitting dampers with edge gaskets. Gaskets must be mechanically fastened (use of adhesive alone shall not be acceptable). Damper blades shall be gasketed with side seals to provide an air leakage rate of Class 1A at 1" w.c. pressure differential for a 24"x24" damper. A barometric exhaust damper shall be provided to exhaust air out the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator.

C. Damper Actuator: 24 volt with gear train sealed in oil, with spring return on units 7.5 tons cooling capacity and larger.

2.9 ECONOMIZERS

A. Factory installed by approved rooftop unit manufacturer with fully modulating motorized outside air and return air dampers.

B. To be controlled by differential enthalpy with fixed dry-bulb fixed enthalpy and fixed dry-bulb dry bulb controller with minimum position setting.

C. Shall be capable of introducing up to 100% outside air.

D. Shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.

E. Dampers shall be capable of completely closing when unit is in unoccupied mode.

F. Outside air damper normally closed and return air damper normally open.

G. Provide factory installed and tested, outdoor air monitor that controls outdoor air ± 15% accuracy down to 40 cfm per ton.

H. Economizer assembly shall be California Title 24 compliant. MicroTech III controls shall display a warning, and write a warning to the BAS, if the economizer malfunctions in accordance with Title 24 specifications.

I. Provide a field installed duct/space-mounted C02 sensor. Outside air damper position shall modulate between the demand control ventilation limit (minimum position setpoint) and the ventilation limit (maximum non-economizer position setpoint) to satisfy the space requirements. Damper position shall be controlled to the greater of the two command signals, either minimum outside air flow or space IAQ (CO2).

J. Economizer Fault Detection and Diagnostics (FDD):

1. Air-cooled unitary direct-expansion units that are equipped with an economizer shall include a fault detection and diagnostics system complying with the following:

a. The following temperature sensors shall be permanently installed to monitor system operation:

1) Outside air.
2) Supply air.
3) Return air.

b. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F.

c. Refrigerant pressure sensors, where used, shall have an accuracy of ± 3 percent of full scale.

d. The unit controller shall be configured to provide system status by indicating the following:

1) Free cooling available.
2) Economizer enabled.
3) Compressor enabled.
4) Heating enabled.
5) Mixed air low limit cycle active.
6) The current value of each sensor.

e. The unit controller shall be capable of manually initiating each operating mode so that the operation of compressors, economizers, fans, and the heating system can be independently tested and verified.

f. The fault detection and diagnostics system shall be configured to detect the following faults:

1) Air temperature sensor failure/fault.
2) Not economizing when the unit should be economizing.
3) Economizing when the unit should not be economizing.
4) Damper not modulating.
5) Excess outdoor air.

g. The unit shall be configured to report faults to a fault management application available for access by day-to-day operating or service personnel or annunciated locally on zone thermostats.

2.10 POWER EXHAUST

A. Factory installed by economizer supplier or compatible equivalent.

B. Controlled by economizer controls.

C. Power exhaust shall be factory wired to electrical section complete with conduit, feeders, disconnect, and overcurrent protection. Power exhaust shall be energized based on building pressure or when dampers open past the adjustable setpoint of the economizer control.

D. Must comply with Energy Code Fan Power Limitation formula.

E. Fans:

1. Exhaust Fans: Propeller or SWSI plenum fan.

2. All fans shall be aluminum or composite construction with fan shaft: turned, ground and polished steel; keyed to wheel hub.

3. Fan and motor assemblies shall be resiliently mounted.

4. Direct drive motor.

5. All fan bearings must be capable of being lubricated by easily accessible grease fittings.

6. All fans must be statically and dynamically balanced.

F. Motors:

1. Motors shall be open drip-proof with grease lubricated bearings.

2. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section 23 05 13.

3. No equipment shall be selected or operate above 90% of its motor nameplate rating.

4. Motor shall have 1.15 service factor.

5. ECM motors may be provided.

2.11 ELECTRICAL

A. Provide with single point power connection to service all controls, dampers, outlet, and fans, complete with non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection, transformer, and convenience outlet.

B. All units must be so constructed that when the electrical section access panel is opened, all electrical power to the unit (with the exception of the 120 volt duplex convenience outlet) is disconnected by means of a single disconnect**.**

C. All wiring must be labeled, numbered, and terminate in "spade clips". All terminal strips must be keyed to the wiring numbers. Each control device must be permanently labeled to indicate its function.

D. Wiring diagrams for all circuits must be permanently affixed to the inside of the electrical section access panel. The markings of terminal strips and wiring must agree with the numbering on the wiring diagrams.

E. All units shall include a transformer for controls and convenience outlet.

F. Only one power cable connection to the unit shall be necessary.

G. Motor shall include phase failure protection and prevent the motor from operation in the event of phase loss.

2.12 OPERATING CONTROLS - VARIABLE VOLUME UNITS

A. Temperature transmitter located in supply air shall signal electronic logic panel to control mixing dampers and cooling in sequence to maintain 55°F(adj.).

B. Control cooling by modulating compressors.

C. Control logic shall allow adjustable supply air reset under low load or airflow conditions.

D. Dehumidification Controls: Maintain the relative humidity setpoint with the hot refrigerant gas reheat coil.

E. Seven-day timeclock with spring carry over (or electronic clock with battery backup) shall control unit on occupied/unoccupied schedule. At night, unit shall be off. Locate clock in remote control panel with status lights. OR Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. Provide two stage morning warm-up thermostat to hold outdoor dampers closed and energize heat until return air temperature reaches set point.

G. Program Options: Each central control panel is individually configurable as an air conditioner controller for a variable volume system.

H. Supply Air Temperature Sensor Input: The supply air temperature sensor monitors the air handling unit discharge air temperature. It is used by the central control panel to control the stages of heating and cooling, and to protect the air handling unit from excessively high or low discharge air temperatures. The leaving air temperature sensor requires twisted, shielded pair wire. Terminations are screw terminals.

I. Operators Panel: An operator's panel may be used to control up to two central control panels. The 16-button keypad and 2 line/40-character display shall give the operator individual zone status and control from one location.

1. Zone control functions include:

a. Occupied heat/cool setpoints.
b. Unoccupied heat/cool setpoints.

2. Zone status includes:

a. Current zone temperature.
b. Current occupancy mode.
c. Current heat/cool mode.

3. Time-of-day scheduling shall be available by group, individually for each of the four groups. Scheduling shall be two on/off periods per day for each of the seven weekdays. A holiday schedule shall also be available for each group. Up to 24 holiday dates can also be scheduled. Groups timed override can be enabled from the keypad for a two-hour period. Operator's panel shall have a 365 day clock with daylight savings time and leap year functions.

[* * * * * OR * * * * *]

2.13 DDC TEMPERATURE CONTROLS

A. Install standalone control module providing communication between unit controls and packaged DDC temperature control system.

B. Control module shall be compatible with temperature control system specified in Section 23 09 00. Provide BACnet _____ gateway for communication.

2.14 ULTRAVIOLET GERMICIDAL IRRADIATION (UVGI):

A. Provided and installed by unit manufacturer. Refer to Section 23 33 00 for requirements.

B. Portal: The UV lamp plenum area shall be equipped with a viewing port for viewing the lamp assembly. Portal shall be constructed to allow viewing without the possibility of exceeding the Minimal Erythermal Dose.

C. Interlock: Include all interlocks and wiring to assure UV light assembly is not energized when any access door is opened. Provide lockout tagout switches to turn off UV lamps when persons are in the unit. Signage shall indicate CAUTION: ULTRAVIOLET ENERGY IN DUCT. DO NOT OVERRIDE THE SAFETY DEVICE OR OTHERWISE ACTIVATE LAMPS WITH DOOR OPEN.

D. Location: System shall be installed a minimum of 8 inches and maximum of 20 inches from coil surface (based on UVC manufacturer's calculations and recommendations.) Install on tracks allowing the UV fixture to slide into place. Tracks shall be designed so the UV fixtures can be easily maintained and replaced. Interlock all UV lamps to turn on and off together.

2.15 ACOUSTICS

A. Maximum Sound Power Levels at Unit Discharge and Return/Exhaust Inlet:

Octave Band Center Frequency (Hz) (dB re: 10^{-12}W)	1 63	2 125	3 250	4 500	5 1000	6 2000	7 4000	8 8000
Discharge								
Inlet								

B. Manufacturer shall submit calculated sound power levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings and illustrated by the manufacturer.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting curb and provide watertight enclosure to protect ductwork and utility services. Install unit level.

C. All field wiring shall be in accordance with the National Electrical Code.

D. P-traps must be provided for all drain pans.

E. Comb all coils to repair bent fins.

F. Contractor shall coordinate unit access stair and walkway placement to ensure compliance with OSHA requirements.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide initial start-up and shutdown during first year of operation.

END OF SECTION

SECTION 23 81 26
SPLIT SYSTEM AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Split system air conditioning wall, ceiling-mounted, and/or ceiling-concealed units.

1.2 REFERENCES

A. ARI 210 - Unitary Air Conditioning Equipment
B. ARI 240 - Air Source Unitary Heat Pump Equipment
C. ANSI NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
D. ANSI/ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
E. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
F. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
G. ASHRAE 52 - Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
H. ASTM B1003 - Standard Specification for Seamless Copper Tube for Linesets.
I. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.
J. UL - Underwriters' Laboratories.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Section 23 05 00.

B. Indicate drain, electrical, and refrigeration rough-in connections on shop drawings or product data.

C. Submit manufacturer's installation instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer’s installation instruction for rigging, unloading, and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location until units are ready for immediate installation.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/NFPA 90A for the installation of computer room air conditioning units.

B. Conform to ASHRAE 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.7 WARRANTY

A. Provide five (5) year manufacturer's warranty on all compressors.

PART 2 - PRODUCTS

2.1 SPLIT SYSTEM WALL AND CEILING-MOUNTED UNITS

A. Acceptable Manufacturers:

1. LG
2. Daikin Applied
3. Mitsubishi

B. Manufactured Units:

1. Provide packaged, air-cooled, factory assembled, pre-wired and pre-piped unit consisting of cabinet, fans, filters, remote condensing unit, and controls. Wall-mounted units shall be furnished with integral wall mounting bracket and mounting hardware.

2. Assemble unit for wall-mounted or ceiling installation with service access required.

3. Performance shall be as scheduled on the drawings.

4. Unit shall be rated per AHRI Standards 210/240 and listed in the AHRI directory as a matched system.

5. Provide unit with factory-supplied cleanable air filters.

6. The units shall be listed by Electrical Laboratories (ETL) in accordance with UL-1995 certification and bear the ETL label.

7. All wiring shall be in accordance with the National Electric Code (NEC).

C. Evaporator Fans and Motors:

1. Fans:

a. The evaporator fan shall be direct drive with a single motor having permanently lubricated bearings.

b. The fan shall be statically and dynamically balanced.

c. The indoor fan shall have at least three speeds.

2. Motor:

a. Direct driven, digitally controlled with multiple speeds. Permanently lubricated with internal overload protection.

D. Electrical Panel:

1. Service Connections, Wiring, and Disconnect Requirements: Conform to the National Electrical Code and local electrical codes.

E. Control:

a. The unit shall have a hard-wired wireless 7-day programmable remote controller to operate the system. Provide wall mounting bracket for controller.

b. Remote controller shall have “automatic”, “dry” (dehumidification), and “fan only” operating modes.

c. The remote controller shall have the following features:

1) *On/Off* power switch.
2) *Mode Selector* to operate the system in auto, cool, heat, fan, or dehumidification (dry) operation.
3) *Fan Setting* to provide multiple fan speeds.
4) *Swing Louver* for adjusting supply louver discharge.
5) *On/Off Timer* for automatically switching the unit off or on.
6) *Temperature Adjustment* allows for the increase or decrease of the desired temperature.
7) *Powerful Operation* to allow quick cool down or heating up in the desired space to achieve maximum desired temperature in the shortest allowable time.

d. The remote controller shall perform fault diagnostic functions that may be system related, indoor or outdoor unit related depending on the fault code.

e. Temperature range on the remote controller shall be 64°F to 90°F in cooling mode and 50°F to 86°F in heating mode.

f. The indoor unit microprocessor shall have the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote controller.

F. Outdoor Unit:

1. General:

a. The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be completely factory assembled and pre-wired with all necessary electronic and refrigerant controls.

2. Cabinet:

a. The outdoor unit shall be fabricated of galvanized steel, bonderized and coated with a baked enamel finish for corrosion protection.

3. Fan:

a. The fan shall be direct drive, propeller type fan with fan guard.
b. Fan blades shall be statically and dynamically balanced.
c. The fan shall have permanently lubricated type bearings.

d. Motor shall be protected by internal thermal overload protection.
e. Airflow shall be horizontal discharge.

4. Coil:

a. The outdoor coil shall be nonferrous construction with corrugated fin tube.
b. The coil shall be protected with an internal guard.
c. Refrigerant flow from the condenser shall be controlled via a metering device.

5. Compressor:

a. Hermetic or scroll refrigerant compressors with resilient suspension system, inverter driven, oil strainer, sight glass/moisture indicator, internal motor protection, high pressure switch, and crankcase heater.

b. The outdoor unit shall have an accumulator and four-way reversing valve.

6. Refrigerant:

a. Unit shall use R-410a.
b. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.

G. Condensate Pump:

H. Refrigerant Piping:

1. Design Pressure: 450 psig.

2. Maximum Design Temperature: 250 F.

3. Piping - 4" and under.

a. Tubing: Type ACR seamless copper tube linesets, ASTM B1003. Sizes indicated are nominal designation.

b. Joints: Brazed with silver solder.

c. Fittings: Wrought copper solder joint, ANSI B16.22.

d. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged, and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

I. Piping – 1-3/8” and Under (Contractor’s Option):

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Dual concentric crimp band mechanical press connection.

3. Fittings: Refrigerant grade copper in accordance with ASTM B75 or ASTM B743 with embedded HNBR O-ring.

4. Acceptable Manufacturers: Parker Zoomlock

J. Piping – 1-3/8” and Under (Contractor’s Option):

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Mechanically attached connector, axially swaged compression connection.

3. Fittings: Refrigerant grade copper in accordance with ASTM B75 or ASTM B743. Brass body with two stabilization inserts in accordance with ASTM B15/B16M, two steel rings in accordance with ASTM A108-13, anerobic adhesive sealant.

4. Acceptable Manufacturers: Anvil Vulkan Lokring

5. Refrigerant linesets are are not permitted.

   a. Provide manufacturer-packaged refrigerant linesets and accessories of sizes needed for installation. Verify lengths of piping required for installation.

6. Insulation:

   a. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Minimum 1/2” thick for pipe sizes < 1-1/4” and 3/4” thick for pipe sizes 1-1/4” and above.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that proper power supply is available.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install units in accordance with manufacturer's instructions. Install all units level and plumb. Indoor units shall be installed using manufacturer’s standard mounting hardware securely fastened to building structure.

2. Refer to Section 23 05 29 for roof support rails, concrete base for outdoor unit.

3. Coordinate the exact mounting location of all indoor and outdoor units with architectural and electrical work. Coordinate installation of ceiling-mounted units with ceiling grid layout. Provide additional ceiling grid reinforcement or modification as required and coordinate the work with the GC. Locate the indoor unit where it is readily accessible for maintenance and filter changes. Where outdoor units are located on the roof, locate at least 10’ from the roof edge.

4. Verify locations of wall-mounted remote controllers with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Height above finished floor shall not exceed 48”.

B. Condensate Removal:

1. Install condensate piping with trap and route from drain pan to nearest drain. Discharge to nearest code-approved receptor or to a properly vented indirect waste fitting. Flush all piping before making final connections to units.

C. Comb all coils to repair bent fins.

D. Install new filters in the unit at Substantial Completion.

E. A factory-authorized service agent shall assist in commissioning the unit and inspecting the installation prior to startup. Submit startup report with O&M manuals.

3.3 REFRIGERANT PIPING

A. Install refrigerant piping from the indoor unit(s) to the condensing unit. Refrigerant pipe sizes, lengths, specialties and configurations shall be as recommended by the manufacturer. Evacuate refrigerant piping and fully charge system with refrigerant per manufacturer’s requirements.

B. Provide weather-tight insulated roof curb to accommodate refrigerant piping and conduit roof penetrations.

C. Insulate all refrigerant piping. Both liquid and suction lines shall be insulated between the indoor and outdoor units.

D. Joining of Piping:

1. Brazed Joints:

a. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.

b. Flux shall conform to ANSI/AWS A5.31.

c. Remove composition discs and all seals during brazing if not suitable for a minimum of 840°F.

2. Mechanical Press Connection:

a. Copper press fitting shall be made in accordance with the manufacturer’s installation instructions.

b. Examination: Upon delivery to the jobsite, examine copper tubing and fittings for debris, defects, incise marks (manufacturer's engraving on tube), holes, or cracks.

c. Fully insert tubing into the fitting and mark tubing.

d. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.

e. Joint shall be pressed with a tool approved by the manufacturer.

f. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

3. Axially Swaged Connection:

a. Brass axially swaged connectors shall be installed in accordance with the manufacturer's installation instructions.

b. Installers shall be trained by a certified Vulkan LOKRING trainer. Provide proof of certification upon request.

E. Insulation:

1. Insulate all refrigerant pipes between the heat pump and indoor units. This includes the liquid pipe, the suction pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant components in the piping between the indoor and heat pump units shall also be insulated. The insulation shall have a continuous vapor barrier and shall pass through hangers and supports unbroken. All exterior insulated piping shall be painted with minimum of one (1) coat of UV resistant paint. Over size hangers and supports to allow the insulation to pass through unbroken. Following are the minimum insulation thicknesses unless noted otherwise in the manufacturer's literature or required by local AHJ:

ASHRAE 2016 | 2013 | 2010 || IECC 2018 | 2015 | 2012	
Pipe System	**Insulation Thickness**
Refrigerant Suction (40ºF & Below) Up to 1” 1” and up	 1/2” 1”
Refrigerant Suction (41ºF to 60°F) Up to 1-1/2” 1-1/2” and up	 1/2” 1”
Refrigerant Low Pressure Gas (141°F61°C-200°F93°C) Up to 1-1/2” 1-1/2” and up	 1-1/2” 2”
Refrigerant High Pressure Gas (201°F94°C-250°F121°C) Up to 4”	 2-1/2”
Refrigerant Liquid Up to 1-1/2” 1-1/2” and up	 1” 1-1/2”

California Tittle 24 - 2016	
Pipe System	**Insulation Thickness**
Refrigerant Suction (40ºF & Below) Up to 1” 1” and up	 1” 1-1/2”
Refrigerant Suction (41ºF to 60°F) Up to 1-1/2” 1-1/2” and up	 1/2” 1”
Refrigerant Low Pressure Gas (141°F to 200°F) Up to 1-1/2” 1-1/2” and up	 1-1/2” 2”
Refrigerant High Pressure Gas (201°F to 250°F) Up to 4”	 2-1/2”
Refrigerant Liquid Up to 1” 1” and up	 1” 1-1/2”

END OF SECTION

SECTION 23 81 45
VARIABLE REFRIGERANT FLOW HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable refrigerant flow split system heat pump (heat/cool).
B. Variable refrigerant flow split system heat pump with heat recovery (simultaneous heat/cool).
C. Refrigerant piping/tubing and insulation.

1.2 REFERENCES

A. ANSI/AHRI 210/240 – Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
B. ANSI/AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
C. ANSI/ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
E. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

1.3 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 23 05 00.

B. Indicate water, drain, and electrical rough-in connections on shop drawings or product data.

C. Submit manufacturer's installation instructions.

D. Submit manufacturer’s warranty information.

E. Submit installing contractor’s manufacturer training certification.

F. Submit refrigerant charge. Charge calculation should be based on installed piping lengths and equipment capacities.

G. VRF Piping Layout Drawings:

1. Submit detailed VRF piping layout drawings at 1/8" = 1’-0” minimum scale complete with the following information:

a. Actual pipe routing, fittings, hanger and support types, accessories, etc. with lengths and refrigerant charge noted.

b. Include insulation thickness and type of insulation.

c. Room names and numbers, ceiling types, and ceiling heights.

d. Indicate location of all beams, bar joists, etc., along with bottom of steel elevations, for each member.

2. Submit VRF piping and equipment layout drawings. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of piping drawings for Contractor's use if the Contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Submittals shall be in accordance with Section 23 05 00.

H. Submit Electrical Power and Controls Diagrams:

1. Power wiring diagrams for each component.

2. Wiring diagrams and layouts for each control panel showing all termination numbers.

3. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Show all interface wiring to the control system.

4. Schematic diagrams for all field sensors and controllers.

5. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.

6. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Label all terminals.

7. All installation details and any other details required to demonstrate that the system will function properly.

8. All interface requirements with other systems.

I. Sequences: Submit 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. **The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.**

J. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.

K. Clearly identify work by others in the submittal.

L. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

1.4 DELIVERY STORAGE AND HANDLING

A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 WARRANTY

A. Installing contractor shall perform tasks required by manufacturer to ensure maximum available warranty is achieved. This will include but is not limited to:

1. System design performed by manufacturer certified designer.
2. System installation performed by manufacturer certified installer.
3. Complete system commissioning paperwork and submit to manufacturer.

B. Provide one (1) year manufacturer’s warranty on all parts and labor (excluding compressors).

[* * * * * OR * * * * *]

C. Provide minimum five (5) year manufacturer's parts warranty (one-year basic warranty plus four-year extended warranty) on all parts (excluding compressors) and one (1) year labor warranty.

[* * * * * OR * * * * *]

D. Provide minimum ten (10) year manufacturer's parts warranty (one-year basic warranty plus nine-year extended warranty) on all parts (excluding compressors) and one (1) year labor warranty.

E. Provide minimum five (5) year manufacturer’s compressor parts warranty.

F. Contractor shall provide one (1) year parts and labor warranty on the associated controls system, including all devices, wiring, and programming.

1.7 DEMONSTRATION

A. Engage manufacturer or factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain individual units and complete system.

PART 2 - PRODUCTS:

2.1 ACCEPTABLE MANUFACTURERS

A. Mitsubishi
B. Daikin AC
C. Panasonic/Sanyo
D. LG
E. Toshiba Carrier
F. Samsung
G. Trane

2.2 SYSTEM DESCRIPTION

A. The variable capacity, heat recovery, heat pump air conditioning system shall be a variable refrigerant flow split system. The system shall consist of multiple evaporators using PID control and inverter driven heat pump unit. The unit shall consist of direct expansion (DX), air-source water-source heat pump air conditioning system, and variable speed driven compressor multi zone split system.

B. Branch Circuit ControllersSolenoid Valve Kits Branch Selector Heat Recovery UnitMode Changing Unit:

1. The unit shall be constructed from galvanized steel plate and be internally insulated with polyurethane foam. The connection to the system shall be either via brazed connection or flare nuts.

2. The unit shall be connected to the indoor units or group of indoor units via its own dedicated connection. This connection shall supply power and control signals to the solenoid valves in the unit.

3. The unit shall have integral controls and be factory assembled, wired, and piped.

4. The unit shall include an integral drain pan and condensate pump as required.

5. The unit electrical power shall be 208-230V/1-phase/60Hz 208-230V/3-phase/60Hz or as noted on the drawings.

6. Provide unit with at least two (2) additional unused connections for future expansion and maintenance. Provide isolation valves and caps on unused connections.

C. Indoor Units:

1. Wall Mounted:

a. Acoustic Performance: The indoor units' sound pressure shall not exceed 35 dBA at low speed measured at 3.3 feet from the units.

b. Construction:

1) The indoor units shall be completely factory assembled and tested. Included in each unit is factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. Each unit shall have at least one auto-swing louver for efficient air distribution, which closes automatically when the unit stops. The remote controller shall be able to set five (5) steps of discharge louver angle. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The condensate drain pipe shall be able to be connected to either left or right sides.

c. The indoor units shall be equipped with a return air thermistor.

d. The indoor unit shall be separately powered.

e. Unit Cabinet:

1) The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.

2) The cabinet shall be constructed of molded plastic cover with sound absorbing foamed polystyrene and polyethylene insulation.

f. Fan:

1) The fan shall be a direct-drive cross-flow type, statically and dynamically balanced with high and low fan speeds available.

2) The fan motor shall be thermally protected.

g. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

h. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

2. Four-way Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette for installation into the ceiling cavity, equipped with an air panel grille as scheduled and specified in this section. The indoor unit shall have four-way air distribution and an ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via motorized louvers that can be horizontally and vertically adjusted from 0° to 90° angle.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) The 4-way supply airflow shall be field modifiable to 3-way and 2-way airflow to accommodate various installation configurations, including corner installations.

3) Return air shall be through the concentric panel, which shall include a filter.

4) The indoor units shall be equipped with a return air thermistor.

5) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be recessed into the ceiling.

2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.

3) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by a washable long-life filter with mildew proof resin.

g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

3. Round 360° Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette for installation into the ceiling cavity, equipped with a round air panel grille as scheduled and specified in this section. The indoor unit shall have round 360° air distribution and an ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via multiple fans.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) Return air shall be through the concentric panel, which shall include a filter.

3) The indoor units shall be equipped with a return air thermistor.

4) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be recessed into the ceiling.

2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.

3) The cabinet shall be constructed with sound-absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by a washable long-life filter with mildew proof resin.

g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

4. One-way Ceiling-Recessed Cassette:

a. The indoor unit shall be a ceiling cassette indoor unit for installation into the ceiling cavity, equipped with an air panel grille as scheduled. The indoor unit shall have a one-way air distribution type, ivory white, impact resistant, washable decoration panel. The supply air shall be distributed via motorized louvers that can be horizontally and vertically adjusted from 0° to 90° angle.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 33 dBA at low speed measured at 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3--minute fused time delay, and test run switch.

2) Return air shall be through the concentric panel, which shall include a filter.

3) The indoor units shall be equipped with a return air thermistor.

4) The indoor unit shall be separately powered.

d. Unit Cabinet:

1) The cabinet shall be space saving and shall be located into the ceiling.

2) Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.

3) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds available.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coil:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 25 inches635 mm lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

5. Ceiling Concealed Ducted (Low Static Pressure):

a. The indoor unit shall be a built-in ceiling concealed indoor unit, low static pressure (LSP), for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing as scheduled. The indoor unit shall be manufactured for ducted horizontal discharge air, with ducted horizontal return air or bottom return air configuration (as scheduled or shown on the drawings). The external static pressure shall be as scheduled on the drawings.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

6. Ceiling Concealed Ducted (High Static Pressure):

a. The indoor unit shall be a built-in ceiling concealed indoor unit, high static pressure (HSP), for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel as scheduled. The indoor unit shall be manufactured for ducted horizontal discharge air, with ducted horizontal return air or bottom return air configuration (as scheduled or shown on the drawings). The external static pressure shall be as scheduled on the drawings.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

3) The cabinet shall be factory insulated for use in unconditioned indoor spaces.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

7. Ceiling Suspended:

a. The indoor unit shall be a ceiling suspended indoor unit. The unit shall be constructed of galvanized steel with painted finish as scheduled. The indoor unit shall be manufactured for a horizontal discharge air with bottom return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall range from 22 dB(A) to 31 dB(A) at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the ceiling and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 18 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

8. Floor Standing Exposed:

a. The indoor unit shall be a floor standing exposed indoor unit. The unit shall be constructed of galvanized steel with painted finish as scheduled. The indoor unit shall be manufactured for a vertical discharge air with bottom front return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be located against the wall, with top mounted supply and bottom return.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

9. Floor Standing Concealed:

a. The indoor unit shall be a floor standing concealed indoor unit. The unit shall be constructed of galvanized steel with painted finish as scheduled. The indoor unit shall be manufactured for a ducted discharge air with bottom front return air configuration.

b. Acoustic Performance: The indoor units' sound pressure shall range from 22 dBA to 31 dBA at low speed 5 feet from the unit.

c. Construction:

1) The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have a booster cable for adjustable static pressure capability.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

4) The switch box shall be reached from the side or bottom for ease of service and maintenance.

d. Unit Cabinet:

1) The cabinet shall be in the wall or casework and ducted to the supply and return openings.

2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

e. Fan:

1) The fan shall be direct-drive type, with statically and dynamically balanced impeller with high and low fan speeds.

2) The fan motor shall be thermally protected.

f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

g. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

h. Vertical Horizontal Air Handling Unit: The indoor unit shall be a floor standing vertical horizontal air handling unit with ducted discharge.

i. Acoustic Performance: Sound pressure shall range from not exceed 41 dBA at low speed measured 3.3 feet from the unit.

j. Construction:

1) Indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic modulating expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function.

2) The indoor units shall be equipped with a return air thermistor.

3) The indoor unit shall be separately powered.

k. Unit Cabinet:

1) Unit cabinet shall be constructed of galvanized steel with painted finish.

2) Cabinet shall be single wall construction with sound absorbing foamed polystyrene and polyethylene insulation.

3) Cabinet shall be factory insulated for use in unconditioned indoor spaces.

l. Fan:

1) Fan shall be direct-drive, forward curved fan, statically and dynamically balanced impeller with high, medium and low fan speeds.

2) Fan shall have static pressure up to 0.5” W.C.

3) Fan motor shall be thermally protected.

m. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

n. Coils:

1) Coils shall be of the direct expansion type, constructed from copper tubes expanded into aluminum fins to form a mechanical bond.

2) The refrigerant connections shall be flare connections, and the condensate shall be coordinated with piping material specified in Section 23 21 00.

3) A condensate pump with at least 20 inches of lift shall be located below the coil in the condensate pan, with a built-in high-level safety alarm to shut down the unit.

4) A thermistor shall be located on the liquid and gas line.

2.3 PIPING

A. Design Pressure: 450 psig.
Maximum Design Temperature: 250 F.

B. Piping - 4" and under.

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Brazed with silver solder.

3. Fittings: Wrought copper solder joint, ANSI B16.22.

4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

C. Piping – 1-3/8” and Under (Contractor’s Option):

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Dual concentric crimp band mechanical press connection.

3. Fittings: Refrigerant Grade Copper in accordance with ASTM B75 or ASTM B743 with embedded HNBR O-ring.

4. Acceptable Manufacturers: Parker Zoomlock.

D. Piping – 1-3/8” and Under (Contractor’s Option):

1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.

2. Joints: Mechanically attached connector, axially swaged compression connection.

3. Fittings: Refrigerant Grade Copper in accordance with ASTM B75 or ASTM B743. Brass body with two stabilization inserts in accordance with ASTM B15/B16M, two steel rings in accordance with ASTM A108-13, anerobic adhesive sealant.

4. Acceptable Manufacturers: Anvil Vulkan Lokring

E. Insulation:

1. EPDM (NBR/PVC Blend is not permitted) elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.25 maximum 'K' value at 75ºF, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). If thickness required in Part 4 - Execution does not meet 25/50 flame spread/smoke developed rating, use multiple layers of a thickness that does meet 25/50 flame spread/smoke developed.

PART 3 - CONTROLS

3.1 GENERAL

A. The unit shall have controls provided with the unit by the manufacturer to perform input functions necessary to operate the system.

B. Computerized PID control shall be used to maintain room temperature within 1°F of setpoint.

C. The unit shall be equipped with a programmable drying cycle that dehumidifies while inhibiting changes in room temperature.

D. The indoor circuit board shall be wired to enable auxiliary heating when at least one of the following occurs:

1. Coil thermistor temperature drops below a factory setpoint in heating mode.
2. Heat pump temperature drops below setpoint (adj.).
3. Based on a user adjustable schedule.

3.2 SIMPLE REMOTE CONTROL – TYPE A

A. The wired remote controller shall be able to control one (1) group (maximum of 16 units) and shall be able to function as follows:

1. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions.

2. The controller shall be able to immediately display fault location and condition.

3. An LCD digital display shall allow the temperature to be set in 1°F units.

4. The controller shall be equipped with a thermostat sensor in the remote controller, making possible more comfortable room temperature control.

B. The wired remote controller shall have the following features:

1. Operation: Start/Stop, Temperature Setting, Fan Speed.

2. Monitoring: Status, malfunction flashing, malfunction content, filter sign, operation mode, temperature setting, permit/prohibit selection, fan speed, airflow direction.

3. Control Management: Field Setting Mode, Group Setting, Auto Restart.

4. The controller shall also be able to switch an external dry contact via a 12-volt DC relay (field supplied).

3.3 DELUXE REMOTE CONTROL – TYPE B

A. The wired remote controller shall be able to control one (1) group (maximum of 16 indoor units) and shall be able to function as follows:

1. The controller shall have a self-diagnosis function that constantly monitors the system for malfunctions.

2. The controller shall be able to immediately display fault location and condition.

3. An LCD digital display shall allow the temperature to be set in 1°F units.

4. The controller shall be equipped with a thermostat sensor in the remote controller, making possible more comfortable room temperature control.

B. The wired remote controller shall have the following features:

1. Operation: Start/Stop, Operation Mode, Temperature Setting, 60°F - 90°F, Setpoint Range, Fan Speed, Airflow Direction.

2. Monitoring: Status, malfunction flashing, malfunction content, filter sign, operation mode, temperature setting, permit/prohibit selection, fan speed, airflow direction.

3. Scheduling: ON/OFF Timer.

4. Control Management: Field Setting Mode, Group Setting, Auto Restart.

5. The controller shall also be able to switch an external dry contact via a 12-volt DC relay (field supplied).

3.4 SYSTEM CONTROLLER – TYPE C

A. The controller shall control at least 50 units and shall be able to be used in conjunction with all room controller types. Collective and individual group commands are available with permit/prohibit individual remote controller function. At least five system controllers shall be able to reside on any one communication bus.

3.5 CENTRAL CONTROLLER – TYPE D

A. This controller shall be wall mounted and hard wired, either directly to the control system or via gateway. It shall be manufactured in ABS plastic with an LCD display and shall be the manufacturer's standard color. The controller shall be capable of individually controlling the following functions on at least 128 indoor units:

1. On/off
2. Operating mode
3. Setpoint
4. Fan speed
5. Louver position
6. Timer settings
7. Test run

B. The controller shall also be capable of displaying the following information individually for at least 128 indoor units:

1. On/off
2. Operating mode
3. Setpoint
4. Fan speed
5. Louver position
6. Timer settings
7. Test run
8. Fault diagnosis

C. Each central controller unit can be accessed either locally or remotely via standard internet software. The central controller will be able to indicate system alarms via volt free contacts, as well as providing control points for other devices. Additionally, the central controller shall be able to monitor individual usage of heating and cooling demands, report alarm and conditions to nominated email address, and enable remote alteration of systems setpoints to registered users. All required software costs and licensing fees shall be included for the life of the systems.

3.6 MAINTENANCE ACCESS

A. Provide all gateways and connection cabling for performing maintenance functions on system.

B. Provide all software and registration codes as required to allow access into advanced maintenance functions.

3.7 SEQUENCE

A. Install a remote mounted temperature sensor.

B. The thermostat shall stage heating or cooling as required to maintain space setpoint at 72°F (adj.).

C. Thermostat shall automatically change the indoor unit mode based on the space setpoint.

D. If space setpoint continues to drop once indoor unit has been changed to heating mode, the thermostat shall enable the space electric baseboard heat.

E. Control system shall have capability to control electric baseboard heat.

F. Central controller shall enable dedicated heat pump unit based on an adjustable occupancy schedule. Coordinate enable/disable function with AHU manufacturer.

3.8 SYSTEM INTEGRATION

A. The manufacturer's control system shall be capable of integrating with the building automation system with built in hardware or separate add-on interfaces. All additional devices shall be provided by the manufacturer.

B. The system shall be compatible with LonWorks®, BACnet®, Modbus®, or N2®. Refer to Section 23 09 00.

PART 4 - EXECUTION

4.1 INSTALLATION

A. Install in accordance with manufacturer's instructions. Install all piping, fittings, and insulation to meet manufacturer's requirements. Install units level and plumb. Evaporator fan components shall be installed using manufacturer's standard mounting devices securely fastened to building structure. Install and connect refrigerant tubing and fittings.

B. Installing contractor shall attend manufacturer sponsored training to obtain installation certification.

C. Installer shall supply isolation ball valves for zoned refrigerant isolation. Installer shall supply isolation ball valves with Schrader connection for isolating refrigerant charge and evacuation at each connected indoor unit and heat pump unit. Isolation ball valves, with Schrader connection, are required for instances of indoor unit isolation for troubleshooting, repair, or replacement without affecting the remainder of the system. Isolation ball valves with Schrader connection are also required at heat pump unit connection to isolate unit for troubleshooting, repair, or replacement and as required to provide partial capacity heating/cooling in the instance of a failure of one of the multiple heat pump unit compressors.

D. Insulate all refrigerant pipes between the heat pump and indoor units. This includes the liquid pipe, the suction pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant components in the piping between the indoor and heat pump units shall also be insulated. The insulation shall have a continuous vapor barrier and shall pass through hangers and supports unbroken. All exterior insulated piping shall be painted with minimum of one (1) coat of UV resistant paint. Over size hangers and supports to allow the insulation to pass through unbroken.

Following are the minimum insulation thicknesses unless noted otherwise in the manufacturer's literature or required by local AHJ:

ASHRAE 2016 | 2013 | 2010 || IECC 2018 | 2015 | 2012	
Pipe System	**Insulation Thickness**
Refrigerant Suction (40ºF & Below) Up to 1" 1" and up	 1/2" 1"
Refrigerant Suction (41ºF to 60°F) Up to 1-1/2" 1-1/2" and up	 1/2" 1"
Refrigerant Low Pressure Gas (141°F61°C-200°F93°C) Up to 1-1/2" 1-1/2" and up	 1-1/2" 2"
Refrigerant High Pressure Gas (201°F94°C-250°F121°C) Up to 4"	 2-1/2"
Refrigerant Liquid Up to 1-1/2" 1-1/2" and up	 1" 1-1/2"

California Tittle 24 - 2016	
Pipe System	**Insulation Thickness**
Refrigerant Suction (40ºF & Below) Up to 1" 1" and up	 1" 1-1/2"
Refrigerant Suction (41ºF to 60°F) Up to 1-1/2" 1-1/2" and up	 1/2" 1"
Refrigerant Low Pressure Gas (141°F to 200°F) Up to 1-1/2" 1-1/2" and up	 1-1/2" 2"
Refrigerant High Pressure Gas (201°F to 250°F) Up to 4"	 2-1/2"
Refrigerant Liquid Up to 1" 1" and up	 1" 1-1/2"

E. Engage manufacturer or factory-authorized service representative to perform startup service. Manufacturer shall provide on-site startup and commissioning assistance through job completion. Complete installation and startup checks according to manufacturer's written instructions.

F. Fully charge system with refrigerant per manufacturer's requirements.

G. Field Quality Control:

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing.

2. Perform the following field tests and inspections, and prepare test reports:

a. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

b. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Coordinate installation of units with architectural and electrical work. Coordinate installation of ceiling recessed units with ceiling grid layout. Additional ceiling grid reinforcement or modification is the responsibility of the Mechanical Contractor and shall be coordinated with the General Contractor.

I. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Height above finished floor shall not exceed 48".

J. Contractor is responsible for routing all condensate drains from all indoor equipment to a nearby floor drain or standpipe. If ceiling heights or space finish does not accommodate gravity drainage, Contractor is responsible for providing a condensate pump and all electrical work required.

K. Contractor is responsible for installing VRF heat pump control system. Contractor shall coordinate with the Temperature Controls Contractor to determine extent of integration with building automation system (BAS). Equipment that is required to integrate the VRF heat pump system with the BAS is the responsibility of the VRF heat pump installing contractor. Final connections between VRF heat pump system and BAS shall be by the Temperature Controls Contractor.

4.2 JOINING OF PIPE

A. Brazed Joints:

1. Make up joints with brazing filler metal conforming to ANSI/AWS A5.8. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to brazing. Apply flux evenly, but sparingly, to all surfaces to be joined. Brazing filler metal with a flux coating may also be used. Heat joints uniformly to proper brazing temperature so braze filler metal flows to all mated surfaces. Wipe excess braze filler metal, leaving a uniform fillet around cup of fitting.

2. Flux shall conform to ANSI/AWS A5.31.

3. Remove composition discs and all seals during brazing if not suitable for a minimum of 840°F.

B. Mechanical Press Connection:

1. Copper press fitting shall be made in accordance with the manufacturer’s installation instructions.

2. Examination: Upon delivery to the jobsite, examine copper tubing and fittings for debris, defects, incise marks (manufacturer's engraving on tube), holes, or cracks.

3. Fully insert tubing into the fitting and mark tubing.

4. Prior to making connection, the fitting alignment shall be checked against the mark made on the tube to ensure the tubing is fully engaged in the fitting.

5. Joint shall be pressed with a tool approved by the manufacturer.

6. Installers shall be trained by manufacturer personnel or representative. Provide documentation upon request.

C. Axially Swaged Connection:

1. Brass axially swaged connectors shall be installed in accordance with the manufacturer’s installation instructions.

2. Installers shall be trained by a certified Vulkan LOKRING trainer. Provide proof of certification upon request.

END OF SECTION

SECTION 26 05 00
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)
B. CCR California Code of Regulation
C. CBC California Building Code
D. CFC California Fire Code
E. CEC California Electric Code
F. CMC California Mechanical Code
G. CPC California Plumbing Code
H. California Title 24 - Building Energy Efficiency Standards
I. SCAQMD Southern California Air Quality Management Division

1.3 SCOPE OF WORK

A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.

B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.

C. Description of Systems shall be as follows:

1. Electrical power system to and including luminaires, equipment, motors, devices, etc.

2. Electrical power service system from the Utility Company to and including service entrance equipment, distribution and metering.

3. Grounding system.

4. Fire alarm system.

5. Wiring system for temperature control system as shown on the drawings.

6. Wiring of equipment furnished by others.

7. Removal work and/or relocation and reuse of existing systems and equipment.

8. Telecommunications rough-in, as shown on drawings, for installation of telecommunications equipment by others under separate contract.

9. Technology Systems as described in Division 27/28 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.

D. Work Not Included:

1. Telecommunications cabling will be by others Division 27, in raceways and conduits furnished and installed as part of the Electrical work.

2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.4 OWNER FURNISHED PRODUCTS

A. The Owner will supply the following items for installation and/or connection by this Contractor:

1. IT Equipment switches for 3 server rooms.

B. The following items shall be relocated, installed and/or connected by this Contractor:

1. Existing egress lights to be re-circuited to new emergency panel.

C. The Owner will supply manufacturer's installation data for new equipment purchased by him for this project.

D. This Contractor shall make all electrical system connections shown on the drawings **or** required for fully functional units.

E. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.5 WORK SEQUENCE

A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours are required.

B. Itemize all work and list associated hours and pay scale for each item.

1.6 ALTERNATES

1.7 UNIT PRICES

1.8 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.

2. “Technology Contractors” refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.

3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.

4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.

5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.

6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.

7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.

8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.

10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.

3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements, California Code of Regulation Title 24, Article E725.

4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

    a. Luminaires.
    b. Gravity flow piping, including steam and condensate.
    c. Electrical bus duct.
    d. Sheet metal.
    e. Cable trays, including access space.
    f. Other piping.
    g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.

2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.

3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.

4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.

2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.

3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.

2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.

3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.

4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".

2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.

3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.

4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.

5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the telecommunications ground bar.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.9 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

a. Scale of drawings:

1) General plans: 1/4 Inch = 1 '-0" (minimum).

2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

    c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.10 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.

2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Los Angeles Codes, Laws, Ordinances and other regulations having jurisdiction.

2. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.

3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.

4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.

6. If there are no local codes having jurisdiction, the current issue of the NEC shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.

3. Pay all charges for permits or licenses.

4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.

5. Pay all charges arising out of required inspections by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter’s Laboratories, Inc. or a nationally recognized testing organization.

8. Pay all telephone company charges related to the service or change in service.

E. Utility Company Requirements:

1. Secure from the private or public utility company all applicable requirements.

2. Comply with all utility company requirements.

3. The Owner shall make application for and pay for new electrical service equipment and installation. The Contractor shall coordinate schedule and requirements with the Owner and Utility Company.

4. Furnish the meter socket metering compartment with CT space within the main switchboard. Verify approved manufacturers and equipment with the Utility Company.

5. The Owner shall apply and pay for any changes for removal of existing electrical service by the utility company. The Contractor shall verify approved manufacturers and equipment with the Utility Company.

F. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.

3. Scaling of the drawings will not be sufficient or accurate for determining these locations.

4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.

6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.

7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.

8. Where used in electrical documents the word “furnish” shall mean supply for use, the word “install” shall mean connect up complete and ready for operation, and the word “provide” shall mean to supply for use and connect up complete and ready for operation.

9. Any item listed as furnished shall also be installed unless otherwise noted.

10. Any item listed as installed shall also be furnished unless otherwise noted.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing AutoCAD MEP.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.11 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
26 05 03	Through Penetration Firestopping
26 05 13	Wire and Cable
26 05 15	Medium Voltage Cable and Accessories
26 05 17	Electric Heat Trace and Snow Melt
26 05 23	Manufactured Wiring Assemblies
26 05 26	Grounding and Bonding
26 05 29	Undercarpet Cable Systems
26 05 33	Conduit and Boxes
26 05 35	Surface Raceways
26 05 36	Cable Trays
26 05 37	Manholes
26 05 38 and Layout Plan	Underfloor Ducts
26 05 48	Seismic Requirements for Equipment and Supports
26 05 53	Electrical Identification
26 05 73	Power System Study
26 09 13	Power Monitoring and Control System
26 09 23	DALI Lighting Control Systems
26 09 33	Lighting Control System
26 11 00	Secondary Unit Substation
26 12 00	Dry-Type Distribution and Power Transformers
26 12 13	Liquid-Filled Substation Distribution Transformers
26 12 19	Pad-Mounted, Liquid-Filled Transformers
26 12 21	Pole-Mounted Overhead Distribution Transformers
26 13 13	Medium Voltage Metal-Clad Vacuum Circuit Breaker Switchgear
26 13 14	Pad Mounted Medium Voltage Switchgear

Referenced Specification Section	Submittal Item
26 13 15	Pad-Mounted Medium Voltage SF6 Switchgear
26 13 34	Medium Voltage Metal-Enclosed Load Interrupter Switchgear
26 13 35	Paralleling and Distribution Switchgear Medium Voltage
26 18 39	Medium Voltage Motor Controllers
26 18 39.02	Medium Voltage AC Drive Motor Controllers
26 19 00	Overhead Power Distribution
26 20 00	Service Entrance
26 22 00	Dry Type Transformers
26 23 00	Low-Voltage Switchgear
26 24 13	Switchboards
26 24 14	Paralleling and Distribution Switchboard
26 24 16	Panelboards
26 24 19	Motor Control
26 24 21	Hospital Isolated Power Systems
26 24 22	Integrated Power Center
26 24 23	Packaged Power Center
26 25 00 and Layout Plan	Busway
26 25 05	Cable Bus
26 26 00	Power Distribution Unit
26 27 16	Cabinets and Enclosures
26 27 23	Indoor Service Poles
26 27 26	Wiring Devices
26 27 29	Electric Vehicle Charging Station
26 28 13	Fuses
26 28 16	Disconnect Switches
26 28 21	Contactors
26 29 23	Variable Frequency Drives
26 31 00	Solar Photovoltaic Systems
26 32 13	Packaged Engine Generator Systems
26 33 53	Static Uninterruptible Power Supply (UPS)
26 35 00	Power Conditioners
26 35 33	Power Factor Correction Equipment
26 36 00	Transfer Switch
26 41 00	Lightning Protection Equipment
26 43 00	Surge Protection Devices
26 51 00	Lighting
26 51 19	LED Lighting
26 52 15	Emergency Lighting Inverter
26 56 68	Sports Lighting
28 31 00	Fire Alarm and Detection Systems
28 31 50	Air Sampling Smoke Detection System
Drawings	Clock System
Drawings	Photocells, Timeclocks, Relays

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

   a. Date
   b. Project title and number
   c. Contractor’s name and address
   d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
   e. Description of items submitted and relevant specification number
   f. Notations of deviations from the contract documents
   g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

   a. Date
   b. Project title and number
   c. Architect/Engineer
   d. Contractor and subcontractors’ names and addresses
   e. Supplier and manufacturer’s names and addresses
   f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
   g. Description of item submitted (using project nomenclature) and relevant specification number
   h. Notations of deviations from the contract documents
   i. Other pertinent data
   j. Provide space for Contractor’s review stamps

3. Composition:

   a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

   b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

   c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor’s Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

c. The Contractor's review shall include, but not be limited to, verification of the following:

1) Only approved manufacturers are used.
2) Addenda items have been incorporated.
3) Catalog numbers and options match those specified.
4) Performance data matches that specified.
5) Electrical characteristics and loads match those specified.
6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
7) Dimensions and service clearances are suitable for the intended location.
8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**

6. Submittal Identification and Markings:

a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor’s responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer’s approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. Submittal file name: 26 XX XX.description.YYYYMMDD
   b. Transmittal file name: 26 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.

2. The Contractor shall submit ten (10) paper copies of each shop drawing.

3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.12 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

   a. Material: Delivered cost of product with taxes paid.
   b. Labor: Labor cost, excluding overhead and profit.

3. Itemize the cost for each of the following:

   a. Overhead and profit.
   b. Bonds.
   c. Insurance.
   d. General Requirements: Itemize all requirements.

4. For each line item having an installed cost of more than $5,000, break down costs to list major products or operations under each item. At a minimum, provide material and labor cost line items for the following:

   a. Each piece of equipment requiring shop drawings. Use the equipment nomenclature (SB-1, PANEL P-1, etc.) on the Schedule of Values.
   b. Each type of small unitary equipment (e.g., FDS, FCS, CS, etc.). Multiple units of the same type can be listed together provided quantities are also listed so unit costs can be determined.
   c. Each conduit system (medium voltage, normal, emergency, low voltage systems, etc.). In addition, for larger projects breakdown the material and labor for each conduit system based on geography (building, floor, and/or wing).
   d. Fire alarm broken down into material and labor for the following:
      1) Engineering
      2) Controllers, devices, sensors, etc.
      3) Conduit
      4) Wiring
      5) Programming
      6) Commissioning
   e. Site utilities (5’ beyond building)
   f. Seismic design
   g. Testing
   h. Commissioning
   i. Record drawings
   j. Punchlist and closeout

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.13 CHANGE ORDERS

A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.14 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.

B. Keep all materials clean, dry and free from damaging environments.

C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.

D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.15 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.16 WARRANTY

A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.

B. The warranty period for all work in this specification Division shall commence on the date of Substantial Completion or successful system performance whichever occurs later. The warranty may also commence if a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization of the Owner. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.17 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.18 CONTINGENCY

A. Include in the Base Bid a contingency of one percent (1%) to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.19 MATERIAL SUBSTITUTION

A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications, and fit in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on his part or on the part of other Contractors whose work is affected.

D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on his part or on the part of other Contractors whose work is affected.

E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

1.20 PROJECT COMMISSIONING

A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and 26 08 00, and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS

2.1 GENERAL

A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.

2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

3. Trim bottom and sides of excavations to grades required for foundations.

4. Protect excavations against frost and freezing.

5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.

6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.

8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.

9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.

12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.

2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.

2. Furnish all necessary sand for backfilling.

3. Dispose of the excess excavated earth as directed.

4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.

5. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.

6. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6” uniform horizontal layers with each layer compacted separately to required density.

7. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.

8. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.

9. Backfill with sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.

10. Place all backfill above the sand in uniform layers not exceeding 6” deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.

11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.

12. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6” of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.

2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days’ notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.

2. Covering exterior walls, interior partitions and chases.

3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor’s schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer’s review. This includes, but is not limited to:

a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.

b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.

c. Luminaire whips are supported above the ceiling.

d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.

e. Luminaires are suspended independently of the ceiling system when required by these contract documents.

f. All wall penetrations have been sealed.

2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.

3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

3.4 PROJECT CLOSEOUT

A. The following paragraphs supplement the requirements of Division 1.

B. IDPH Pre-Occupancy Requirements:

1. Each Contractor must submit all forms and certifications required by IDPH relating to their work at 85% completion of the project or when directed by the Owner/Architect/Engineer.

C. Final Jobsite Observation:

1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.

2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.

3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor’s final payment.

4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling tiles.

D. The following must be submitted before Architect/Engineer recommends final payment:

1. Operation and maintenance manuals with copies of approved shop drawings.

2. Record documents including marked-up or reproducible drawings and specifications.

3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.

4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.

5. Inspection and testing report by the fire alarm system manufacturer.

6. Start-up reports on all equipment requiring a factory installation or start-up.

E. Circuit Directories:

1. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. O&M file name: O&M.div26.contractor.YYYYMMDD
b. Transmittal file name: O&Mtransmittal.div26.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Paper Copy Submittal Procedures:

1. Once the electronic version of the manuals has been approved by the Architect/Engineer, paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.

2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. “Peel and stick” labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.

3. Binder Labels: Label the front and spine of each binder with “Operation and Maintenance Instructions”, title of project, and subject matter.

4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.

D. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect’s/Engineer’s shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copies of all factory inspections and/or equipment startup reports.

5. Copies of warranties.

6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

7. Dimensional drawings of equipment.

8. Detailed parts lists with lists of suppliers.

9. Operating procedures for each system.

10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

11. Repair procedures for major components.

12. Replacement parts and service material requirements for each system and the frequency of service required.

13. Instruction books, cards, and manuals furnished with the equipment.

14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.

15. Copies of all panel schedules in electronic Microsoft Excel spreadsheet (.xlsx) file. Each panelboard shall be a separate tab in the workbook.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.

D. The instructions shall include:

1. Maintenance of equipment.
2. Start-up procedures for all major equipment.
3. Description of emergency system operation.

E. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.

F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.

G. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner’s representatives for the electrical and specialized systems.

2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 RECORD DOCUMENTS

A. The following paragraphs supplement the requirements of Division 1.

B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

F. Record actual routing of conduits exceeding 2 inches.

3.8 PAINTING

A. This Contractor shall paint the following items:

B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.

C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.

D. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect his color preference before ordering.

F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.

G. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.

H. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.

I. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:

1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.

2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.

3. Color of paint shall be as follows:

3.9 ADJUST AND CLEAN

A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.

C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.

B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner’s representative prior to setting equipment.

C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner’s representative will result in removal and reinstallation of the equipment at the Contractor’s expense.

D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. Low Emitting Materials – Adhesives and Sealants.

2. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

3. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

4. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

3.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

A. Within the limits of Construction:

1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.

2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.

B. Outside the limits of Construction:

1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.

2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.

3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

C. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:

1. General Contractor shall erect and maintain dust barriers throughout the construction work. These barriers shall be reasonably airtight and shall prevent entry into the construction zone by unauthorized persons. Reasonably airtight means construction equivalent to full-height temporary or permanent walls with joints taped or sealed, and shafts and other penetrations sealed as well as possible. Fire resistant polyethylene is acceptable; if flame spread/smoke developed ratings are demonstrated to conform to the applicable building codes and licensing acts.

2. The Contractor shall continuously maintain the construction zone under a negative pressure of at least 0.01" w.g. minimum relative to all adjacent areas of the building.

a. Exhaust fans used for this purpose shall filter air and discharge it outdoors or to the least populated area adjacent to the construction work using negative air machines designed specifically for this purpose. All filtration for air recirculated back into the building shall be HEPA (99.97% DOP efficiency) for work adjacent to healthcare or elderly facilities. If no work is adjacent to these areas, 95% filtration is acceptable. Filtering air discharged to outdoors shall be accomplished with 30% filters.

b. If air is discharged outdoors, maintain all required distances to doors, windows, air intakes, etc.

c. If high levels of Volatile Organic Compounds (VOC's) or odors are released, activated carbon or equivalent filtration shall also be employed. Exhaust shall not discharge near doors, air intakes, pedestrians, gathering areas, or operable windows.

d. Adjusting existing air handling equipment to assist in pressure control is acceptable, if approved by the Owner and the authority having jurisdiction.

e. Seal return, exhaust, and supply air openings in or near the construction zone that serve existing air handling systems, and rebalance the systems for proper operation. If this is impractical, add filters at the intakes of sufficient cross sectional area to minimize the pressure drop and avoid the need for rebalancing.

f. Maintain pressure control one hour before and after all construction periods, and 24 hours per day in healthcare or elderly facilities.

3. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:

   a. Minimizing the amount of dust generated.
   b. Reducing solvent fumes and VOC emissions.
   c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.

4. Request that the Owner designate an IAQ representative.

5. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.

6. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.

7. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.

8. Request copies of and follow all Owner's IAQ and infection control policies.

9. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.

10. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.

11. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings under Construction".

3.12 SYSTEM STARTING AND ADJUSTING

A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.

B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.

C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.

D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.13 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.

2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.

3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.

4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.

5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than NEC Standards. Take readings between conductors, and between conductors and ground.

6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)

2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain. Ground resistance values shall be verified by the Architect/Engineer at the time the readings are taken.

3. If the ground resistance value obtained is more than the value set forth in Section 26 05 26, the following shall be done to obtain the value given:

a. Verify that all connections in the service ground system are secure.

b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.

c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.

d. Review results with the Architect/Engineer.

4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:

a. Date of test.

b. Number of hours since the last rain.

c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.

d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.

e. Make, model, and calibration date of test equipment.

f. Tabulation of measurements taken and calculations made.

C. Other Equipment:

1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

D. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

E. Contractor shall thermographic study all electrical gear, switchboard, panelboards, etc. at the end of construction to identify any unusual conditions/heating within the equipment. Coordinate with Owner/Architect/Engineer to have an Owner/Architect/Engineer representative present during testing.

F. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.

G. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for “benchmark” amperages.

3.14 UTILITY REBATE

A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.

B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

END OF SECTION

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, medium voltage testing report has been submitted.
6. Per Section 26 05 00, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
8. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
9. Report of instruction of Owner’s representative has been submitted as per Section 26 05 00.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

* * * * * *

SECTION 26 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 - Fire Tests of Building Construction and Materials.
B. UL 723 - Surface Burning Characteristics of Building Materials
C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
F. Intertek / Warnock Hersey - Directory of Listed Products
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
I. The Building Officials and Code Administrators National Building Code
J. 2018 International Building Code
K. NFPA 5000 – Building Construction Safety Code
L. CBC California Building Code

1.4 SUBMITTALS

A. Submit under provisions of Division 1 Section 26 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Interek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

F. Submit VOC rating of firestopping material in g/L (less water) with documentation that it meets the limits set forth in SCAQMD Rule 1168.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

a. Floor penetrations located outside wall cavities.
b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq.ft. at both ambient temperature and 400°F.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

F. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. Low Emitting Materials – Adhesives and Sealants.

2. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

3. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

4. South Coast Air Quality Management District Rule SCAQMD 1113 – Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk
4. Tremco; Sealant/Weatherproofing Division
5. Johns-Manville
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems

9. Wiremold/Legrand: FlameStopper
10. Dow Corning Corp
11. Fire Trak Corp
12. International Protective Coating Corp

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

E. Provide firestopping systems allowing continuous insulation for all insulated pipes.

F. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
F Rating = Floor/Wall Rating
T Rating = Floor/Wall Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
F Rating = Wall Rating
T Rating = 0
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999

Penetrating Item	UL System No.
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Walls) = 0 or Wall Rating
T Rating (Floors) = Floor Rating
L Rating = Penetrations in Smoke Barriers

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

G. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

H. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 26 05 13
WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building wire
B. Cabling for remote control, signal, and power limited circuits
C. Fire rated and circuit integrity (CI) cable and assemblies
D. Healthcare facilities cable (HFC)
E. Armored cable (AC)
F. Metal-clad cable (MC)
G. Nonmetallic-sheathed cable (NM)

1.2 RELATED WORK

A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

A. ASTM B800-05 – Standard Specification for 8000 Series Aluminum Alloy Wire Electrical Purposes-Annealed and Intermediate Tempered.
B. ASTM B801-07 – Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation
C. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
D. NFPA 70 - National Electrical Code (NEC)
E. UL 44 – Thermoset-Insulated Wires and Cables
F. UL 83 – Thermoplastic-Insulated Wires and Cables
G. UL 854 – Service-Entrance Cables
H. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords
I. UL 2196 – Fire Resistive, Fire Resistant and Circuit Integrity Cables
J. California Division of State Architect (DSA) Interpretation of Regulations

1.4 SUBMITTALS

A. Submit shop drawings and product data under the provisions of Section 26 05 00.

B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600-volt insulation, THHN/THWN or XHHW-2.

B. Feeders and Branch Circuits Larger Than 6 AWG: Aluminum, AA-8000 series alloy, compact stranded conductor, 600-volt insulation, USE-2/RHH/RHW-2 or XHHW-2.

1. Aluminum conductors shall not be allowed for the following:

a. Utility service entrance conductors.

b. Fire pump service entrance, controller, and motor.

c. Elevator equipment.

d. Motor loads 100A and larger.

e. Medical equipment.

f. Emergency generator conductors to and from generator distribution panel / paralleling gear.

g. Refer to Section 26 05 26 Grounding & Bonding for acceptance of AL conductors.

h. Refer to Section 26 41 00 Lightning Protection System for acceptance of AL conductors.

C. Feeders and Branch Circuits Larger Than 6 AWG in Underground Conduit: Copper, stranded conductor, 600-volt insulation, THWN or XHHW-2.

D. Feeders and Branch Circuits Larger Than 6 AWG in Underground Conduit: Aluminum, AA-8000 series alloy, compact stranded conductor, 600-volt insulation, USE-2/RHH/RHW-2.

E. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600-volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings. Aluminum, compact stranded conductor is not acceptable for feeder and branch circuits 6 AWG and smaller.

F. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings. Three conductor stranded coverall helical copper tape shield. Shield shall be terminated at both ends of cable with an approved termination.

G. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.

H. Aluminum conductors are not to be used for feeds to motor loads.

I. Operating Room Power Isolation Systems: Copper, stranded conductor, with low leakage insulation, Type 'XLP' ‘XHHW-2’.

J. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating.

2.2 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS:

A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.

1. Fire alarm
2. Low voltage switching
3. Building automation systems and control
4. Sound
5. Electronic control
6. Security
7. TV
8. Telephone

9. Data
10. Clock

B. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60ºC, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

D. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 FIRE-RATED AND CIRCUIT INTEGRITY (CI) CABLE AND ASSEMBLIES

A. Properties and requirements of fire rated cables and assemblies:

1. 2HR fire rated for horizontal and vertical installations.

B. Acceptable fire-rated cables and listed assemblies:

1. Feeder assembly located outside the structure (example: below finished grade) or encased in concrete; minimum 2 inches [50mm] of concrete).

2. Mineral Insulated Cables: Copper conductor, 600-volt insulation, rated 90ºC, Type MI.

3. MC Cable: Copper conductor, 600V thermoset, low smoke zero halogen silicone rubber insulation, continuously welded corrugated copper armor for equipment grounding conductor, rated 90°C, UL listed 2196. MC fire rated cable shall not be used for branch circuits that required redundant equipment ground paths per code.

a. Approved Manufacturer:

1) VITALink MC
2) Raychem Tycothermal MC

4. Fire rated cable in phenolic RTRC conduit: Copper conductor, 600-volt RHW-2 or RW90 low smoke zero halogen (LSZH) insulation, rated 90°C. Assembly shall be UL listed 2196 and UL circuit integrity (FHIT).

a. Approved Manufacturers:

1) Draka Lifeline
2) VITALink 300

2.4 ARMORED CABLE (AC)

A. Conductors shall be copper, 600-volt insulation, THHN. Armored cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Armored Cables, UL 4, and include flexible metallic interlocked armor.

B. Minimum conductor size for branch circuit wiring shall be 12 AWG, with larger wires used where specified.

C. Armored cables may be used for branch circuit wiring in non-patient care areas as defined in NEC 320, subject to acceptance by State and local codes.

D. Armored cable shall **NOT** be used for circuits serving the Essential Electrical System.

2.5 METAL-CLAD CABLE (MC)

A. Conductors shall be copper, 600-volt insulation, THHN. Metal clad cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Metal-Clad Cables, UL 15694, exterior of metal interlocked armor.

B. Minimum conductor size for branch circuit wiring shall be 12 AWG, with larger wires used where specified.

C. Metal-clad cables may be used for branch circuit wiring in non-patient care areas as defined in NEC 330, subject to acceptance by State and local codes.

D. Metal-clad cable shall **NOT** be used for circuits serving the Essential Electrical System.

2.6 NONMETALLIC-SHEATHED CABLE

A. Nonmetallic-Sheathed Cable, Size 14 through 4 AWG:

1. Copper conductor, 600-volt insulation, rated 90ºC, Type NM. Nonmetallic-sheathed cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Nonmetallic-sheathed Cables, UL 719.

2. An equipment grounding conductor shall be provided with circuit conductors in all cables. Size per NEC 250.

3. Nonmetallic-sheathed cables may be used for branch circuit wiring as defined in NEC 334. Nonmetallic-sheathed cables shall not be used for other circuits.

B. Underground Feeder and Branch Circuit Cable: Copper conductor, 600-volt insulation, rated 60°C, Type UF.

C. Service Entrance Cable: Copper conductor, 600-volt insulation, XHHW, Type USE.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Above Accessible Ceilings:

1. Building wire shall be installed in raceway.

2. Metal clad cable, Type MC, 1/2” size with minimum #12 conductors and ground, shall be allowed for flexible whips to individual luminaires **on non-essential circuits**. The flexible whips shall be between 18” to 60” in length per NEC 410.116(C).

B. All Other Locations: Building wire in raceway.

C. Above Grade: All conductors installed above grade shall be type “THHN”.

D. Underground or In Slab: All conductors shall be type “THWN”.

E. Low Voltage Cable (less than 100 volts): Low voltage cables in ducts, plenums, and other air handling spaces shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.

1. J-hooks
2. Bridle rings with saddle supports

F. Fire-Rated 2-Hour Feeders and Circuit Requiring Continuous Operation (CI): Refer to Part 2 of this section for acceptable products and assemblies. Installation shall meet UL 2196.

3.2 CONTRACTOR CHANGES

A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.15(B)(16) (formerly 310.16 for NEC 2008 and earlier). Service entrance and fire pump feeder conductors are based on copper conductor installed in underground electrical ducts, NEC Table B.310.15(B)(2)(7) (formerly B.310.7 for NEC 2008 and earlier).

B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.

C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.15(B)(2)(7) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.

D. Record drawing shall include the calculations and sketches.

3.3 GENERAL WIRING METHODS

A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.

B. Use no wire smaller than 18 AWG for low voltage control wiring (<100 volts).

C. 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.

D. Use no wire smaller than 8 AWG for outdoor lighting circuits.

E. The ampacity of multiple conductors in one conduit shall be derated per NEC 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.

F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

G. Splice only in junction or outlet boxes.

H. Neatly train and lace wiring inside boxes, equipment, and panelboards.

I. Make conductor lengths for parallel circuits equal.

J. All conductors shall be continuous in conduit from last outlet to their termination.

K. Terminate all spare conductors on terminal blocks, and label the spare conductors.

L. Cables or wires shall not be laid out on the ground before pulling.

M. Cables or wires shall not be dragged over earth or paving.

N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.

O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.

P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.4 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires. Do not use wire pulling lubricant for isolated (ungrounded) power system wiring.

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. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through raceway.

D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.

E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.

F. Only nylon rope shall be permitted to pull cables into conduit and ducts.

G. Completely and thoroughly swab raceway system before installing conductors.

H. Conductor Supports in Vertical Raceways:

1. Support conductors in vertical raceways in accordance with NEC 300.19 and Table 300.19(A) Spacing of Conductors Supports.

2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

3.5 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.

B. Use suitable cable fittings and connectors.

C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.

D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.

E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.

F. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.

G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.6 FIRE-RATED CABLE AND ASSEMBLY INSTRUCTIONS

A. Terminations of the fire-rated cable must be outside of the fire zone.

B. Fire-rated cable shall be installed according to the manufacturer's instructions, recommendations, and UL listing.

C. Route fire-rated cable and assemblies separate from other feeders and distribution. Install cable and assemblies in locations protected from physical damage.

D. Refer to Electrical Identification Section 26 05 53 for specific identification requirements.

3.7 WIRING CONNECTIONS AND TERMINATIONS

A. Splice and tap only in accessible junction boxes.

B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.

C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.

D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor. Cold shrink connector insulator with 1kV rating shall be used in damp and wet locations.

F. Thoroughly clean wires before installing lugs and connectors.

G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.

I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:

1. Facing the front and operating side of the equipment, the phase identification shall be:

a. Left to Right - A-B-C
b. Top to Bottom - A-B-C

J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

K. Use antioxidant joint compound on all aluminum conductor terminations. Apply antioxidant joint compound per manufacturer's recommendations.

3.8 AC, MC, AND NONMETALLIC-SHEATHED CABLE INSTALLATION

A. AC/MC shall NOT be used for circuits serving the Essential Electrical System.

B. Cable shall be supported by an approved means every 4.5' and within 12" of outlet boxes, junction boxes, cabinets, or fittings.

C. Cable may be unsupported in the following conditions:

1. Cable is no longer than 2' in length at terminals where flexibility is necessary.
2. Cable is not more than 4.5' from the last point of support for connections within an accessible ceiling to light fixtures or equipment.

D. Conductor ampacity shall be derated as required by the NEC where more than three current carrying conductors are used.

E. Each 120 and 277-volt circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for cable derating.

F. Cables shall be cut using a rotary cutter as recommended by the manufacturer to eliminate nicking and cutting of the conductors.

G. Bending radius shall comply with the requirements listed in the NEC for the type and size of cable being installed, but shall not be less than 5-times the diameter of the cable in any case.

H. At cable terminations, a fitting shall be provided to protect wires from abrasion, unless the design of the outlet boxes or fittings is such as to afford equivalent protection, and, in addition, an insulating bushing or its equivalent protection shall be provided between the conductors and the armor.

I. All wiring devices supplied by nonmetallic-sheathed cables shall be mounted in an outlet box.

3.9 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division 1.

B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a “Megger”. The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform resistance of parallel conductors.

C. MI cable shall have the insulation resistance of each cable tested with a 500-volt dc megohmeter prior to energizing the cables. Tabulate resistance values and submit to Architect/Engineer for acceptance.

D. Inspect wire and cable for physical damage and proper connection.

E. Torque test conductor connections and terminations to manufacturer's recommended values.

F. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

G. Provide documentation of the manufacturer’s recommended lug torque value for copper and aluminum conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.

H. Protection of wire and cable from foreign materials:

1. It is the Contractor’s responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer’s performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

I. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor’s responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service and distribution panelboards**: [DP-#], [DP-#]**
B. Lighting and appliance branch circuit panelboards**: [Panel '###']**
C. Fusible branch circuit panelboards**: [Panel '###']**

1.2 RELATED SECTIONS AND WORK

A. Refer to the One-Line Diagram and Panel Schedules for size, rating, and configuration.

1.3 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers
B. NEMA FU 1 – Low voltage cartridge fuses
C. NEMA KS 1 - Enclosed Switches
D. NEMA PB 1 - Panelboards
E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
G. UL 248 – Low-Voltage Fuses
H. UL 67 - Panelboards

1.4 SUBMITTALS

A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Selective coordination study to prove that all essential electrical systems, emergency systems and legally required standby system panelboards are selectively coordinated with all supply side overcurrent protective devices.

1.5 SPARE PARTS

A. Keys: Furnish four (4) each to the Owner.

B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.

C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.

2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D QMB, I-Line
b. General Electric Spectra ADS
c. Siemens F2, P4
d. Cutler Hammer PRL4, PRL5

B. Panelboards: NEMA PB 1; type as shown on the drawings.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with aluminum copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240-volt panelboards; 50,000 amperes rms symmetrical for 480-volt panelboards, or as shown on the drawings.

H. Fusible 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.

I. Fuse Clips (Switches 600 Amperes and Smaller): Provide with Class 'R' rejection clips. Fuse Clips (601 Amperes and Larger): Designed to accommodate Class 'L' fuses.

J. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

K. Molded Case Circuit Breakers with Current Limiters: Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

L. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

M. Solid State Molded Case Circuit Breakers: **(All breakers identified on plans as solid-state with 1,200 ampere frame sizes and below.)** Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover.

N. Arc Energy Reduction:

1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps or larger.

2. Energy-Reducing Maintenance Switch: Provide an energy-reducing maintenance switch visual status indication when engaged. Install the maintenance switch at the entrance to the electrical room in the first section of the electrical equipment.

O. Suitable for use as service entrance equipment.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D NQ, NF
b. General Electric AQ, AE
c. Siemens P1
d. Cutler Hammer PRL1, PRL2

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. hinged trim to allow access to wiring gutters without removal of trim and flush lock all keyed alike. Hinged trim shall be secured with screws. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper aluminum bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.

J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.4 COLUMN WIDTH PANELBOARDS

A. General

1. Approved Manufacturers:

a. Square D NQ, NF
b. General Electric AQ, AEC
c. Siemens P1
d. Cutler Hammer PRL1-LX, PRL2-LX

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. hinged trim to allow access to wiring gutters without removal of trim and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.

G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

2.5 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:

a. Bussmann
b. Littelfuse
c. Siemens SQSCP
d. Mersen MFCP

B. Provide cabinet front with concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

C. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

D. Overcurrent protective devices shall be UL listed, with voltage, amperage, number of poles, and short-circuit current rating as shown on the panelboard schedule. Multi-pole branch circuit protection devices shall trip on an overcurrent of any pole to prevent single-phasing of the load.

E. Fuse holder shall be finger-safe with trim installed. Fuses shall only be removable when terminals are not energized.

F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future fuse units.

G. All multiple-section panelboards shall have the same dimensional backbox and cabinet front size.

H. Minimum Integrated Short Circuit Rating: As shown on the drawings.

I. Branch fuse disconnect shall have visible ON/OFF indication, blown fuse indicating lights, and permanently installed lockout means.

2.6 LOAD CENTERS

A. General

1. Approved Manufacturers:

a. Square D
b. General Electric
c. Siemens
d. Cutler Hammer

B. Load Centers: Circuit breaker load center.

C. Enclosure: General-Purpose.

D. Provide pull ring and latch lock on door. Finish in manufacturer's standard gray enamel.

E. Provide load centers with bus ratings as shown on the drawings.

F. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.

G. Molded Case Circuit Breakers: **Provide plug-on circuit breakers with integral thermal and instantaneous magnetic trip in each pole, with common trip handle for all poles. Provide breaker interrupting ratings as indicated on the plans. Where necessary to meet interrupting ratings, breakers shall be provided with automatically resetting current limiting elements in each pole. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings.**

H. Do not use tandem circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide custom typed circuit directory for each branch circuit panelboard. Provide updated custom typed circuit directory for each existing branch circuit panelboard with new or revised circuits per the scope of work. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

E. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.

F. Install fuses in fusible switch assemblies.

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, fusible switches, and fuses.

END OF SECTION

SECTION 26 27 16
CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures
B. Cabinets
C. Terminal blocks and accessories
D. Custom utility pedestals **[CUP-#]**

1.2 REFERENCES

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
B. ANSI/NEMA ICS 1 - Industrial Control and Systems
C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems
D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems

1.3 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

C. Include cabinets and enclosures in composite electronic coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

D. Custom Utility Pedestal:

1. Provide dimensioned diagram of cabinet including front, side, and floor plan views. Show layout of power and control components in evaluation views.

2. Provide schematic diagram of power, control functions, panelboards, and other components.

3. Submit installation instructions.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Construction: NEMA 250; Type 1 3R 4, 14 gauge steel. Provide stainless steel construction for operating rooms, invasive procedure rooms, and medical scanning rooms.

B. Finish: Manufacturer's standard polyester powder paint finish.

C. Covers: Continuous hinge with stainless steel hinge pin. Covers longer than 24 inches shall have 3-point latching.

D. Locks: Flush 1/4 turn cylinder key latch 3-point latch kit with padlock handle quick-release latch.

E. Provide interior white painted metal panel for mounting terminal blocks and electrical components.

2.2 CABINETS

A. Cabinet Boxes: Galvanized steel with removable endwalls, dimensions as indicated on the drawings. Provide stainless steel construction for operating rooms, invasive procedure rooms, and medical scanning rooms.

B. Cabinet Fronts: Steel, flush surface type with concealed trim clamps, screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray baked enamel.

2.3 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.

B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide conduit hubs knockouts on enclosures.

C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

2.5 **[CUP-#]** CUSTOM UTILITY PEDESTAL

A. General:

1. Approved Manufacturers - Cabinet:

a. Milbank
b. Approved custom utility pedestal vendor
c. Individual components field installed by contractor

2. Approved Manufacturers - Panelboard, contactors, photocell, relays:

a. Square D
b. General Electric
c. Siemens
d. Cutler Hammer

3. Approved Manufacturers - Control Components, Time Clocks:

a. Paragon
b. Intermatic
c. Tork

B. Enclosure:

1. Vandal-resistant cabinet, stainless steelNEMA 3Rwhile in use, with lockable cover, UL listed, and [natural, black, white, custom color powder coat finish].

2. Utility Section: Separate isolated utility metering compartment with hinged lockable cover.

3. Customer Section:

a. Separate isolated customer section with NEMA 3R while in usehinged lockable cover.

b. Dead front construction with hinged cover to live components.

4. Provide protective pocket inside front cover with schematic diagram, wiring diagram, and layout drawings of control wiring and components within enclosure.

C. Utility Meter: 2 utility meter sockets per local LADWP requirements.

D. Customer Distribution: Separate customer distribution section for power and control equipment.

1. Main disconnect sized per one-line diagram and suitable for use as service disconnect.

2. Dry type transformer sized per one-line diagram.

3. Panelboard:

a. Copper bus, neutral, and ground bus
b. Bus rating: [per one-line diagram

4. Panelboard with contactor control of bus:

a. Copper bus, neutral, and ground bus

b. Bus rating: per one line diagram

c. Contractor: NEMA ICS 2 and UL 508; electrically held, 2 wire control. [Provide with hand-off-auto switch located in customer dead front panel].

d. Control Sequence:

1) Photocell on. Timeclock off

5. Time Switch:

a. Time switch, 7 day, electronic, 30 setpoints available, LCD display, 12 or 24-hour format, minimum 200 hours battery backup, one SPDT 15-amp contact, UL listed.

b. Time switch, 7 day astronomic, 1 channel, electronic, one SPDT 5-amp contact, LCD display, 12 or 24-hour format, minimum 100 hours carryover, UL listed.

6. Labeling:

   a. Provide engraved plastic laminate label inside cover for the following items:

      1) [Power source and location]
      2) [Branch circuit breakers, loads served]
      3) [Hand-off-Auto and other control devices]

7. Provide with line side surge arrestor.

8. Provide with photocell.

9. Transfer Switch - [Automatic, Manual double throw, Key interlock]:

   a. NEMA ICS 2: [2, 3, 4] pole, electrically operated

   b. Provide two (2) N.O. and two 92) N.C isolated contacts

   c. Approved Manufacturers:

      1) Asco
      2) Russ Electric
      3) GE Zenith

10. Generator Connection: [Pin and sleeve, Permanent cable connection to automatic transfer switch].

11. Provide with optional pedestal mounting base.

12. Environment Control: Provide cabinet with [unit heaters, A/C unit].

13. Surge Protection Devices:

14. [Provide with fire rated plywood panel for mounting of customer equipment: 3/4 inch x [ ] inch x [ ] inch.]

15. [Provide with viewable window for meter section.]

16. [Provide with factory concentric knockouts for conduit entry locations.]

17. Maintenance Receptacle:

   a. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use aluminum cover located on side of enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.

B. Provide accessory feet for free-standing equipment enclosures.

C. Install trim plumb.

D. Custom Utility Pedestal:

1. Concrete Pad: Provide flush with grade-mounted concrete pad with rebar reinforcement. Pad size: Cabinet size plus 12 inches to allow for mow/landscape apron, 8 inch deep.

2. Provide stainless steel anchor bolts and install per manufacturer's instructions.

3. Provide generator start signal cabling to generator.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Device plates and box covers
B. Modular connectors
C. Receptacles
D. Countertop and furniture receptacle assemblies
E. Pin and sleeve devices
F. Floor boxes
G. Service fitting
H. Pedestal style box
I. Poke-through fittings
J. Pendant cord/connector devices
K. Cord and plug sets
L. Cord reel

1.2 QUALITY ASSURANCE

A. Provide similar devices from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NEC Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.

C. Comply with the NEC.

1.3 REFERENCES

A. DSCC W-C-896F – General Specification for Electrical Power Connector
B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
C. NEMA WD 1 – General Color Requirements for Wiring Devices
D. NEMA WD 6 – Wiring Devices – Dimensional Requirements
E. NFPA 70 - National Electrical Code (NEC)
F. UL 498 – Standard for Attachment Plugs and Receptacles
G. UL 943 – Standard for Ground Fault Circuit Interrupters

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

C. Submit manufacturer occupancy sensor coverage patterns applicable to this project. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

D. Provide a non-returnable sample of each countertop and furniture-mounted receptacle assembly as part of the submittal process.

1.5 COORDINATION

A. Receptacles for Owner Furnished Equipment: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

C. Coordinate installation of receptacle assemblies in countertops and furniture with the contractor providing the countertop or furniture. Contractor shall coordinate penetrations and conduit routing in countertops and furniture with drawings and other obstacles below the installation surface.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

A. All switch, receptacle, outlet, and coverplate colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

A. All switches, receptacles, and outlets shall be complete with the following:

1. Unbreakable thermoplastic/thermoset plastic coverplates in finished spaces where walls are finished.

2. #302 stainless steel coverplates in unfinished spaces for flush boxes.

3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.

C. Install nameplate identification as indicated in Section 26 05 53.

D. Plate securing screws shall be metal with head color matching the wall plate finish.

a.

2.3 MODULAR CONNECTORS

A. Devices listed below are traditional wired devices. Contractor option to provide equivalent modular connector-type devices (Hubbell Snap Connect, Pass & Seymour Plug Tail, Leviton Lev-Lock, Copper ArrowLink) where applicable.

B. Wiring devices with modular wiring type quick connectors shall comply with the following in addition to the above:

1. Wired with #12 THHN Cu, stranded or solid, 3 or 4 wire as required for device, minimum 6” lead length.

2. Connector contacts shall be crimped or welded.

2.4 RECEPTACLES

A. Refer to Electrical Symbols List for device type.

B. Devices that are shaded on the drawings shall be red.

C. **[REC-DUP]**: NEMA 5-20R Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.

2. Approved Manufacturers: Hubbell 5352A, Leviton, 5362-S, Pass & Seymour 5362, Cooper 5352.

3. Approved Manufacturers: (Decorative), Hubbell DR20, Leviton 16362, Pass & Seymour 26342, Cooper 6352.

4. Approved Manufacturers: Hubbell 5352, Leviton 5362-S, Pass & Seymour 5362, Cooper 5362.

5. Approved Manufacturers: Hubbell 5362, Leviton 5362, Pass & Seymour 5362A, Cooper AH5362.

6. Approved Manufacturers: Hubbell HBL8300, Leviton 8300, Pass & Seymour 8300, Cooper AH8300.

D. **[REC-DUP-GFI]**: NEMA 5-20R Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GF20L, Leviton GFNT2, Pass & Seymour 2097, Cooper SGF20.

4. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

5. Approved Manufacturers: Hubbell GFR-8300HL, Leviton GFNT2-HG, Pass & Seymour 2097HG, Cooper SGFH20.

E. **[REC-DUP-GFI-R]**: Remote Ground Fault Device:

1. Ground fault device for remote downstream receptacles. 125-volt, 20 amp. Test and reset buttons in impact resistance thermoplastic face.

2. Approved Manufacturers: Hubbell GFBF20, Leviton 6895, Pass & Seymour 2085, Cooper VGFD20.

F. **[REC-DUP-WP]**: NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GFTR20/(RW57300) WP826, Leviton GFWT2/(5977-CL) M5979, Pass & Seymour 2097TRWR/(WIUC10-C) WIUCAST1, Cooper WRSGF20/(WIU-1) WIUMV-1.

G. **[REC-DUP-XP]**: NEMA 5-20R Explosion Proof Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type, Class 1, Division 1 rated. Spring-loaded cover with gasket. Mount in cast box with threaded openings.

2. Approved Manufacturers: Appleton EFSC175, Crouse-Hinds ENRC21201, Killark UGR5-20231.

H. **[REC-ISO]**: NEMA 5-20R Isolated Ground Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with orange impact resistant thermoplastic face. Orange coverplate with 'Isolated Ground' stenciled in black.

2. Approved Manufacturers: Hubbell IG20, Leviton 5362-IG, Pass & Seymour IG5362, Cooper IG5362.

3. Approved Manufacturers: Hubbell IG-8300, Leviton 8300-IG, Pass & Seymour IG8300, Cooper IG8300.

I. **[REC-ISO-SUR]**: NEMA 5-20R Isolated Ground and Surge Suppression Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with orange impact resistance thermoplastic face, light, and alarm. Orange coverplate with 'Isolated Ground' stenciled in black.

2. Approved Manufacturers: Hubbell IG5362OSA, Leviton 5380-IG, Pass & Seymour IG5362-OSP, Cooper IG5362RNS.

3. Approved Manufacturers: Hubbell IG8362OSA, Leviton 8380-IG, Pass & Seymour IG8300-OSP, Cooper IG8300HG_S.

J. **[REC-ISO-SUR-QUAD]**: NEMA 5-20R Double Duplex Isolated Ground and Surge Suppression Receptacle:

1. Consists of two duplex isolated ground and surge suppression receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Isolated Ground and Surge Suppression Receptacle above.

K. **[REC-USB]**: NEMA 5-20R Receptacle with USB Charger:

1. 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Type A USB charging rated at 5VDC 2.1A. Mounted in double gang backbox.

2. Approved Manufacturers: Hubbell USB20X2, Pass & Seymour TR5362USB, Cooper TR7766.

3. 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. One Type A USB charging rated at 5VDC 2.1A. Two Type C USB charging rated at 5VDC 5.0A. Mounted in double gang backbox.

4. Approved Manufacturers: Hubbell USB USB20C5

5. Approved Manufacturers: Hubbell USB8300, Pass & Seymour TR8300USB, Leviton T5832-HG.

L. **[REC-ARC]**: NEMA 5-20R Receptacle with Arc Fault Circuit Interrupts

1. 125-volt, 20 amp, 3-wire grounding type hospital grade, arc fault circuit interrupter receptacle with test and reset buttons in impact resistant thermoplastic face.

2. Approved Manufacturers: Leviton AFTR2.

M. **[REC-SIM-520R]**: NEMA 5-20R Simplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell HBL5361, Leviton, 5361, Pass & Seymour 5361, Cooper 5361.

N. **[REC-SIM-530R]**: NEMA 5-30R Simplex Receptacle:

1. 125-volt, 30 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell HBL9308, Leviton 5371, Pass & Seymour 3802, Cooper 5716N.

O. **[REC-SIM-550R]**: NEMA 5-50R Simplex Receptacle:

1. 125-volt, 50 amp, 3-wire grounding type, phenolic face.

2. Approved Manufacturers: Hubbell HBL9360, Cooper 1253.

P. **[REC-SIM-620R]**: NEMA 6-20R Simplex Receptacle:

1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL5461, Leviton 5461, Pass & Seymour 5871, Cooper 5461.

Q. **[REC-SIM-630R]**: NEMA 6-30R Simplex Receptacle:

1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9330, Leviton 5372, Pass & Seymour 3801, Cooper 5700N.

R. **[REC-SIM-650R]**: NEMA 6-50R Simplex Receptacle:

1. 250-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9367, Leviton 5374, Pass & Seymour 3804, Cooper 5709N.

S. **[REC-SIM-720R]**: NEMA 7-20R Simplex Receptacle:

1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour 7621.

T. **[REC-SIM-730R]**: NEMA 7-30R Simplex Receptacle:

1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9315, Leviton 9730-A, Pass & Seymour, Cooper 5795N.

U. **[REC-SIM-750R]**: NEMA 7-50R Simplex Receptacle:

1. 277-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9365, Leviton 9750-A, Pass & Seymour, Cooper.

V. **[REC-SIM-1420R]**: NEMA 14-20R Simplex Receptacle:

1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8410, Pass & Seymour 3820, Cooper 5759.

W. **[REC-SIM-1430R]**: NEMA 14-30R Simplex Receptacle:

1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +24 AFF.

2. Approved Manufacturers: Hubbell HBL9430A, Leviton 278, Pass & Seymour 3864, Cooper 5744N.

X. **[REC-SIM-1450R]**: NEMA 14-50R Simplex Receptacle:

1. 125/250-volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4” AFF.

2. Approved Manufacturers: Hubbell HBL9450A, Leviton 279, Pass & Seymour 3894, Cooper 5754N.

Y. **[REC-SIM-1460R]**: NEMA 14-60R Simplex Receptacle:

1. 125/250-volt, 60 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9460A, Leviton 9460, Pass & Seymour, Cooper 9460N.

Z. **[REC-SIM-1520R]**: NEMA 15-20R Simplex Receptacle:

1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8420, Leviton, Pass & Seymour, Cooper.

AA. **[REC-SIM-1530R]**: NEMA 15-30R Simplex Receptacle:

1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8430A, Leviton 8430, Pass & Seymour 5740, Cooper 8430N.

BB. **[REC-SIM-1550R]**: NEMA 15-50R Simplex Receptacle:

1. 250-volt, 50 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL8450A, Leviton 8450, Pass & Seymour 5750, Cooper 8450N.

CC. **[REC-SIM-1560R]**: NEMA 15-60R Simplex Receptacle:

1. 250-volt, 60 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL9460A, Pass & Seymour 5760, Cooper 8460N.

DD. **[REC-SIM-L520R]**: NEMA L5-20R Simplex Receptacle, Locking Type:

1. 125-volt, 20 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L520, Cooper CWL520R.

EE. **[REC-SIM-L530R]**: NEMA L5-30R Simplex Receptacle Locking Type:

1. 125-volt, 30 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L530, Cooper CWL530R.

FF. **[REC-SIM-L620R]**: NEMA L6-20R Locking Type Simplex Receptacle:

1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2320, Leviton 2320, Pass & Seymour L620R, Cooper CWL620R.

GG. **[REC-SIM-L630R]**: NEMA L6-30R Locking Type Simplex Receptacle:

1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2620, Leviton 2620, Pass & Seymour L630R, Cooper CWL630R.

HH. **[REC-SIM-L720R]**: NEMA L7-20R Locking Type Simplex Receptacle:

1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2330, Leviton 2330, Pass & Seymour L720R, Cooper CWL720R.

II. **[REC-SIM-L730R]**: NEMA L7-30R Locking Type Simplex Receptacle:

1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2630, Leviton 2630, Pass & Seymour L730R, Cooper CWL730R.

JJ. **[REC-SIM-L1420R]**: NEMA L14-20R Locking Type Simplex Receptacle:

1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL 2410, Pass & Seymour L1420, Cooper CWL1420R.

KK. **[REC-SIM-L1430R]**: NEMA L14-30R Locking Type Simplex Receptacle:

1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL 2710, Leviton 2710, Pass & Seymour L1430R, Cooper CWL1430R.

LL. **[REC-SIM-L1520R]**: NEMA L15-20R Locking Type Simplex Receptacle:

1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2420, Leviton 2420, Pass & Seymour L1520R, Cooper CWL1520R.

MM. **[REC-SIM-L1530R]**: NEMA L15-30R Locking Type Simplex Receptacle:

1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2720, Leviton 2720, Pass & Seymour L1530R, Cooper CWL1530R.

NN. **[REC-SIM-L1620R]**: NEMA L16-20R Locking Type Simplex Receptacle:

1. 480-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2431, Pass & Seymour L1620R, Cooper CWL1620R.

OO. **[REC-SIM-L1630R]**: NEMA L16-30R Locking Type Simplex Receptacle:

1. 480-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.

2. Approved Manufacturers: Hubbell HBL2730, Leviton 2730, Pass & Seymour L1630R, Cooper CWL1630R.

PP. **[REC-SIM-L2120R]**: NEMA L21-20R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 20-amp 5 wire grounding type.

2. Approved Manufacturers: Hubbell HBL2510, Cooper CWL2120R, Pass & Seymour L2120R.

QQ. **[REC-SIM-L2130R]**: NEMA L21-30R Locking Type Simplex Receptacle:

1. 120/208Y 3 phase 30-amp 5 wire grounding type.

2. Approved Manufacturers: Hubbell HBL2750, Cooper CWL2130R, Pass & Seymour L2130R.

RR. **[REC-SIM-XP]**: NEMA 5-20R Explosion Proof Simplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type, Class 1, Division 1, Group C rated. Factory sealed, dead end.

2. Approved Manufacturers: Appleton CPE1-2375, Crouse-Hinds CPS152201, Killark KRS-215-220.

SS. **[REC-TAMP]**: NEMA 5-20R Tamper Resistant Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.

2. Approved Manufacturers: Hubbell BR20TR, Leviton TBR20, Pass & Seymour TR5362, Cooper TRBR20.

3. Provide decorative style duplex tamper resistant receptacles in public spaces where walls are finished.

4. Approved Manufacturers: (Decorative), Hubbell DR20TR, Leviton TDR20, Pass & Seymour TR2635.

5. Approved Manufacturers: Hubbell HBL8300SG, Leviton 8300-SG, Pass & Seymour TR63-H, Cooper TR8300.

TT. **[REC-TAMP-GFI]**: NEMA 5-20R GFI Tamper Resistant Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type tamper-resistant with test and reset buttons in impact resistant thermoplastic face.

2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

3. Approved Manufacturers: Hubbell GFTR20, Cooper TRSGF20, Pass & Seymour 2097TR, Leviton GFTR2.

4. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

5. Approved Manufacturers: Hubbell GFR8300 SG, Cooper TRSGFH20, Pass & Seymour 2097HGTR, Leviton GFTR2-HG.

UU. **[REC-TAMP-QUAD]**: NEMA 5-20R Double Duplex Tamper Resistant Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Tamper Resistant Receptacle above.

VV. **[REC-DUP-O]**: NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap. Bottom half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and NEC 2014 compliant marking on face of device.

2. Approved Manufacturers: Pass & Seymour 5362H, Leviton 5362-1P, Hubbell, Cooper.

WW. **[REC-QUAD-O]**: NEMA 5-20R Plug Load Controlled Duplex Receptacle:

1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Plug Load Controlled Duplex Receptacles above.

XX. **[REC-QUAD]:** NEMA 5-20R Double Duplex Receptacle:

1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.

2. Approved manufacturers: Refer to Duplex Receptacle above.

YY. **[REC-QUAD-GFI]**: NEMA 5-20R Double Duplex GFI Receptacle:

1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.

ZZ. **[REC-QUAD-USB]**: NEMA 5-20R Double Duplex USB Receptacle:

1. Consists of two duplex USB receptacles, double gang box, plaster ring and faceplate.

2. Approved Manufacturers: Refer to USB Receptacle above.

AAA. **[REC-QUAD-WP]**: NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:

1. Consists of two duplex, GFI receptacles. Double gang box. Provide NEMA 3R rated while-in-use cast aluminum cover.

2. Approved Manufacturers:

   a. Receptacle: Refer to GFCI Receptacle above.

   b. Cover: Intermatic WP1030MXD, Pass & Seymour WIUCAST2, Thomas & Betts Red Dot 2CKU.

BBB. **[REC-XR#]**: 600-volt, 60 amp, 3-pole, 4-wire Locking Type Simplex Receptacle for X-ray Isolated Power Equipment:

1. Black nylon or polycarbonate face. Cast aluminum surface mounted box, 45° angle adapter, weather protective lift cover on receptacle.

2. Approved Manufacturers: Hubbell HBL26410-RECP/HBL26401-BOX/HBL26404-ADAPTER, Pass & Seymour 26420/26401/26404, Cooper 26420/26401/26404.

CCC. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.

DDD. Side wired devices shall have four binding screws that are undercut for positive wire retention.

EEE. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.

FFF. Isolated ground receptacles shall have the equipment ground contacts connected only to the green grounding screw terminal of the device with inherent electrical isolation from the mounting strap.

GGG. Integral surge suppression receptacles with integral surge suppression shall comply with the following:

1. Category A3 listed.

2. Line to ground, line to neutral, and neutral to ground modes.

3. Metal-oxide varistors with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 210 joules per mode.

4. Status indication: Light visible in the face of the device and audible alarm to indicate device is no longer active or in service.

5. Distinctive symbol on device face to denote SPD-type device.

6. Device shall be blue with blue coverplate.

7. NEMA 5-20R duplex receptacle, 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap.

    a. Approved Manufacturers: Hubbell HBL5362SA, Leviton, Pass & Seymour, Cooper.

HHH. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

2.5 COUNTERTOP AND FURNITURE RECEPTACLE ASSEMBLIES

A. **[REC-#]**: Pop-up Style Receptacle Assembly Listed for Countertop Applications.

1. 125-volt, 15/20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Two (2) NEMA 5-15R/5-20R, with both simplex devices on same face or opposite face of assembly, gasketed countertop enclosure, UL 948 section 146 spill test. Architect to select finish from standard factory options. Device(s) installation, orientation, and finish shall be coordinated with Architect/Engineer prior to installation. Provide mockup installation for review and acceptance.

2. Product Specific Coordination:

    a. The Contractor shall provide provisions as required to maintain the product listing. Refer to the manufacturer's instructions for a complete list of product specific installation requirements.

    b. Hubbell: Provide GFCI circuit breaker for overcurrent protection device serving branch circuit.

c. Lew Electric: Provide a REC-DUP-GFI in the cabinet cavity below the countertop for the device to plug into. Coordinate installation of the duplex device with the space available in the below countertop cabinet.

d. Branch Circuit: Provide a 15A/1P circuit breaker for 15 amp rated devices served by a dedicated branch circuit.

3. Approved Manufacturers: Hubbell RCT200, Lew Electric PUR20.

B. **[REC-#]**: Pop-up Style Receptacle Assembly Listed for Furniture Installation.

1. 125-volt, 15/20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Two (2) NEMA 5-15R/5-20R, with both simplex devices on same face of assembly. Two (2) Type A USB charging rated at 5VDC 2.1A. Mounted in 5”x5”x5” maximum pop-up enclosure. Architect to select finish from standard factory options.

2. Device(s) installation, orientation, and finish shall be coordinated with Architect/Engineer prior to installation. Provide mockup installation for review and acceptance.

3. Product Specific Coordination:

a. The Contractor shall provide provisions as required to maintain the product listing. Refer to the manufacturer’s instructions for a complete list of product specific installation requirements.

b. Hubbell: Provide a REC-DUP-GFI in the cabinet cavity below the countertop for the device to plug into. Coordinate installation of the duplex device with the space available in the below countertop cabinet.

c. Lew Electric: Provide GFCI circuit breaker for overcurrent protection device serving branch circuit.

d. Wiremold: Provide GFCI circuit breaker for overcurrent protection device serving branch circuit.

e. Branch Circuit: Provide a 15A/1P circuit breaker for 15 amp rated devices served by a dedicated branch circuit.

4. Approved Manufacturers: Hubbell WSBUSB2X2, Wiremold DQFPUST, Lew Electric PUFP-CT-2USB.

2.6 PIN AND SLEEVE DEVICES

A. Industrial heavy-duty pin and sleeve devices shall comply with IEC 309-1.

1. IEC rated pin and sleeve watertight IP67 receptacle, raintight screw cap with safety chain and matching plug.

B. **[REC-Z#]**: 120/208 277/480-volt, 30 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers:

Voltage	Hubbell	Pass & Seymour	Cooper	Leviton
120/208	HBL530R9W / HBL530P9W	PS530R9W / PS530P9W	AH530R9W /AH530P9W	
277/480	HBL530R7W / HBL530P7W	PS530R7W / PS530P7W	AH530R7W /AH530P7W	

C. **[REC-Z#]**: 120/208 277/480-volt, 60 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers:

Voltage	Hubbell	Pass & Seymour	Cooper	Leviton
120/208	HBL560R9W / HBL560P9W	PS560R9W / PS560P9W	AH560R9W /AH560P9W	
277/480	HBL560R7W / HBL560P7W	PS560R7W / PS560P7W	AH560R7W /AH560P7W	

D. **[REC-Z#]**: 120/208 277/480-volt, 100 amp, 3-pole, 4-wire Pin and Sleeve Receptacle:

1. Approved Manufacturers:

Voltage	Hubbell	Pass & Seymour	Cooper	Leviton
120/208	HBL5100R9W / HBL5100P9W	PS5100R9W / PS560P9W	AH560R9W /AH560P9W	
277/480	HBL5100R7W / HBL5100P7W	PS560R7W / PS560P7W	AH560R7W /AH560P7W	

E. **[REC-Z#]**: 480-volt, 60 amp, 4-pole, 4-wire Pin and Sleeve Simplex Receptacle:

1. Surface-mount enclosure with 15° mounting box, 1-1/2” conduit hub, raintight screw cap with safety chain.

2. Approved Manufacturers: Appleton ACRE6044-150, Crouse-Hinds ARE6475, Killark.

F. **[REC-Z#]**: 480-volt, 100 amp, 4-pole, 4-wire Pin and Sleeve Simplex Receptacle:

1. Surface-mount enclosure with 15° mounting box, 2” conduit hub.

2. Approved Manufacturers: Appleton ACJA-1044-200, Crouse-Hinds, Killark.

G. **[REC-Z#]**: 600-volt, 30 amp, 3-phase, 3-wire Pin and Sleeve Simplex Receptacle:

1. Provide with raintight, weatherproof enclosure.

2. Approved Manufacturers: Appleton ACR3033, Crouse-Hinds AR337, Killark.

2.7 FLOOR BOXES

A. Color: Verify with Architect.

B. Coordinate with Technology drawings for voice/data outlet requirements.

C. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Fully adjustable, cast iron.

D. **[FB-#]**: Flush-mounted, round, cast iron floor box with one (1) **[REC-DUP]**. Fully adjustable, round brass cover with duplex flap cover and brass carpet flange.

1. Approved Manufacturers:

a. Hubbell B2537 (Box), S3925 (Cover), S3082 (Flange), HBL5362 (Recept)
b. Wiremold 880 CS1
c. Steel City 602-SC / P60-DS

E. **[FB-#]**: Fully adjustable cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with brass 2-1/8" x 3/4" combination cover for power connections to partitions by others, connection wire by EC. One compartment with brass 1-1/2" x 1-1/2" duplex thread cover with one (1) 3/4" and one (1) 1" conduit stubbed to above the lay-in ceiling routed to the corridor cable tray.

1. Approved Manufacturers:

a. Hubbell B4233 (Box), S2425 (Cover), S3625 (Cover), SB3085 (Flange)
b. Wiremold 880CS2
c. Steel City 642

F. **[FB-#]**: Cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with one (1) **[REC-DUP]** and brass duplex flap cover. One compartment with brass 2-1/8" x 3/4" combination cover and one (1) 3/4" and one (1) 1" conduit stubbed to above the lay-in ceiling routed to the corridor cable tray.

1. Approved Manufacturers:

a. Hubbell B4233 (Box), S2425 (Cover), S3825 (Cover), SB3084 (Flange), 5362 (Recept)
b. Wiremold 880CS2
c. Steel City 642

G. **[FB-#]**: Recessed multi-service floor box - tele/power/data. Equivalent mounting space of four (4) single gang boxes consisting of one (1) **[REC-DUP]**, one (1) voice outlet, one (1) data outlet, and one (1) spare. Cast iron adjustable rectangular floor box with cover. Provide one (1) 1" conduit for information outlet cabling, one (1) 1" conduit for audio/visual cabling, and one (1) 1" conduit as spare. Route low voltage cabling conduits to above the lay-in ceiling the corridor cable tray.

1. Approved Manufacturers:

a. Wiremold RFB4-CI
b. Steel City 665-CI
c. Hubbell LCFBCA

H. **[FB-#]**: Three service floor box - tele/power/data. Equivalent mounting space of four (4) single gang boxes consisting of one (1) **[REC-DUP]**, one (1) voice outlet, one (1) data outlet, and one (1) spare. Steel adjustable rectangular floor box with flush cover. Provide one (1) 1" conduit for information outlet cabling, one (1) 1" conduit for audio/visual cabling, and one (1) 1" conduit as spare. Route low voltage cabling conduits to above the lay-in ceiling the corridor cable tray.

1. Approved Manufacturers:

a. Wiremold RFB4
b. Steel City 665
c. Hubbell HBLCFB301BASE

2.8 SERVICE FITTING BOX

A. **[FB-#]**: Service fitting style box with 1" chase nipple. Two (2) **[REC-DUP]**. Install back to back in box.

1. Approved Manufacturers:

a. Hubbell SC-3099, (2)HBL5362, (2)S8
b. Steel City SFH-50

B. **[FB-#]**: Cast aluminum service fitting style box mounted to underfloor duct. one (1) **[REC-DUP]**.

1. Approved Manufacturers:

a. Walker Duct
b. Square D
c. Thomas & Betts

2.9 PEDESTAL STYLE BOX

A. **[REC-PED]**: Cast aluminum pedestal style box with 1" hub. One (1) **[REC-DUP]**. Install back to back in box. Provide stainless steel cover plates.

1. Approved Manufacturers:

a. Hubbell SA6686, HBL5362, (2)Covers
b. Thomas & Betts

B. **[REC-PED-QUAD]**: Cast aluminum pedestal style box with 1" hub. Two (2) **[REC-DUP]**. Install back to back in box. Provide stainless steel cover plates.

1. Approved Manufacturers:

a. Hubbell SA6688, (2)HBL5362, (2)Covers
b. Thomas & Betts

2.10 POKE-THROUGH FITTINGS

A. UL listed as fire-rated poke-through device for 1, 1-1/2 and 2 hour rated floors: include fire stops and smoke barriers in through-floor component. UL514A listed for scrub locations and approved for use in the City of Los Angeles.

B. Terminate in 4-inch square by 2-1/2-inch deep junction box.

C. Suitable for installation with a floor thickness of 2-1/4 to 7 inches.

D. Semi-flush die-cast aluminum carpet flange.

E. Spring loaded receptacle covers.

F. Verify color with Architect.

G. **[REC-FB-#]**: Fire Rated Poke-Through:

1. Flush mounted. For use with 3-inch core holes. 125-volt, 20 amp, NEMA 5-20R duplex receptacle with 3/4" conduit and junction box. Provide with two (2) data jacks. With painted aluminum flange.

2. Approved Manufacturers: Hubbell PT2X2, Wiremold, Thomas & Betts.

H. **[REC-FB-#]**: Fire Rated Poke-Through:

1. Flush mounted. For use with 4-inch core holes. Provide with 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for six data jacks and oversized conduit, with painted aluminum flange.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1PT4X4, Wiremold, Thomas & Betts.

I. **[REC-FB-#]**: Fire-Rated Multi-Service Recessed Poke-Through:

1. Recessed mounted. For use with 6-inch core holes. Provide with two 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for eight data jacks and 2" conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1R6 series, Wiremold 6AT series.

J. **[REC-FB-#]**: Fire-Rated Multi-Service Recessed 8" Poke-Through:

1. Recessed mounted. For use with 8-inch core holes. Provide with two (2) 125-volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for 12 data jacks and 2" conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1R8 series, Wiremold 8AT series.

2.11 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, heavy-duty grade or refer to Details as shown on drawings.

1. Body: Nylon with screw-open cable gripping jaws and provisions for attaching external cable grip.

B. External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire stand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.12 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

2.13 CORD REELS

A. **[CR-#]**: 50' 3#12 AWG type 'SOW-A' cord with adjustable ball stop. 120 volt, NEMA 5-20R, simplex receptacle connector, rated 16 amps continuous.

1. Approved Manufacturers:

a. Daniel Woodhead 92433, 9521 w/ Hubbell 5369CY
b. Appleton RL153L
c. Hubbell HBL HBL45123C20

B. **[CR-#]**: 25' 3#16 AWG type 'SJOW-A' cord with adjustable ball stop. Two 120-volt NEMA 5-15R receptacles mounted in cast outlet box, rated 10 amps.

1. Approved Manufacturers:

a. Daniel Woodhead 925
b. Appleton RL2510
c. Hubbell HBLC25163C

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.

B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This may include X-ray or similar non-destructive means.

D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.

E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

G. Install devices and wall plates flush and level.

H. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.

I. Test receptacles and modular wiring connectors for proper polarity, ground continuity and compliance with requirements.

J. Healthcare devices shall be tested in accordance with NFPA 99 6.3.3 for grounding, voltage, and impedance measurements.

K. Floor Box Installation:

1. Set boxes level and flush with finish flooring material.

2. Use cast iron floor boxes for installations in slab on grade. Trim shall match floor covering to be used.

3. Provide a minimum horizontal offset of 24 inches between boxes.

4. Provide saw-cutting and patching of existing concrete floors as necessary for floor box installations within existing floors.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fusible switches
B. Non-fusible switches
C. Molded case circuit switches
D. Molded case switches
E. Motor disconnect switch
F. Mechanically interlocked disconnect
G. Enclosures

1.2 RELATED SECTIONS AND WORK

A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

A. Submit product data under provisions of Section 26 05 00.

B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.

C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

A. **[FDS-#]:** Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, 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: Class 'R' fuse clips only, unless indicated otherwise on the drawings.

B. **[DS-#]:** Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, 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: Type as indicated on the disconnect schedule.

D. Accessories: As indicated on the disconnect schedule.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

A. **[CB-#]:** Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip settings.

3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time adjustments.
d. Ground-fault pickup level, time delay, and I^2t responses.

4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.

B. **[CB-#]:** Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Accessories: As indicated on the disconnect schedule.

2.3 MOTOR DISCONNECT SWITCH

A. **[DS-#]:** Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

B. Enclosures: Type as indicated on the Disconnect Schedule.

C. Ground lug connection provided in enclosure.

D. Accessories: As indicated on the Disconnect Schedule.

E. Listed UL 508 suitable for motor control.

2.4 MECHANICALLY INTERLOCKED DISCONNECT

A. **[DSS-#]:** Switch and Plug Assemblies: Rated for making and breaking loads, enclosed switch with externally operable interlock to prevent disconnecting receptacle with switch in ON position or inserting receptacle in ON position. Padlock lockable provision to meet OSHA lockout/tagout regulations.

B. Enclosures: Type as indicated on the Disconnect Schedule.

C. Ground lug connection provided in enclosure.

D. Accessories: Matching male pin and sleeve plug, two auxiliary/pilot contacts. As indicated on the Disconnect Schedule.

E. Listed UL 2682 suitable for motor disconnect.

2.5 MOBILE DIAGNOSTICS SERVICE DISCONNECT

A. **[MDSD-#]**: Mobile Diagnostics Service Disconnect:

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches where indicated on the drawings.

B. Install fuses in fusible disconnect switches.

C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ADJUSTING

A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable frequency drives [VFD-#]

1.2 RELATED SECTIONS AND WORK

A. Refer to the Variable Frequency Drive Schedule for rating and configuration.

1.3 REFERENCES

A. ANSI/UL Standard 508

B. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems

C. IEEE Standard 519-1992 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters

D. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.

C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details. Provide data as defined in section 26 05 48 Seismic Requirements for Equipment and Supports.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

E. Provide harmonic distortion analysis of total service to prove variable frequency drives proposed do not exceed the latest version of IEEE 519 voltage and current distortion limits as shown in Table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

1.5 EXTRA MATERIAL

A. Furnish under provisions of Section 26 05 00.

B. Provide two of each air filter.

C. Provide three of each fuse size and type.

D. Provide <Insert> spare variable frequency drives of the largest size and type scheduled for the Owner's maintenance stock.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 26 05 00.

B. Accept controllers on site in original packing. Inspect for damage.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 26 05 00.

B. Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

C. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.

D. Shop Drawings: For each VFD.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current rating of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of each motor-control center unit.

2. Wiring Diagrams: Power, signal, and control wiring for VFDs. Provide schematic wiring diagram for each type of VFD.

E. Manufacturer Seismic Qualification Certification: Submit certification that VFDs, accessories, and components will withstand seismic forces defined in Division 26 Section 26 05 48 "Seismic Requirements for Equipment and Supports". Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Variable Torque Applications:

1. Toshiba Q9 Series

2. ABB ACH 550 Series

3. Allen Bradley PowerFlex Series

4. Danfoss VLTFC100 Series

5. Square D, S-Flex / ATV660 Series

6. Eaton MMX / HMX / SVX Series

7. Yaskawa Z1000 Series

B. Contact Torque Applications:

1. Toshiba G9 Series

2. ABB ACS 800 Series

3. Allen Bradley PowerFlex Series

4. Danfoss VLT5000 Series

5. Square D ATV960 Series

6. Eaton SVX Series

7. Yaskawa A1000 Series

2.2 DESCRIPTION

A. Converts 60 Hertz input power at voltage specified to a variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The controller shall be suitable for use with standard NEMA B squirrel cage 1.15 service factor induction motors without requiring any modifications to the motor or the drive.

B. Controller shall have sufficient capacity to provide speed control of the motors shown or noted throughout the specified environmental operating conditions.

C. Controller shall have the functional components listed below:

1. Door interlocked input circuit breaker/fused switch.

2. Input rectifier section to supply fixed DC bus voltage.

3. Smoothing reactor for DC bus.

4. DC bus capacitors.

5. Control transformer.

6. Separate terminal blocks for power and control wiring.

7. Terminal block for operator controls.

8. Sine weighted PWM generating inverter section.

2.3 RATINGS

A. Rated Input Voltage: Refer to Variable Frequency Drive Schedule 208V 480V.

B. Motor Nameplate (Drive Output) Voltage: Refer to Variable Frequency Drive Schedule Refer to Mechanical Schedules.

C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

D. Operating Ambient: 0°C to 40°C.

E. Minimum Relative Humidity Range: 5% to 90% (non-condensing).

F. Minimum Elevation without Derating: 3300 feet.

G. Minimum Efficiency at Full Load: 96 percent.

H. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds or 180% for 0.5 seconds.

I. Starting Torque: 100 percent of rated torque or as indicated.

J. Speed Regulation: Plus or minus 1 percent with no motor derating.

2.4 DESIGN

A. Pulse Width Modulated (PWM) Variable Frequency Drives:

1. Converter shall be of a diode bridge design with a sine-weighted PWM inverter section.

2. Main semi-conductors in the inverter section of controller shall be IGBT transistors capable of a carrier switching frequency of up to 8 kHz. If derating of the inverter is necessary to run at 8kHz, then the unit's derated currents must equal or exceed the motor full load currents listed in NEC Table 430-150.

3. All controllers supplied with semi-conductors capable of switching at less than 8,000 Hertz shall be supplied with a motor acoustic noise reduction filter.

4. Pulse width modulated (PWM) drives shall be supplied with drive input line reactors with a minimum impedance of 3%. Reactors shall be installed to filter entire drive input circuit.

5. Pulse width modulated (PWM) drives shall be supplied with drive input harmonic filter to reduce the total harmonic distortion to less than the IEEE519-1992 limits at the utility service entrance.

6. Drives that are located beyond the manufacturer's recommended maximum distance from the motor shall be provided with dV/dt (long lead) filters.

B. All drives shall have built-in diagnostic capability with status and fault indicators mounted on enclosure door. Complete operating instructions for diagnostics shall be mounted inside of the enclosure door.

C. Drive shall restart after power loss and under-voltage fault. The minimum number of restart attempts required shall be three, field adjustable.

D. The drive shall allow unlimited switching of the output without damage to the drive or motor.

2.5 PRODUCT FEATURES

A. Display: Provide integral digital display to indicate all protection faults and drive status (including overcurrent, overvoltage, undervoltage, ground fault, overtemperature, phase loss, input power ON, output voltage, output frequency, and output current.

B. Protection:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunctions due to system transients,

3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

4. Motor thermal overload relay(s) adjustable and capable of NEMA Class 10 20 30 motor protection and sized per motor nameplate data. When multiple motors are connected to the VFD output, each motor shall have a manual starter with properly sized overload protection.

5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

6. Instantaneous line-to-line and line-to-ground overcurrent trips on input and output.

7. Loss-of-phase protection.

8. Reverse-phase protection.

9. Short-circuit protection (fuses or circuit breaker).

10. Motor overtemperature fault.

C. Acceleration Rate Adjustment: 0.5 - 30 seconds.

D. Deceleration Rate Adjustment: 1 - 30 seconds.

E. Minimum Adjustment Range for the Lower Output Frequency shall be: 0 to 40 Hertz.

F. Minimum Adjustment Range for the Upper Output Frequency Range shall be: 40 to 90 Hertz.

G. Minimum Volts/Hertz Range: 3.7 to 8.6 volts/Hertz.

H. Provide MANUAL-OFF-AUTOMATIC selector switch and manual analog speed control mounted on the front of the enclosure.

I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.

J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.

K. Provide adjustable skip frequencies on the drive output (minimum of three ranges).

L. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption, and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.

M. Power-Interruption Protection: After a power interruption, it prevents the motor from re-energizing until the motor has stopped.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:

1. Power on.

2. Run.

3. Overvoltage.

4. Line fault.

5. Overcurrent.

6. External fault.

Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:

1. Output frequency (Hz).

2. Motor speed (rpm).

3. Motor status (running, stop, fault).

4. Motor current (amperes).

5. Motor torque (percent).

6. Fault or alarming status (code).

7. PID feedback signal (percent).

8. DC-link voltage (VDC).

9. Set-point frequency (Hz).

10. Motor output voltage (V).

S. Control Signal Interface:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.

2. [Pneumatic Input Signal Interface:]3 to 15 psig (20 to 104 kPa).

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:

a. 0 to 10-V dc.

b. 0-20 or 4-20 mA.

c. Potentiometer using up/down digital inputs.

d. Fixed frequencies using digital inputs.

e. RS485.

f. Keypad display for local hand operation.

4. Output Signal Interface:

    a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:

        1) Output frequency (Hz).
        2) Output current (load).
        3) DC-link voltage (VDC).
        4) Motor torque (percent).
        5) Motor speed (rpm).
        6) Set-point frequency (Hz).

5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1A) for remote indication of the following:

    a. Motor running.

    b. Set-point speed reached.

    c. Fault and warning indication (overtemperature or overcurrent).

    d. PID high- or low-speed limits reached.

T. Communications: Provide a communications card to interface VFD with Facility Management Control System (FMCS). Coordinate interface requirements with the FMCS provided under Section 23 09 00. Interface shall allow all parameter settings of VFD to be programmed via FMCS control and displayed on FMCS operator workstation. Provide capability for VFD to retain these settings within the nonvolatile memory.

U. Three- Two- Contactor Automatic Manual Bypass:

1. Provide contactors, motor running overload protection, under-voltage and loss of phase protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include[isolation switch or third contactor] to allow maintenance of inverter during bypass operation.

2. All bypass circuitry shall be located within the same enclosure as the variable frequency drive.

3. All fire alarm and/or smoke control interconnections (e.g., air handling unit shutdown) shall apply regardless of whether control is through VFD or bypass.

4. Provide a Drive-Bypass Selector Switch.

5. Provide nameplate with instructions for switching from drive to bypass and from bypass to drive. Provide instructions for isolating VFD for maintenance.

V. Control:

1. With the "Manual-Off-Auto" switch in the "Manual" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the manual speed potentiometer on the drive door.

2. With the "Manual-Off-Auto" switch in the "Auto" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the input signal from an external source.

3. If applicable, with the "Drive-Bypass" in the "Bypass" position, regardless the position of the "Manual-Off-Auto" switch, the motor shall be connected across the lines and shall be run at full speed.

4. With the "Manual-Off-Auto" switch in the "Off" position, if applicable, the drive run circuit shall be open and the VFD shall not operate.

5. If applicable, signal from the fire alarm control panel shall shut down VFD and bypass.

6. All disconnect switches between VFD and motor(s) shall include an auxiliary contact interlock wired to the VFD fault trip input to shut down the drive upon opening of the disconnect main contacts.

2.6 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. All VFD supplied for fans shall have dynamic or DC injection braking capability to provide a means of rapid deceleration of the AC motor in not more than one (1) minute. Adjust controls to stop the motor within 30 seconds.

C. **All high inertia loads that cannot be stopped in 30 seconds with the VFD dynamic braking or DC injection braking shall be provided with a chopper module and dynamic braking resistor to stop the motor within 30 seconds.**

D. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

E. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

F. Control Relays: Auxiliary and adjustable time-delay relays.

G. Standard Displays:

1. Output frequency (Hz).

2. Set-point frequency (Hz).

3. Motor current (amperes).

4. DC-link voltage (VDC).

5. Motor torque (percent).

6. Motor speed (rpm).

7. Motor output voltage (V).

H. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

I. Fabrication:

1. Enclosure: NEMA 250, Type 1.

2. Finish: Manufacturer's standard enamel.

J. Forced Ventilation:

1. Inlet filter, outlet filter.

2. Blower fan sized to maintain VFD at rated operating temperatures for ambient conditions of enclosure location.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The VFD manufacturer shall provide certification that heat test has been completed.

B. The Electrical Contractor shall have a factory service engineer present for the start-up, field calibration, and check-out of each VFD installed. Factory service engineer shall be required to return to the site for recalibration or set-up should unit not function as specified during system commissioning. All costs shall be a part of This Contract. Provide tag with date and signature of factory service Engineer on inside cover of each drive.

3.2 INSTALLATION

A. Install variable frequency drive equipment in accordance with the manufacturer's instructions.

B. Floor mount VFD on prefabricated or field fabricated supports with controls no higher than 6'-6" and no lower than 3'-0" AFF. Mount supports on 1/2" thick vibration isolation pads set on concrete housekeeping pads.

C. Provide engraved phenolic nameplates under the provisions of Section 26 05 53.

D. Connections: All conduit connections to the VFD shall be by flexible conduit.

E. Input, output, and control wiring shall each be run in separate conduits.

F. All interlocking required by the drive manufacturer shall be the responsibility of the Electrical Contractor.

3.3 STARTUP AND COMMISSIONING

A. Verify all settings, parameters, and adjustments with other contractors prior to startup. Make all adjustments and setting to coordinate with controls and equipment.

B. Accelerate the motor to full speed and verify operation. Decelerate the motor to a stop and verify operation. Slowly operate the motor over the speed range and check for resonance.

C. Make all adjustments and settings to coordinate with controls and equipment prior to Substantial Completion. Verify that drive is set for auto restart after power loss and undervoltage fault.

D. Document settings in the Operations and Maintenance manual.

END OF SECTION

SECTION 26 31 00
SOLAR PHOTOVOLTAIC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Photovoltaic Panels and Arrays
B. Power Optimizers
C. Photovoltaic Grid Tie String Inverter
D. Photovoltaic Central Inverter
E. Microinverters
F. Combiner/Disconnect
G. Photovoltaic Monitoring Equipment and Accessories
H. Photovoltaic Mounting Systems

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in photovoltaic panel or inverter systems with five years documented experience.

B. Installer: Equipment installer shall be NABCET certified or be certified by photovoltaic inverter and panel manufacturers. Licensed electrical contractors with electrical apprenticeship documentation shall also be acceptable.

C. Operate, commission, and demonstrate seven (7) days of complete photovoltaic system operation prior to turnover to the Owner.

1. Refer to the Part 3 for system commissioning requirements.

1.3 REFERENCES

A. ANSI C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
B. IEEE 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
C. IEEE 929 - Recommended Practices for Utility Interface of Photovoltaic Systems.
D. IEEE 1547 - Standard for Interconnecting Distributed Resources with Electronic Power Systems.
E. IEEE 1547.1 - Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.
F. NEC 690 - Solar Photovoltaic (PV) Systems.
G. UL 1703 - Standard for Flat-Plate Photovoltaic Modules and Panels
H. UL 1741 - Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
I. UL 1998 - Standard for Software in Programmable Components

1.4 SUBMITTALS

A. Submit product data under provision of Section 26 05 00.

B. Photovoltaic Panels: Include unit dimensions, weight, material construction, wattage, voltage, current, open circuit voltage, short circuit current, installation and maintenance information, and manufacturer voltage correction factor in information.

C. Photovoltaic Inverter: Include unit dimensions, weight, installation and maintenance information. Also include the following:

1. Input: DC voltage range, max current input.

2. Output: AC voltage range, total harmonic distortion, power factor, efficiency, maximum current output.

3. General: Power consumption, enclosure type, compliance with references.

4. Environment: Ambient temperature rating, cooling requirements.

D. Array Mounting Frame:

1. Calculations, drawings and installation details shall be designed and sealed by a Structural Engineer licensed in the State of California experienced in solar mounting frame design and installation.

2. Design of support shall be performed for loading indicated in this specification and structural general notes.

3. Coordination drawing drawn to scale and coordinating the photovoltaic array with other systems and equipment in the vicinity for use in the development and layout of the mounting frame.

4. Clear indication of design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.

5. Plan drawings and details shall be cross-referenced. Details provided are to clearly indicate attachment to structure, correctly representing the fastening requirements.

E. Provide list of certified installers with proof of certification.

F. Provide calculation of expected annual total kilowatt hours for proposed equipment and installation.

G. Provide a list of manufacturer and model for photovoltaic panels, power optimizers, inverters and racking system with bid form for evaluation.

1.5 SPARE PARTS

A. Provide spare parts under provisions of Section 26 05 00.

B. Provide three (3) additional fuses of each type and size installed.

C. Provide one (1) additional inverter convection cooling fan for each inverter module.

D. Provide two (2) spare photovoltaic panels.

E. Provide two (2) spare microinverters.

1.6 DELIVERY, STORAGE, HANDLING

A. Store and protect products under provisions of Section 26 05 00.

B. Store in warm and dry location or per manufacturer’s requirements.

C. Handle per manufacturer's requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit data under provision of Section 26 05 00.

B. Include description of operation and servicing procedures, list of major components, recommended remedial and preventative maintenance procedures, and list of spare parts.

1.8 WARRANTY

A. Photovoltaic Panels and Array: Provide 20-year warranty for power production under provisions of Section 26 05 00. Equipment shall maintain minimum 80% of the manufacturer-published wattage output rating for 20 years. Provide 5-year workmanship warranty.

B. Photovoltaic Inverter: Provide 20-year warranty of equipment and installation.

C. Include coverage for travel, parts, and service.

1.9 SYSTEM DESCRIPTION

A. Complete photovoltaic system rated 100 kW 1000 volt DC at STC including photovoltaic panels, inverter system, combiner/disconnects, metering, and reporting equipment. Systems shall be configured to produce 480Y/277 3 phase 4 wire 60 Hz power.

B. Grid-tie interconnection with utility, including island protection and net metering.

C. The photovoltaic system shall include a metering system for total system power production and a reporting system to monitor individual components.

D. The photovoltaic system and inverter shall be configured as a grid inter-tie solar photovoltaic system. The individual inverters shall automatically de-energize their output to the building electrical system and disconnect from the photovoltaic panels upon loss of the utility electrical service. The photovoltaic inverter system shall remain disconnected until the electrical utility voltage has been restored.

E. Equipment shall be identified for use in solar photovoltaic systems.

F. Equipment, including wiring, fuses, circuit breakers, etc., used in any DC portion of the photovoltaic power system shall be listed for use in 1000 volt DC circuits.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PHOTOVOLTAIC PANEL MANUFACTURERS

A. SolarWorld series (basis of design)
B. Kyocera series
C. Mission Solar series
D. Or pre-approved equals

2.2 PHOTOVOLTAIC PANELS AND ARRAYS

A. Equipment Ratings:

1. Maximum Rated Power (STC) Pmax: 340 watts
2. Operating Power Point Voltage Vmpp: 59.7 VDC
3. Maximum Power Point Current Impp: 5.7 A
4. Maximum Open Circuit Voltage Voc: 71.3 VDC
5. Maximum Short Circuit Current Isc: 6.13 A
6. Nominal Operating Cell Temperature Conditions (NOCT) Pmax44°C

B. Operating Environment Conditions:

1. Operating Temperature: -40 to 90°C
2. Wet location listed

C. Cell Material: Silicon-based solar cell construction with UV stabilized polymer. Provide with bypass diode technology for partial shading operation.

D. Panel Construction: Anodized aluminum frame with ground point and tempered glass cover.

E. Dimensions: 39.4” wide x 1.84” deep x 66” long.

1. Maximum Weight: 45 lbs.

F. Panel Connections and Terminations:

1. Provide manufacturer’s wiring and quick-connect terminations for series creation of module-strings installation of panels.

2. Provide manufacturer wiring to combiner boxes for parallel grouping of module-strings.

3. All exterior wire and terminations shall be listed sunlight resistant.

2.3 POWER OPTIMIZERS

A. Provide power optimizer modules mounted to back of panels to track MPPT and minimize losses from shading and uneven string lengths.

B. Minimum Efficiency: 98%

C. Maximum System Voltage: 1000 VDC

D. Operating Temperatures: -40 to 85°C

E. Protection Rating: IP68 / NEMA 6P

F. Power optimizer must have been tested with submitted photovoltaic panel.

2.4 COMBINER/DISCONNECT

A. Combination of combiner box and solar array disconnect in a single enclosure.

B. Load break switch rated 1000 VDC maximum with lockout provisions.

C. Fuse holders rated 30 amp maximum. Terminal blocks for each PV string.

D. Provide fused surge protective device (SPD) with visual status indicator and remote contact signaling. BUSSMAN BSP series or approved equal.

E. Enclosure: NEMA 4X.

2.5 PHOTOVOLTAIC GRID TIE STRING INVERTERS

A. Acceptable Inverter Manufacturers: Manufacturer and model must have been tested and be compatible with photovoltaic panel model. Model capacities may change number of inverters required and shall be agreed to during submittals.

1. SMA America series (basis of design)
2. Xantrex Technology Inc. series
3. Fronius USA, LLC series
4. Yaskawa - Solectria series
5. Solar Edge
6. Or pre-approved equals

B. Equipment Ratings:

1. AC Output Power Rating for Inverter: 100000 watt
2. Output Voltage: 480Y/277V 3 phase
3. Power Factor: 1.0
4. Minimum CEC Efficiency: 97.5%
5. MPPT Operating Voltage Range: 150 to 1000 VDC
6. Minimum number of MPPT tracker inputs: 2
7. Total Harmonic Distortion: Less than 5%
8. DC Voltage Ripple: Less than 5%
9. Enclosure: NEMA 3R

C. Operating Environment Condition:

1. Maximum ambient temperature: 113 °F
2. Wet location listed

D. Inverter Technology: Transformerless Full DC/AC rectification, real sine-wave output with high frequency pulse width modulation PWM.

E. Internal Protection: Inverter shall measure utility voltage, current, and impedance. Loss of utility power shall cause inverter to shut down and disconnect its output to the AC bus and input from the DC bus. Inverter shall automatically reconnect to AC output bus and DC input bus upon return of utility source.

F. The inverter shall be constructed to not allow backfeeding from the electrical utility to the photovoltaic panels or DC input bus.

G. The inverter shall have integral AC and DC disconnects.

H. The inverter shall be cooled via a forced air cooling fan.

I. Inverters shall be provided with Ethernet connection for metering and recording system outputs. Provide communication gateway device(s) as required to connect inverter system to the Owner’s LAN or network router.

2.6 PHOTOVOLTAIC GRID TIE CENTRAL INVERTERS

A. Acceptable Inverter Manufacturers: Manufacturer and model must have been tested and be compatible with photovoltaic panel model.

1. EATON Power Xpert Solar series
2. Schneider Electric XC series
3. Yaskawa - Solectria SGI series
4. Or pre-approved equals

B. Equipment Ratings:

1. AC Output Power Rating for Inverter: ##0,000 watt
2. Output Voltage: 480V 3 phase
3. Power Factor: 1.0
4. Minimum CEC Efficiency: 97.5%
5. Maximum Input Voltage1000 VDC
6. Total Harmonic Distortion: Less than 5%
7. DC Voltage Ripple: Less than 5%
8. Enclosure: NEMA 3R

C. Operating Environment Condition:

1. Maximum ambient temperature: 113 °F
2. Wet location listed

D. Inverter Technology: Transformerless Full DC/AC rectification, real sine-wave output with high frequency pulse width modulation PWM.

E. Internal Protection: Inverter shall measure utility voltage, current, and impedance. Loss of utility power shall cause inverter to shut down and disconnect its output to the AC bus and input from the DC bus. Inverter shall automatically reconnect to AC output bus and DC input bus upon return of utility source.

F. The inverter shall be constructed to not allow backfeeding from the electrical utility to the photovoltaic panels or DC input bus.

G. The inverter shall have integral AC and DC disconnects. The inverter shall be cooled via forced air cooling fans.

2.7 PHOTOVOLTAIC INVERTERS (MICROINVERTERS ALTERNATE)

A. Acceptable Inverter Manufacturers: Manufacturer and model must have been tested and be compatible with photovoltaic panel model.

1. ENPHASE Model M250 or C250 series (basis of design)
2. SolarBridge / SunPower SPR- X22
3. Or approved equal

B. Equipment Ratings:

1. Maximum Input Power Rating for Each Inverter: 210-350 watt
2. Output Voltage: 120/240 120/208 480Y/277VAC 60 Hz
3. Power Factor: > 0.95
4. Minimum CEC Efficiency: 94.2%

5. Total Harmonic Distortion: Less than 10%
6. Maximum night time power consumption: 30 mW

C. Operating Environment Condition:

1. Operating Temperature range: -40° to 65°C
2. Enclosure: NEMA 6 or IP66 wet location listed

D. Inverter Technology: Full DC/AC rectification, real sine-wave output with high frequency pulse width modulation PWM.

E. Internal Protection: Inverter shall measure utility voltage, current, and impedance. Loss of utility power shall cause inverter to shut down and disconnect its output to the AC bus and input from the DC bus. Inverter shall automatically reconnect to AC output bus and DC input bus upon return of utility source.

F. The inverter shall be constructed to not allow backfeeding from the electrical utility to the photovoltaic panels or DC input bus.

G. The inverter shall be convection cooled.

H. Inverters shall be provided with Ethernet or powerline communications for metering and recording system outputs. Provide communication gateway device(s) as required to connect inverter system to the Owner's LAN or network router.

2.8 METERING AND REPORT

A. Personal Computer Software: Provide manufacturer's software for metering and reporting on personal computer. The Electrical Contractor shall install and provide provision for custom initialization of the photovoltaic system software package.

B. Displayed and Recorded Data:

1. The following data shall be provided for each photovoltaic inverter and updated every 10 seconds.

a. Power
b. kWh today
c. Total kWh
d. Date
e. Time

2. The following data shall be provided for the entire photovoltaic system:

a. Power
b. kWh today
c. Total kWh
d. Date
e. Time
f. kWh to utility today
g. Total kWh to utility

3. The above information shall be recorded, logged, and compiled by the personal computer software for production and performance evaluation purposes.

4. Provide data reporting and recording of all manufacturers' standard reporting functions and data acquisition reporting.

5. Monitoring and metering for public displays, web pages, and in-facility displays. System shall include 3-phase metering, gateway, and internet capabilities. Display screens shall include:

    a. Energy meters of generation and usage
    b. 15-minute energy demand
    c. Historical graphs of daily, three-day, weekly, monthly, and annual
    d. Weather module displaying irradiance, temperature and wind speed, and National government weather feed.
    e. Equivalencies options including gasoline, light bulbs, trees, and tons of CO2
    f. Customizable options and pages

6. Display equipment: Indoor/outdoor public kiosk flat panel PC 50” monitoring LCD Owner furnished display to be coordinated with monitoring and metering system.

7. Central inverter communications and monitoring for performance, trouble, and diagnostics. Input and output voltages, amperages, and power and fault alarms shall communicate to the gateway and designated users.

2.9 ARRAY MOUNTING

A. Basis of design is given so integrator can provide design and installation of an equivalent system that is compatible with the provided modules and structure. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

    1. UNIRAC Large Array (U-LA) (Basis of Design)
    2. DPW Direct Power and Water
    3. PROSOLAR

B. Mounting system requirements Roof ground pole non-penetrating ballasted aluminum rail frame mounting system:

    1. 5-degree tilt angle.
    2. Wind load requirements: As indicated on structural general notes.
    3. Total System Weight: 5 lbs/sf
    4. Seismic Requirements: As indicated on structural general notes
    5. Provides four mounting supports for each panel in accordance with manufacturer’s requirements.
    6. Coordinate final dimensions with architectural drawings and existing conditions.
    7. Provisions for mounting microinverters or power optimizers.
    8. Structural aluminum members to be mill finish. All brackets and connections to be stainless steel.
    9. Connect mounting system to electrode grounding system.

C. Provide complete solar array mounting system including rails, splices, fasteners, legs, clamps, standoffs, feet, and anchors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Photovoltaic cabling shall be installed in raceways separate from other building system cabling. Photovoltaic cabling shall be installed in conduit when located interior to the building.

B. The photovoltaic panels and arrays shall be configured in an open circuit, short circuit, or provided with an opaque covering to disable the array from producing electrical power during installation. Refer to the manufacturer's information for additional disabling requirements during installation.

C. Install fuses in all fuse holders and disconnects. Provide a label on the inside of each disconnect identifying the size, type, and model of each fuse installed.

D. Provide provisions to seal all exterior penetrations. All photovoltaic system roof penetrations shall be sealed by the roofing contractor at the expense of the photovoltaic system contractor.

E. Wire and Cable Schedule:

1. These requirements are in addition to the requirements of Section 26 05 13.

2. DC Distribution System:

a. Exterior: Photovoltaic panel manufacturer-supplied cabling with quick connects.

b. Interior: Copper, stranded conductor1000 volt insulation, XLPE or EPR.

c. Underground or Wet Locations: Copper, stranded conductor, 1000 volt insulation, XLPE or EPR.

d. Conductors shall be color coded as follows:

1) PV-: Black
2) PV+: Red
3) Ground Bond: Green

3. AC Distribution System:

a. Refer to Section 26 05 13.

4. Use no wire smaller than 10 AWG for DC wiring of the photovoltaic system.

5. Use 8 AWG for DC wiring of photovoltaic systems with distances between the photovoltaic panel and photovoltaic inverter greater than 100 feet.

F. Interconnect photovoltaic inverters and/or communications gateway to each other and to the facility's local area network patch panel using Category 6 cable or other cable as directed by the inverter manufacturer.

G. Provide provisions for programming and initializing the system metering and reporting software per the Owner's requirements. The Contractor shall organize a meeting with the Owner to finalize the programming and user interfaces of the program software.

H. Install equipment per the manufacturer's recommendations.

3.2 LABELING

A. Refer to Section 26 05 53 for product requirements.

B. Label all photovoltaic system equipment as required by code.

C. Label ground fault indicators:

1. "IN THE EVENT OF A GROUND FAULT INDICATION – THE NORMALLY GROUNDED CONDUCTORS MAY BE ENERGIZED AND UNDERGROUNDED"

D. Label all AC-alternating current and DC-direct current disconnects of the photovoltaic power system.

1. "---PHOTOVOLTAIC SYSTEM DISCONNECT---WARNING. ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION'

E. The AC disconnecting means for each photovoltaic inverter shall be labeled with the following:

1. Operating Current:
2. Operating Voltage:
3. Maximum System Voltage:

F. Short Circuit Current: The interactive system point of interconnection shall be labeled at the disconnecting means with the following:

1. Maximum AC Output Operating Current:
2. Operating AC Voltage:

G. The building service entrance disconnect shall be clearly labeled to identify there is a photovoltaic system interconnection. The location of the interactive system disconnect shall be identified with a plaque reading: "WARNING – PHOTOVOLTAIC SYSTEM DISCONNECT LOCATED AT (ROOM NAME/LOCATION)."

3.3 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 26 05 00.

B. Check for damage and tight connections prior to allowing the photovoltaic panels to begin power generation.

C. Check for damage and proper operation of the photovoltaic inverters.

D. Verify operation of the metering and reporting system components. Adjust and update the graphical user interface for project specific conditions.

3.4 SYSTEM COMMISSIONING

A. Provide system commissioning report under provisions of Section 26 05 00.

B. Notify Architect/Engineer seven days prior to beginning final witness testing of the photovoltaic system.

1. The Electrical Contractor shall fully test the complete photovoltaic system prior to notifying the Architect/Engineer for final witness testing.

C. Test, measure, and record the following system values:

1. Date:
2. Time of test:
3. Testers:
4. Sun overcast conditions (full sun) (scattered clouds) (full cloud coverage).
5. Inverter:

    a. DC input current:
    b. DC input voltage:
    c. AC output current:
    d. AC output voltage:
    e. Output power:

D. Performance Test of Interactive Inverter System:

1. Verify proper operation of the photovoltaic system. Verify the photovoltaic system is producing power and delivering it to the building electrical distribution system.

2. Simulate power outage of electrical utility by switching the main electrical service disconnect from “closed” to “open”.

3. Verify that each individual photovoltaic inverter has stopped producing electrical energy and has disconnected itself from the photovoltaic panels and building electrical distribution system.

4. Simulate return of utility electrical power by switching the main electrical service disconnect from “open’ to “closed”.

5. Verify each photovoltaic inverter has reconnected to the photovoltaic panels and building electrical distribution system. Verify power delivery from the photovoltaic inverters to the building electrical distribution system.

6. Document any test failure, including reason for failure and corrective actions. Retest the photovoltaic system to complete satisfactory operation.

3.5 OWNER TRAINING

A. Provide Owner training under provisions of Section 26 05 00.

B. Provide complete overview of the photovoltaic system to the Owner including:

1. System overview
2. System operation
3. Manufacturer maintenance instructions
4. System component locations
5. Operation of the metering and reporting components and software

C. Minimum Training Time:

1. Eight hours includes:

a. Four hours system components.
b. Four hours computer software operation.

END OF SECTION

SECTION 26 32 13
PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Packaged engine generator system
B. Heat exchanger
C. Exhaust silencer and fittings
D. Subbase fuel tank
E. Remote annunciator panel
F. Battery and charger
G. Weatherproof enclosure

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 22 30 00 - Plumbing Equipment
B. Section 23 21 00 - Hydronic Piping
C. Section 23 57 00 - Heat Exchangers

1.3 REFERENCES

A. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
B. ANSI/NEMA AB 1 - Molded Case Circuit Breakers
C. ANSI/NEMA MG 1 - Motors and Generators
D. NFPA 37 - Installation and Use of Stationary Combustion Engines and Gas Turbines
E. NFPA 70 - National Electrical Code (NEC)
F. NFPA 110 - Standard for Emergency and Standby Power Systems
G. Environmental Protection Agency EPA Emission Standards for Compressed Ignition Engines

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 26 05 00.

B. Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.

C. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, remote radiator, and remote annunciator.

D. Submit certificates for compliance with EPA Emissions Standards for Compressed Ignition Engines.

E. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

1.5 EXTRA MATERIALS

A. Submit maintenance materials under provisions of Section 26 05 00.

B. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal toolbox.

C. Provide two additional sets of each fuel, oil, and air filter element required for the engine generator system. Provide additional fuel polishing filters for one year of operation.

D. Provide one fuse for every type and rating used.

E. Provide five (5) extra DC incandescent lamps and five (5) compact fluorescent lamps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 26 05 00.

B. Store and protect products under provisions of Section 26 05 00.

C. Accept packaged engine generator set and accessories on site in crates and verify damage.

D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.7 SYSTEM DESCRIPTION

A. Engine generator system to provide source of emergency and standby power.

B. System Capacity: 60 KW, 75 KVA at an ambient temperature between -20°F and 110°F; continuous standby rating using engine-mounted radiator.

C. System Capacity: 60 Starting KW, 75 Starting KVA at specified voltage dip.

D. Operation: In accordance with ANSI/NFPA 99.

1.8 COORDINATION DRAWINGS

A. Reference Coordination Drawings article in Section 26 05 00 for required generator electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings. Show generator, fuel system components, battery system components, and exhaust system in 1/4” scale plan of room.

1.9 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 26 05 00.

B. Accurately record location of engine generator and mechanical and electrical connections.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 26 05 00.

B. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.11 QUALIFICATIONS

A. Manufacturer: Company specializing in packaged engine generator system with minimum five (5) years documented experience.

B. Supplier: Authorized distributor of engine generator manufacturer with service facilities within 50 miles of the project site.

1.12 WARRANTY

A. Provide a five (5) year warranty under provisions of Section 26 05 00.

1.13 MAINTENANCE SERVICE

A. Furnish service and maintenance of packaged engine generator system for one (1) year from Date of Substantial Completion. Maintenance service shall be performed by skilled employees of manufacturer's designated service organization. Include quarterly exercising, and routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts, supplies, and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Caterpillar.
B. Cummins Power Generation.
C. Kohler.
D. MTU On Site Energy
E. Generac

2.2 PACKAGED ENGINE-GENERATOR SET

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.

B. Safety Standard: Comply with ASME B15.1 and UL 2200.

C. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, model and serial number, and component rating in integrated set and as required by the contract documents.

D. Fabricate engine-generator set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.

E. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components. Provide a rigging diagram permanently attached to the mounting frame to indicate the capacity of each lifting attachment and the generator-set center of gravity.

F. Maximum Dimensions: as indicated on drawing.

2.3 ENGINE

A. Type: Water-cooled in-line or V-type, four-stroke cycle spark-ignition compression ignition diesel electric ignition internal combustion engine.

B. Rating: Sufficient to operate at 100 percent load for two hours at specified elevation and ambient limits.

C. Fuel: Appropriate for use of B10 biodiesel.

D. Engine Speed: 1800 RPM.

E. Governor: Isochronous type with speed sensing.

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.

G. Frequency Response:

1. Steady State Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

2. Transient Response: Less than 5 percent for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady state operating band within 5 seconds.

H. Fuel System: Engine mounted diesel fuel pump and relief-bypass valve. Natural gas system carburetor, secondary gas regulator, fuel shutoff solenoid valve, and flexible fuel connectors.

I. Fuel Supply System:

1. Base-Mounted Fuel Tank: UL 142 2085 listed fuel tank with 8 hour rated (NFPA 110 minimum run time by class) capacity including a secondary containment. Integral rupture basin with leak detection. Provide fueling port with an overfill prevention type receptacle and lockable cap for exterior units. The tank shall include structural steel supports for top mounted engine generator set. Furnish complete with flexible fuel line connectors remote lockable cover, and analog level gauge. Furnish complete with float switches to indicate low and high fuel level. The footprint of the base-mounted fuel tank shall not exceed the footprint of the generator frame for interior applications or the footprint of the enclosure for exterior installations.

2. Fuel Cooler: Provide unit-mounted fuel cooler with all required hoses, fittings and mounting hardware. Generators without a unit-mounted radiator shall have an integral fan powered by a 120V circuit.

J. Lubrication System: Engine or skid mounted filter and strainer, thermostatic control valve capable of full flow and designed to be fail safe, and crankcase drain arranged for gravity drainage with siphon or pump.

K. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F, and suitable for operation on 120 208-1Ø 208-3Ø 277 480-1Ø 480-3Ø volts AC. The minimum wattage of the heater shall be watts or as recommended by the manufacturer.

L. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.

1. Fan and Core: Nonferrous-metal construction sized to contain expansion of total system. Blower type fan, sized to maintain safe engine temperature in ambient temperature of 110°F. Radiator Airflow Restriction: 0.5 inches of water, maximum.

2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anti-corrosive additives.

3. Provide expansion tank with gage glass and petcock, and self-contained, thermostatic-control temperature control valve.

M. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel. Provide the following accessories:

1. Battery: Voltage to match starter with capacity for three cranking cycles without recharge. Provide with battery cables and acid resistant battery tray.

2. Battery-Charging Alternator: Factory mounted on engine with solid state voltage regulation.

3. Remote Start Circuit Monitoring: Provide continuous monitoring of the generator start circuits. A failure shall initiate visual and audible alarms at the generator, remote annunciators, and start the generator.

4. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet ANSI/NEMA 250, Type 1 requirements.

5. Provide two battery strings, two DC power supply/chargers with monitoring, and a best battery selector system. Each shall be sized to provide total starting capacity.

6. DC Power Supply/Charger: Utility grade current limiting type with battery temperature compensation designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave filtered rectifier, digital DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet ANSI/NEMA 250, Type 1 requirements

7. Best battery selector system for dual battery single load configuration. Solid-state design must isolate battery strings from each other.

N. Exhaust System: Critical type silencer (85 dBA max at 10 feet), side inlet with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions. Silencer shall include a threaded opening for connection of ¾” drain line. Opening shall be flush on inside of silencer.

O. The packaged engine generator shall comply with the current Environmental Protection Agency EPA Emissions standards.

P. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine-generator control panel.

Q. Mounting: Provide unit with suitable spring-type vibration isolators.

2.4 GENERATOR

A. Generator: ANSI/NEMA MG 1; three phase, re-connectible brushless synchronous generator with brushless exciter and PMG alternator excitation.

B. Rating: As indicated on the drawings, at 0.8 power factor, 60 Hertz at 1800 RPM to match engine rating.

C. Insulation: ANSI/NEMA MG 1, Class F Class H.

D. Temperature Rise: 105°C continuous.

E. Enclosure: ANSI/NEMA MG 1; open drip-proof.

F. Voltage Regulation:

1. The maximum instantaneous voltage dip (IVD) shall be 30 percent.

2. Include solid-state type voltage regulator, separate from exciter to match engine and generator characteristics, with voltage regulation ±1 percent from no load to full load. Include manual controls to adjust voltage drop ±5 percent voltage level, and voltage gain.

G. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.5 CONTROLS AND INDICATION

A. Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator–set vibration.

B. Engine-Generator Control Panel: ANSI/NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:

1. Alarm indication as required by NFPA 110 for a Level 1 2 system.
2. AC frequency meter.
3. AC output voltmeter with phase selector switch.
4. AC output ammeter with phase selector switch.
5. Output voltage adjustment.
6. DC voltmeter (alternator battery charging).
7. Engine start/stop selector switch.
8. Engine running time meter.
9. Oil pressure gauge.
10. Engine coolant temperature gauge.
11. Shut down devices for overspeed, coolant high-temperature, coolant low-level, and oil low-pressure.

12. Fuel derangement alarm.
13. Generator overload.
14. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
15. Remote Alarm Contacts: Pre-wire SPST contacts to terminal strip for remote alarm functions required by ANSI/NFPA 99.
16. Ground fault indication.
17. Generator control and start signal failure.
18. Remote Engine Annunciator Panel: ANSI/NFPA 99 and NFPA 110 for a Level 1 2 system. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a surface flush mounted panel with brushed stainless steel red color painted finish. Provide all interconnecting wiring in conduit per manufacturer's requirements by the Electrical Contractor. The remotely reported alarms shall include the following.
19. Overcrank
20. Low water (engine) temperature
21. High engine temperature pre-alarm
22. High engine temperature
23. Low lube oil pressure pre-alarm
24. Low lube oil pressure
25. Overspeed
26. Low fuel main tank
27. Low coolant level
28. Not in auto
29. Emergency Power Supply (EPS) supplying load
30. High battery voltage
31. Low battery voltage
32. Battery charger failure (includes AC failure)
33. Generator running
34. Normal utility power
35. Emergency stop
36. Rupture basin alarm
37. Alarm for power supply or UPS serving motorized breakers
38. Generator control and start signal failure.
39. 80% load alarm.

C. Remote Engine Manual Start Control: Two-wire remote start control from fire command center. Provide all interconnecting wiring in conduit per manufacturer's requirements (by the Electrical Contractor).

D. Building Automation System Integration:

1. Provide a terminal block to allow the Facility Monitoring and Control System (FMCS) to report generator alarms. Provide individual terminal points for each of the annunciator alarms and pre-alarms. Provide an additional terminal point to combine all generator alarms under a single terminal point. Provide a permanent label for each terminal point. Each terminal will provide a binary output for the FMCS to read. Refer to Section 23 09 00 for alarms reported by the FMCS.

2.6 ACCESSORIES

A. Generator Circuit Breaker: Molded or insulated case, service-rated thermal-magnetic electronic trip type; 100% rated breaker complying with NEMA AB1 and UL 489. The disconnect shall simultaneously open all associated ungrounded conductors and be lockable in the open position.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator is shut down by other protective devices.

4. Mounting: Provide freestanding enclosure or mount integrally with control and monitoring panel.

5. The disconnecting means shall also shut down the prime mover, disable all start control circuits, and be configured with a mechanical reset.

6. Arc Energy Reduction: Provide and arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy system shall be provided for overcurrent protection devices rated 1,200 amps or larger.

B. Remote Manual Stop Station (Emergency Power Off EPO): Provide a remote manual stop station with weather proof stainless steel or die cast housing, red mushroom button - push to stop operation, breakable cover/lens to access mushroom button, 120-volt rated. The manufacturer shall provide automatic monitoring of the EPO switch. Placing the EPO switch in the "Generator Powered OFF" status shall initiate a visual and audible alarm at each generator annunciator panel.

C. Remote Fuel Fill Station: Provide a remote fuel fill station including a fill port within a surface-mounted, lockable, NEMA 3R stainless steel construction with gasketed hinged door and lockable handle. The fill port shall have a minimum overflow holding capacity of five (5) gallons. The fill port inside the cabinet shall be field coordinated. Provide dust cover for fill connection. Include local light and horn alarm with test switch and silence feature when tank level is above 95 percent full. Provide additional float switch in tank for level indication. Include the following accessories:

1. Solenoid valve to prevent additional fuel delivery to the tank when full; 120-volt power provided by Contractor.

2. Lockable drain valve for overflow.

3. Local analog gauge of main tank fuel level.

4. Local digital gauge of main tank fuel level.

D. Provide primary fuel filters in addition to secondary fuel filters.

E. Provide dual redundant engine starters. The redundant engine starters shall be configured to start the engine when the primary engine starter fails.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE SKIN-TIGHT

A. Prefabricated or pre-engineered skintight enclosure with the following features:

1. Construction: Reinforced galvanized steel, metal clad, integral structural steel framed housing anchored to a concrete foundation. Panelized aluminum housing with integral structural framing anchored to a concrete foundation. Construction shall allow access to control panels and service points. The panels shall enclose all components, including intake/exhaust louvers and sound attenuators. Extend the enclosure base frame as required for panels.

2. The generator control panel shall be located no greater than 5’-0” above finished grade for ease of access.

3. Structural Design and Anchorage: Wind resistant up to 100 mph.

4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents. Motor operators shall be spring open, power close operating at 24 volts DC. The louvers shall be connected to the generator starting batteries through appropriate control relays. Louvers shall not extend outside main generator enclosure.

5. Hinged Doors: Provide a minimum of four doors with padlocking provisions. Single doors shall be 36" wide and 84" high. Double doors shall be 60" wide and 84" high. As standard, doors shall include rain-rail moldings above all door openings, recessed, keyed mortise locks, panic bar door hardware and full weather-stripping. Doors shall be removable.

6. Thermal Insulation: Manufacturer’s standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits as required by engine-generator-set components.

7. Fuel Tank Vent: Provide vent piping from the fuel tank to the exterior of the enclosure.

8. Fuel Fill: Provide fill access on the exterior of the enclosure at an elevation not to exceed 5’-0” above finished grade.

9. The exhaust system silencer shall be installed within the enclosure housing.

10. Acoustical Treatment: Provide acoustical treatment of the generator enclosure including wall panels, intake and exhaust air paths, ventilation openings, and tailpipe exhaust. Sound attenuators shall be concealed within the enclosure panels. Panels shall extend from the enclosure base frame to the height of the generator section.

2.8 SITE COORDINATION

A. Generator to property line distance: 5 feet

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work and field dimensions are as shown on the drawings.

B. Verify that required utilities are available in proper location and ready for use.

C. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install remote manual stop station in location shown on plans. Provide 120 Volt power and wiring in conduit as required. Coordinate installation with the manufacturer approved shop drawings and wiring diagrams. The remote manual stop station shall shunt trip the generator mounted circuit breaker and signal the engine prime mover to stop.

C. The A-B-C phase rotation of the generator source shall match the A-B-C phase rotation of the utility source. The Contractor shall verify the generator and utility phase rotation match to prevent three phase motors and similar loads from operating backwards while being served by the generator.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 26 05 00 and in compliance with NFPA 110 requirements.

B. Provide portable test bank for full load test, if required. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.

C. Fill fuel tank prior to start of test.

D. The on-site installation test shall be conducted as follows:

1. With the prime mover in a “cold start” condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening all switches or breakers supplying the primary power to the building or facility.

2. The test load shall be that load that is served by the Emergency Power Supply System (EPSS).

3. The time delay on start shall be observed and recorded.

4. The cranking time until the prime mover starts and runs shall be observed and recorded.

5. The time taken to reach operating speed shall be observed and recorded.

6. The voltage and frequency overshoot shall be recorded.

7. The time delay on transfer to emergency power for each switch shall be recorded. Life safety and critical branch transfer switches must transfer within 10 seconds.

8. The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.

9. The voltage, frequency, and amperes shall be recorded.

10. The prime mover oil pressure and water temperature shall be recorded, where applicable.

11. The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.

12. When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.

13. The time delay on the prime mover cool down period and shutdown shall be recorded.

14. Allow prime mover to cool for 5 minutes.

15. A load shall be applied for 4 hours total. The building load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate rating of the Emergency Power Supply (EPS), less applicable derating factors for site conditions. Observe and record load changes and the resultant effect on voltage and frequency.

16. The full load test shall be initiated immediately after the cooling time has expired by any method that starts the prime mover and, immediately upon reaching rated rpm, picks up 100 percent of the nameplate kW rating on one step, less applicable derating factors for site conditions.

17. During test, record the following at 5-minute intervals for the first 15 minutes and every 15 minutes for the rest of the test:

    a. Kilowatts
    b. Amperes
    c. Voltage
    d. Frequency
    e. Coolant temperature
    f. Enclosure temperature (interior)
    g. Oil pressure
    h. Engine exhaust temperature
    i. Engine inlet temperature
    j. Oil Temperature
    k. Battery charge rate

18. Upon completion of the test and after a cool down period, the crank/rest cycle shall be tested.

    a. Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.
    b. The control switch shall be set at “run” to cause the prime mover to crank.
    c. The complete crank/rest cycle shall be observed and recorded.

19. Test alarm and shutdown circuits by simulating conditions.

E. Contractor shall fill fuel tanks upon completion of test.

F. Testing documentation shall be submitted to the Architect/Engineer for review and approval. Reviewed documentation shall be submitted to AHJ as part of the project close-out certification package.

G. Generator testing worksheets are included with this specification section.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare, start, test, and adjust systems under provisions of Section 26 05 00.

B. Provide UL field inspection of generator.

3.5 ADJUSTING

A. Adjust generator output voltage and engine speed.

3.6 CLEANING

A. Clean work under provisions of Section 26 05 00.

B. Clean engine and generator surfaces. Replace oil and fuel filters.

C. A Clean Air permit is required.

3.7 DEMONSTRATION

A. Provide systems demonstration. Coordinate the demonstration schedule with the Owner and Architect/Engineer.

B. Describe loads connected to emergency and standby systems and restrictions for future load additions.

C. Simulate power outage by interrupting normal source and demonstrate that system operates to provide emergency and standby power.

END OF SECTION

DATE: _____ **W.O.#** _____ **BATTERY VOLT:** 24 **kW:** 1250

CUSTOMER: _____ **KVA:** 1563

ENGINE MODEL: _____ **S/N:** _____ **VOLTAGE:** 480 **PHASE:** 3

GENERATOR MODEL: _____ **S/N:** _____ **FUEL TYPE:** Diesel **HERTZ:** 60

UNIT RATING: _____ **PKG** _____ **TESTED BY:** _____ **RPM:** 1800

ELAPSED TIME	DURATION	1 VOLTS	2 VOLTS	3 VOLTS	1 AMPS	2 AMPS	3 AMPS	KW	TARGET KW	HZ	RPM	HOUR METER	P.F.	OIL PRESS.	FUEL PRESS.	AMBIENT AIR TEMP.	ENGINE WATER TEMP.	EXHAUST TEMP L	EXHAUST TEMP R	ENGINE OIL TEMP.	IN.HG BOOST	COOLANT AT HEAT EXCH. OR RADIATOR OUT	COOLANT AT HEAT EXCH. OR RADIATOR IN	COOLANT AT THE ENGINE OUT	COOLANT AT THE ENGINE IN
0:10	0:10								313																
0:20	0:10								625																
0:40	0:20								1,250																
1:00	0:20								1,250																
1:20	0:20								1,250																
1:40	0:20								1,250																
2:00	0:20								1,250																
2:20	0:20								1,250																
2:40	0:20								1,250																
3:00	0:20								1,250																
3:20	0:20								1,250																
3:40	0:20								1,250																
4:00	0:20								1,250																
4:10	0:10								1,375																
4:20	0:10								625																
4:25	0:05								-																

Load Profile	Time	Load %
	10 Min	25%
	10 Min	50%
	4 Hours	100%
	10 Min	110%
	10 Min	50%
	5 Min	0%

SECTION 27 05 00
BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 REFERENCES

A. OSHPD - Office of State Wide Health Planning and Development (California)
B. CCR California Code of Regulation
C. CBC California Building Code
D. CFC California Fire Code
E. CEC California Electric Code
F. CMC California Mechanical Code
G. CPC California Plumbing Code
H. California Title 24 - Building Energy Efficiency Standards
I. SCAQMD Southern California Air Quality Management Division

1.3 SCOPE OF WORK

A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.

B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.

C. Description of Systems include but are not limited to the following:

1. Structured Cabling System including, but not limited to:

a. New data cabling and terminations.

b. All AV cabling for av-over-IP and other AV system cabling and terminations.

c. Information outlets (IOs) including faceplates, jacks and labeling.
d. Equipment racks, cabinets, cable management and equipment.
e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
f. Cabling pathways.
g. Grounding and Bonding
h. Testing

2. Complete Audio/Visual Systems.

3. Removal/demolition work and/or relocation and reuse of existing systems and equipment.

4. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.

5. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the “Suggested Matrix of Scope Responsibility”.

6. Firestopping of penetrations as described in Section 27 05 03.

1.4 OWNER FURNISHED PRODUCTS

A. Network switches, hubs, and routers.

1.5 WORK SEQUENCE

A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during non-occupied hours. The Owner shall reserve the right to set policy as to when restricted construction hours will be required.

B. Itemize all work and list associated hours and pay scale for each item.

1.6 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.

2. “Electrical Contractor” shall also refer to the Contractor listed in Division 27 of this specification when the “Suggested Matrix of Scope Responsibility” indicates the work shall be provided by the EC. Refer to the Contract Documents for the “Suggested Matrix of Scope Responsibility”.

3. “Technology Contractor” as referred to herein refers to the Contractors listed in Division 27 of this Specification.

4. Low Voltage Technology Wiring: The wiring (less than 120VAC) associated with the Technology Systems, used for analog and/or digital signals between equipment.

5. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications/technology outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling.

C. General:

1. The purpose of these specifications is to outline typical Electrical and Technology Contractor's work responsibilities as related to technology systems including telecommunications rough-in, audio/visual systems rough-in, conduit, power wiring, and low voltage communications and technology wiring. The prime contractor is responsible for all divisions of work.

2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the technology drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the technology drawings but required for the successful operation of the systems shall be the responsibility of the Technology Contractor and included in the Contractor’s bid.

3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of technology systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.

4. This Contractor shall establish electrical and technology utility elevations prior to fabrication and installation. The Technology Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:

    a. Lighting Fixtures
    b. Gravity Flow Piping, including Steam and Condensate
    c. Sheet Metal
    d. Electrical Busduct
    e. Cable Trays, including 12” access space
    f. Sprinkler Piping and other Piping
    g. Conduit and Wireway
    h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the “Suggested Matrix of Scope Responsibility” to be provided by the Electrical Contractor.

2. Responsible for Communications Systems grounding and bonding.

3. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Technology Contractor’s Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.

2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the “Suggested Matrix of Scope Responsibility.”

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the technology bonding system.

5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.7 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.

a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5” and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

d. Maintenance clearances and code-required dedicated space shall be included.

e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.

2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.

    a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

    a. Scale of drawings:

        1) General plans: 1/4 Inch = 1 '-0" (minimum).

        2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).

        3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).

        4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1 '-0" (minimum).

        5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.

3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.

4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.

2. A plotted set of coordination drawings shall be available at the project site.

3. Coordination drawings are not shop drawings and shall not be submitted as such.

4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.

5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.

6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.

8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.

9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

    a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.

    b. Potential layout changes shall be made to avoid additional access panels.

    c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.

    d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.

    e. When additional access panels are required, they shall be provided without additional cost to the Owner.

10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.

11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.8 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:

a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling

b. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises

1) C.1 - Commercial Building Telecommunications Standard

2) C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard

3) C.3 - Optical Fiber Cabling Components Standard

4) C.4 - Broadband Coaxial Cabling and Components Standard

c. ANSI/TIA-569-C - Telecommunications Pathways and Spaces

d. ANSI/TIA-606-B - Administration Standard for Commercial Telecommunications Infrastructure

e. ANSI/TIA-607-B - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

f. ANSI/TIA-862-A - Building Automation Systems Cabling Standard

g. ANSI/TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

h. ANSI/TIA/EIA-598-C - Optical Fiber Cable Color Coding

i. NFPA 70 (NEC) - National Electrical Code (Current Edition)

j. UL 444 - Standard for Safety for Communications Cable

k. California Code of Regulation Title 24, Article E725

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.

2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.

3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.

4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

6. The Contractor must have a BICSI RCDD (Registered Communications Distribution Designer) or CNet CNIDP (Certified Network Infrastructure Design Professional) on-staff serving as a project manager. Project shop drawings and test reports shall be stamped by the RCDD or CNIDP.

7. The Contractor shall have certified BICSI installation technicians or CNet CNIT (Certified Network Infrastructure Technician) on staff to perform the following tasks on the project:

   a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.

   b. Oversee all testing and termination of cabling.

8. The Contractor shall have certified BICSI Installer 2 or CNet CNCI (Certified Network Cabling Installer) on staff to perform the following tasks:

   a. Installation and termination of copper cable.
   b. Installation and termination of optical fiber.

9. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

   a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.

D. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the Los Angeles, California Codes, Laws, Ordinances and other regulations having jurisdiction.

2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.

3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.

4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.

5. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.

6. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

E. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.

2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.

3. Pay all applicable charges for such permits or licenses that may be required.

4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.

7. Pay any charges by the service provider related to the service or change in service to the project.

8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):

   a. Factory Mutual
   b. Underwriters' Laboratories, Inc.

F. Examination of Drawings:

1. The drawings for the technology systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.

3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.

5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.

3. Upon request for electronic media, the Contractor shall complete and return a signed “Electronic File Transmittal” form provided by IMEG.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor’s use of these documents.

H. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Architect/Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Architect/Engineer will be borne entirely by the Contractor.

3. This Contractor shall provide the Architect/Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Architect/Engineer.

1.9 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

Referenced Specification Section	Submittal Item
27 05 03	Through Penetration Firestopping
27 05 26	Communications Bonding
27 05 28	Interior Communications Pathways
27 05 53	Identification and Administration
27 11 00	Communication Equipment Rooms
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 41 00	Professional Audio Video System

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

a. Date
b. Project title and number
c. Contractor's name and address
d. Description of items submitted and relevant specification number
e. Notations of deviations from the contract documents
f. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

a. Date
b. Project title and number
c. Architect/Engineer
d. Contractor and subcontractors' names and addresses
e. Supplier and manufacturer's names and addresses
f. Description of item submitted (using project nomenclature) and relevant specification number
g. Notations of deviations from the contract documents
h. Other pertinent data
i. Provide space for Contractor's review stamps

3. Composition:

a. Submittals shall be submitted using specification sections and the project nomenclature for each item.

b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).

c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor’s Approval Stamp:

   a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

   b. Unstamped submittals will be rejected.

   c. The Contractor’s review shall include, but not be limited to, verification of the following:

      1) Only approved manufacturers are used.
      2) Addenda items have been incorporated.
      3) Catalog numbers and options match those specified.
      4) Performance data matches that specified.
      5) Electrical characteristics and loads match those specified.
      6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
      7) Dimensions and service clearances are suitable for the intended location.
      8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
      9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

   d. The Contractor shall review, stamp and approve all subcontractors’ submittals as described above.

   e. The Contractor’s approval stamp is required on all submittals. Approval will indicate the Contractor’s review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.

6. Submittal Identification and Markings:

   a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

   b. The Contractor shall clearly indicate the size, finish, material, etc.

c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.

d. All marks and identifications on the submittals shall be unambiguous.

7. Schedule submittals to expedite the project. Coordinate submission of related items.

8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.

9. Reproduction of contract documents alone is not acceptable for submittals.

10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.

11. Submittals not required by the contract documents may be returned without review.

12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.

13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

14. Contractor’s responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer’s approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

a. Submittal file name: 27 XX XX.description.YYYYMMDD
b. Transmittal file name: 27 XX XX.description.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.10 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.

2. Break down all costs into:

a. Material: Delivered cost of product with taxes paid.
b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.
2. Change of Subcontractor or supplier occurs.
3. Change of product or equipment occurs.

1.11 CHANGE ORDERS

A. A detailed material and labor take-off shall be prepared for each change order along with labor rates and mark-up percentages. Change orders with inadequate breakdown will be rejected.

B. Change order work shall not proceed until authorized.

1.12 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.13 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.14 NETWORK / INTERNET CONNECTED EQUIPMENT

A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability (“Network Capability”). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.15 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.16 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.17 CONTINGENCY

A. Include in the Base Bid a contingency of one percent (1%) to be used only by change orders issued by the Architect/Engineer. The unused portion of the contingency shall be deducted from the Contract price before final payment is made.

1.18 MATERIAL SUBSTITUTION

A. Where several manufacturers’ names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 Cable Jacket Rating: This project requires all cable jackets to carry a plenum rating.

2.2 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer’s consultants shall be indemnified and shall be made additional insureds under the Contractor’s general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.

B. It is the Contractor’s responsibility to survey the site and include all necessary costs to perform the installation as specified.

C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.

D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 27 sections for further requirements.

2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.

3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

5. All communications cable tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.

2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.

2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."

3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

C. Before final payment will be authorized, this Contractor must have completed the following:

1. Submitted operation and maintenance manuals to the Architect/Engineer for review.

2. Submitted bound copies of approved shop drawings.

3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.

5. Submitted testing reports for all systems requiring final testing as described herein.

6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.

7. Provide System Assurance Warranty certificate for the telecommunications system.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.

2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.

   a. O&M file name: O&M.div27.contractor.YYYYMMDD
   b. Transmittal file name: O&Mtransmittal.div27.contractor.YYYYMMDD

5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.

7. All text shall be searchable.

8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.

2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.

4. Copy of final approved test and balance reports.

5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.

7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.

8. Dimensional drawings of equipment.

9. Capacities and utility consumption of equipment.

10. Detailed parts lists with lists of suppliers.

11. Operating procedures for each system.

12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.

13. Repair procedures for major components.

14. List of lubricants in all equipment and recommended frequency of lubrication.

15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.

B. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.

C. Refer to the individual specification sections for minimum hours of instruction time for each system.

D. Operating Instructions:

1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.

2. If the Contractor does not have Engineers and/or Technicians on staff who can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.

B. All operating conditions and control sequences shall be simulated and tested during the start-up period.

C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

C. This Contractor shall maintain at the job site, a separate and complete set of technology drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer’s hourly rates in effect at the time of work.

D. Record actual routing of all conduits sized 2” or larger.

E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.

F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.

B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.

C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 75% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 25% of testing has been completed.
6. Telecommunications labeling has been provided on at least 25% of each type of component requiring a label.
7. New device grounding and bonding is complete.
8. All Audio/Visual components, cabling and control systems are installed, programmed and operational.

The project will be ready for final jobsite observation prior to the requested date of the observation according to the above list of requirements.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.
It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

Telecommunications – Proof of Certification

There are specific Contractor qualification requirements for this project as defined in Section 27 05 00, which may include Manufacturer Certification and RCDD or CNIDP credentials. This Proof of Certification document, and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:

The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____ Manufacturer Certification Number (if any): _____

If this project requires RCDD certification, complete the following:

RCDD or CNIDP Name: _____ RCDD #: _____ Expiration: _____

Submit the following with the bid:

- This form.
- Proof of Manufacturer Certification indicated above.
- Proof of RCDD or CNIDP status.

SECTION 27 05 03
THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in this Section.

B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

A. UL 263 – Fire Tests of Building Construction and Materials
B. UL 723 - Surface Burning Characteristics of Building Materials
C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
F. Intertek / Warnock Hersey - Directory of Listed Products
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
I. OSHPD - Office of State Wide Health Planning and Development (California)
J. CBC California Building Code
K. The Building Officials and Code Administrators National Building Code
L. 2015 International Building Code
M. NFPA 5000 – Building Construction Safety Code

1.4 SUBMITTALS

A. Submit under provisions of Section 27 05 00.

B. Submit Firestopping Installers Certification for all installers on the project.

C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer’s installation instructions, and UL or Intertek / Warnock Hersey Assembly number.

D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
4. F and T ratings for each firestop system.

E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

F. Submit VOC rating of firestopping material in g/L (less water) with documentation that it meets the limits set forth in SCAQMD Rule 1168.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are 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.

1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings**:**

    a. Floor penetrations located outside wall cavities.
    b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
    c. Wall penetrations above corridor ceilings which are not part of a fire-resistive assembly.
    d. Wall penetrations below any ceiling that are larger than 4" diameter or 16 square inches.

3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq.ft. at both ambient temperature and 400°F.

C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:

1. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.

2. South Coast Air Quality Management District Rule 1168 – Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.

1.7 MEETINGS

A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.

2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

A. Provide one year warranty on parts and labor.

B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk
4. Tremco; Sealant/Weatherproofing Division
5. Johns-Manville
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems
9. Wiremold/Legrand: FlameStopper
10. Dow Corning Corp
11. Fire Trak Corp
12. International Protective Coating Corp

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.

B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.

C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.

D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.

E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.

F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
   F Rating = Floor/Wall Rating
   T Rating = Floor/Wall Rating

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
   F Rating = Wall Rating
   T Rating = 0

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Floors) = Floor Rating

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.

I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.

C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.

D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.

B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:

1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.

C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION

SECTION 27 05 05
TECHNOLOGY DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Technology demolition.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements.

1.3 REFERENCES

A. NFPA 70 – National Electrical Code.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for terminating, patching and cross connecting of existing telecommunications and security systems shall be as specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The drawings are intended to indicate the scope of work required and do not indicate every outlet, box, conduit, or cable that must be removed. The contractor shall coordinate with the owner of the space on additional requirements to preserve or remove other division 27 scope.

B. All existing cabling, device, pathway, and other technology components above the ceiling that is abandoned shall be removed.

C. The contractor shall visit the site prior to submitting a bid and verify existing conditions and scope of work.

D. Whenever possible, the Contractor shall coil existing cable above ceiling for re-termination if cable length will allow for cabling that will remain in place.

E. Where walls, ceilings, structures, etc., are indicated as being renovated on general drawings, the Contractor shall be responsible for the removal of all technology equipment including but not limited to: copper, fiber and coaxial cable, faceplates and jacks, raceways, racking and equipment mounted to the racking, etc., from the renovated area.

F. Where ceilings, walls, structures, etc., are temporarily removed and replaced by others, this Contractor shall be responsible for the removal, storage, and replacement of equipment, devices, fixtures, raceways, wiring, systems, etc.

G. Verify that abandoned wiring and equipment serve only abandoned equipment or facilities. Extend conduit and wire to facilities and equipment that will remain in operation following demolition. Extension of conduit and wire to equipment shall be compatible with the surrounding area.

H. Coordinate scope of work with all other Contractors and the Owner at the project site. Schedule removal of equipment and technology service to avoid conflicts.

3.2 PREPARATION

A. Not all services within the building will be inactive or abandoned. Verify abandonment status with the building owner, General Contractor and Architect/Engineer prior to demolition.

B. Prior to commencing with demolition, a proposed implementation narrative with schedule shall be submitted to the Architect/Engineer for approval.

C. The contractor shall provide proof that only qualified personnel with extensive telecommunications experience will perform the demolition. No laborers will be allowed in the cable removal process.

D. The contractor shall coordinate with owner to verify all cabling, patch cords and cross connects have been removed from active equipment that is to remain during the duration of the renovation.

E. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on active equipment, use technicians experienced in such operations. Assume all equipment and systems must remain operational unless specifically noted otherwise on drawings.

3.3 DEMOLITION AND EXTENSION OF EXISTING TECHNOLOGY WORK

A. Demolish and extend existing technology work under provisions of Division 1 of Architectural Specifications and this Section.

B. Some cabling within the ceiling space may serve other building tenants; care shall be exercised to prevent service interrupts.

C. Remove, relocate, and extend existing installations to accommodate new construction.

D. Remove abandoned low voltage cabling and raceway to source of cabling according to the NEC. Refer to the NEC for definition of Abandoned Communications Cabling.

E. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces. Remove all associated clamps, hangers, supports, etc. associated with raceway removal.

F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is removed. Patch openings created from removal of devices to match surrounding finishes.

G. Disconnect and remove abandoned patch panels, blocks and other distribution equipment.

H. Repair adjacent construction and finishes damaged during demolition and extension work. Patch openings to match existing surrounding finishes.

I. Maintain access to existing technology installations that remain active. Modify installation or provide access panels as appropriate.

J. Extend existing installations using materials and methods compatible with existing technology installations, or as specified.

K. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

L. This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or are to be reused.

B. Patch panels, blocks and other connectivity equipment: Clean exposed surfaces and check tightness of connections. Re-terminate any loose connections; the contractor shall notify the Architect/Engineer of any permanently damaged or unusable equipment.

C. Technology items (e.g., patch panels, equipment racks, jacks, faceplates, blocks, cabling, etc.) Removed and not relocated remain the property of the owner. Contractor shall place items retained by the owner in a location coordinated with the owner. The contractor shall be responsible for the disposal of material the owner does not want.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of applicable Division 27 specifications.

END OF SECTION

SECTION 27 05 28
INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.

1.2 RELATED WORK

A. Section 26 05 33 - Conduit and Boxes
B. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements.

1.4 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.5 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

B. Coordination Drawings:

1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.6 DRAWINGS

A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Refer to Section 26 05 33 for conduit requirements for this project.

2.2 CABLE HANGERS AND SUPPORTS

A. Provide a non-continuous cable support system suitable for use with open cable.

B. Cable Hooks:

1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.

2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.

3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.

C. Cable Hangers:

1. Adjustable, non-continuous cable support slings for use with low voltage cabling.

2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.

3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.

4. Cabling hanger load limit shall be 100 lbs per foot.

5. Manufacturer: Erico Caddy, CableCat CAT425, Arlington Fittings TI Series or approved equal.

PART 3 - EXECUTION

3.1 INNER DUCT INSTALLATION REQUIREMENTS

A. Inner duct shall be riser or plenum rated as required by the installation environment. At minimum, inner duct should extend to the ladder rack above the termination enclosure at system endpoints. Where not installed in a continuous length, inner duct segments should be spliced using couplings designed for that purpose.

B. All exposed inner duct is to be labeled at 35-foot (10-meter minimum) intervals with tags indicating ownership, the cable type (e.g., "Fiber Optic Cable") and the cables it contains (e.g., MA-CS or FS-CS).

C. Where exposed, fiber optic cable shall be installed in protective inner duct.

D. Contractor shall determine optimum size and quantity to satisfy the requirements of the installation and to ensure that the mechanical limitations, including minimum bend radius of the cable, are considered.

E. The inner duct should extend into the termination enclosure at system endpoints.

3.2 CABLE HOOK SUPPORT SYSTEM

A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.

B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.

C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".

D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.

E. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet.

F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.

G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.3 CONDUIT AND CABLE ROUTING

A. Refer to Section 26 05 33 for additional requirements.

B. All conduits shall be reamed and shall be installed with a nylon bushing.

C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.

D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.

1. A separate pull box is required for each 90' (or greater) length section.

2. A separate pull box is required after any two (2) consecutive 90-degree bends.

3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.

F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.

G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.4 ATTACHMENT TO METAL DECKING

A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hangar and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

SECTION 27 05 53
IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the identification and administration requirements relating to the structured cabling system and its termination components and related subsystems.

B. Identification and labeling.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Documentation of labeling scheme.

PART 2 - PRODUCTS

2.1 LABELING

A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface an attachment method.

D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.

1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum “quite zone” of 0.25” on each side of the bar code.

2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

E. Color Code: Observe the following requirements for color coding:

1. Labels on each end of a cable shall be the same color for each termination.

2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.

3. Orange (Pantone 15C) shall be used for the demarcation point.

4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.

5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)

6. White shall be used to identify the first-level backbone termination in the main cross-connect.

7. Gray (Pantone 422C) shall be used to identify the second-level backbone termination in the main cross-connect.

8. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.

9. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.

10. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.

11. Red (Pantone 184C) shall be used to identify the termination of key telephone systems.

12. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.

F. Tag all CAT 6A ables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:

1. (Room Number) - (Outlet Number) - (Jack Number) - (Use).

2. “Outlet Number” shall start with 1 in each room, with additional outlets in each room numbered sequentially.

3. “Jack Number” shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.

4. “Use” shall be designated by the following:

   a. “V” for voice (RJ-45)
   b. “D” for data (RJ-45)
   c. “C” for video (coax)
   d. “M” for multimedia retrieval (coax)
   e. “S” for speaker (RCA)

5. Example #1: “106-1-1-V” indicates the top left voice jack in outlet #1 in Room 106.

6. Example #2: “109-3-4-D” indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling: Horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each manhole and pull box.

2. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.

3. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

D. Grounding/Bonding Labeling:

1. The TMGB shall be labeled “TMGB.” There shall be only one TMGB in the facility.

2. Label all TBB conductors connecting to the TMGB with a unique label, located at both ends of the TBB.

3. Each TGB shall be labeled with a unique label.

4. All TBB conductors connecting to the TGB shall be labeled uniquely at each end of the cable.

END OF SECTION

SECTION 27 11 00
COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements related to furnishing and installing equipment for communication equipment rooms.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements
B. Section 27 05 28 - Interior Communication Pathways
C. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for applicable standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

B. Coordination Drawings:

1. Include ladder racking, equipment racks, cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 CABLE MANAGEMENT – HORIZONTAL

A. Equipment Racks:

1. Equipment racks shall be equipped with and horizontal cable management hardware in the form of rings and guides. Racks shall incorporate horizontal covers, to allow an orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular patch panels and/or 110-type termination blocks to the network electronics. horizontal cable management hardware shall be as follows:

a. Horizontal cable management hardware shall be 16 gauge cold rolled steel construction with six (6) pass-thru holes and seven (7) front-mounted 3.5” steel rod D-rings. Provide with cover designed to conceal and protect cable.

b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels.

2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop") cable support ties.

3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is NOT acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Architect/Engineer prior to installation.

2.2 PATCH PANELS

A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.

B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00.

C. The patch panel shall be grounded to the grounding and bonding system for the shielded twisted pair cabling. The contractor shall follow the TIA guidelines for grounding and bonding to the cabling. Refer to the grounding and bonding specifications for additional information.

D. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.

E. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

F. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.3 D-RINGS

A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.

B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.

C. Provide ¼" screw holes for wall mounting.

2.4 COPPER PATCH CORDS

A. Copper patch cords are provided and installed by the owner.

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS

A. Equipment racks shall be furnished and installed as shown on the drawings.

B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide this function.

C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in that area. The rear of the rack should be approximately 40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Architect/Engineer for resolution prior to installation.

D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Architect/Engineer and Site Coordinator(s) prior to installation.

E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure routing of optical fiber and/or copper cabling to the optical fiber distribution cabinets and/or modular patch panels. At minimum, one such horizontal jumper management panel shall be placed below each optical fiber distribution cabinet installed by the Contractor. Additional Jumper Management panels may be required pending installation of other cable types on the equipment rack.

F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack. Refer to grounding requirements below.

3.2 D-RINGS

A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.

B. Locate D-rings on 24” centers vertically and horizontally.

C. Securely attach D-rings to the wall as required by the manufacturer.

3.3 CONDUITS AND CABLE ROUTING

A. Refer to Section 26 05 33 for additional requirements.

B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3” above the floor slab.

C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.

D. All conduits shall be reamed and shall be installed with a nylon bushing.

E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2” or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2”, maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION

SECTION 27 15 00
HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED WORK

A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards and plenum or non-plenum cable requirements.

B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).

C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.

D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:

1. Manufacturer’s data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.

2. Manufacturer’s installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

A. CAT 6A Shielded Cable:

1. The horizontal cable requirements must be met, as well as the following channel requirements.

2. CAT 6A cable shall terminate on rack-mounted modular patch panels in their respective communication equipment room as indicated on the drawings.

3. CAT 6A cable shall be shielded foil twisted pair cabling.

4. Cable shall exceed transmission requirements listed in ANSI/TIA/EIA-568-C.2. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.

5. Performance tests shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not acceptable.

6. Performance data shall be provided by third-party independent testing laboratories only. Testing data shall be submitted on the third-party testing laboratory letterhead. Test data will only be accepted if it displays testing as a channel. Electrical characteristics of the performance of the cable itself will not satisfy this requirement.

7. The structured cabling and connectivity may be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed in Section 27 17 20 as an acceptable manufacturer. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.

8. The 4-connector channel performance margins in the table below shall be guaranteed margins above ANSI/TIA/EIA-568-C.2:

Electrical Value (1 - 500 MHz)	**Minimum Margin**
Insertion Loss:	3%
NEXT:	2 dB
PS NEXT:	3 dB
PSA NEXT:	3dB
ACR-F:	2 dB
PS ACR-F:	3 dB
PSA ACR-F:	3 dB
PSA ACR-F (Average):	3 dB
Return Loss:	2 dB

9. The jacket color for CAT 6A cable shall be blue for data applications and purple for AV applications.

10. Basis of Design:

    a. Hubbell Category 6A FTP Cable #C6AFTP.
    b. Refer to Section 27 17 20 for additional acceptable manufacturers.

2.2 FACEPLATES/JACKS

A. Cat 6A Jacks:

1. CAT 6A horizontal cable shall each be terminated at its designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.

2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.

3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.

4. Where standalone CAT 6A only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.

5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.

6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.

7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall:

   a. Match the faceplate color used for other utilities in the building, or

   b. When installed in surface raceway (if applicable), match the color of that raceway.

8. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:

   a. Be a low-profile assembly.

   b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.

   c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.

   d. Incorporate a shroud that protects the optical fiber couplings from impact damage.

9. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.

10. The CAT 6A modular jacks shall be non-keyed 8-pin modular jacks.

11. The interface between the modular jack and the horizontal cable shall be an angled insulation displacement type contact and shall provide separation for ANEXT suppression. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.

12. CAT 6A modular jacks shall be pinned per TIA-568B.

13. CAT 6A termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:

    a. ANSI/TIA/EIA-568-B.2-10
    b. IEEE 802.af (PoE)
    c. IEEE 802.an 10GBASE-T
    d. ISO/IEC 60603-7
    e. ISO 11801 Class E Compliant
    f. FCC PART 68.5 SUBPART F

14. The color for CAT 6A jacks shall be blue for data applications and purple for AV applications. Alternately, a color-coded bezel or icon may be used to identify the CAT 6A modular jack.

15. Basis of design:

    a. Hubbell shielded jack #SJ6A
    b. Or pre-approved equal

2.3 COPPER WORK AREA CORDS

A. Owner provided and installed.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data STP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.

2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.

3. Manufacturer's minimum bend radius specifications shall be observed in all instances.

4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.

5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.

6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.

7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.

8. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

9. Category 6A cables shall not be mixed with any other category cable in any bundle. Bundles of Category 6A cable shall maintain a 0.5" separation from bundles of cables containing different categories (e.g., Cat 6, Cat 5E).

10. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:

    a. Twelve (12) inches from power lines of <5-kVa.
    b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
    c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
    d. Thirty-nine (39) inches from transformers and motors.

11. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

B. Horizontal Cabling in Modular Furniture:

1. This Contractor shall be responsible for providing and installing cable completely to the information outlet in the furniture. This Contractor's responsibility does not end at the furniture feed point.

2. Where furniture panels are installed to include contact with a wall, cabling shall be fed to the furniture panels via conduit.

3. Where modular furniture is installed without wall contact, the Contractor shall install cabling through floor fittings as shown on the drawings.

4. Cabling shall be protected in the transition from the floor or wall fittings to the modular furniture via a length of flexible plastic conduit or other approved protective means. Conduit fittings shall be compatible with the Floor and Wall Fittings proposed. There shall be no exposed cable in the transition to the modular furniture. Fill ratio (cable area vs. conduit area) in each feed shall not exceed 40%.

5. For purposes of bidding, it is to be assumed that the cable pathway shall be limited to the bottom panel of the modular furniture only. Communications cables would be run through these channels to the jack location.

6. For purposes of bidding, it is to be assumed that it will be the responsibility of the Contractor to punch and reinstall the bottom molding panels on the modular furniture as required to accommodate the communications cabling and information outlets. The panels shall be marked prior to installation by the Owner to identify the desired location of the information outlets.

7. The information outlet shall be secured to the panel via mounting tabs, pop-rivets, screws or other approved method. Use of adhesive tape is not acceptable. The method of securing the information outlet to the panel shall not result in sharp protrusions (e.g., sheet metal screw tip) into the channel behind the panel.

3.2 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Data STP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.

2. If the “last” patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.

3. All ports on the patch panel will need to be grounded to the grounding and bonding system. Refer to the grounding and bonding specifications section for additional information.

4. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

B. Cable Terminations - Fiber Optic:

1. ALL fibers shall be terminated using the specified connector type.

2. All terminated fibers at the telecommunications rooms shall be mated to couplings mounted on panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.

3. All couplings shall be fitted with a dust cap.

4. Fibers from multiple locations may share a common enclosure, however, they must be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure provided that they are clearly identified as such. Fibers from different locations shall NOT share a common connector panel (e.g., “insert”).

5. Slack in each fiber shall be provided to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1 meter (approximately 39") of slack shall be retained regardless of panel position relative to the potential work area.

C. Cable Terminations - Shielded (T1):

1. Shielded cabling shall be terminated on 110-type termination blocks. The blocks shall be wall-mounted at all locations.

2. Blocks shall be sized to provide for a minimum 20% growth in capacity relative to the initial installation.

3. Consistency shall be maintained throughout the installation relative to conductor sequence on the blocks. Building ground and cable shield drain wire shall be terminated immediately to the left of each two data pairs on the cross-connect fields.

4. Designation labels shall be color-coded YELLOW to identify the cabling as a Network Connection. Pairs shall be identified on the labels numerically. Ground and shield shall be identified for each pair.

END OF SECTION

SECTION 27 17 10
TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work, the Contractor shall submit:

1. Complete information on testing procedure as described herein.

2. Test plan summary for each cable type to be tested including equipment to be used, setup, test frequencies or wavelengths, results format, etc.

PART 2 - PRODUCTS

2.1 TESTING COPPER

A. General Requirements:

1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.

2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.

3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.

4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week’s advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.

5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.

6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.

7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.

8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

    a. CAT 6A Cable:

        1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.

        2) Horizontal cable shall be free of shorts within the pairs and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.

        3) CAT 6A horizontal cable shall be tested to 500 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link" including cabling, and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:

            a) Wire Map
            b) Length
            c) NEXT Loss (Pair-to-Pair)
            d) NEXT (Power Sum)
            e) ELFEXT (Pair-to-Pair)
            f) ELFEXT (Power Sum)
            g) Return Loss
            h) Attenuation
            i) Propagation Delay
            j) Delay Skew

        4) The maximum length of horizontal cable shall not exceed 295 feet (90m), which allows 33 feet (10 m) for technology equipment and modular patch cords.

5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6A modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be used during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.

6) CAT 6A horizontal cable testing shall be performed using a test instrument designed for testing to 500 MHz or higher. Test records shall verify "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.

7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.

2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.

3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (USB thumb drive). The thumb drive shall contain the electronic equivalent of the test results as defined by the bid specification and be in the tester's native format as well as summaries of each test in pdf format. Provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. Furnish one (1) copy of the data and display (if applicable) software.

C. Optical Fiber Media Test Data:

1. Test results shall include a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

2. OTDR traces of individual optical fiber "signatures" obtained as specified above shall be provided to the Architect/Engineer in electronic form for review. Trace files shall be so named as to identify each individual optical fiber by location in the cable system and optical fiber number or color. Where traces are provided in electronic form, provide along with the above documentation, one (1) licensed copy of software that will allow for the display of OTDR traces provided. The software shall run on a Microsoft Windows-based personal computer.

D. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 27 17 20
SUPPORT AND WARRANTY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.2 RELATED WORK

A. Section 27 05 00 – Basic Technology Systems Requirements.

1.3 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for relevant standards.

PART 2 - PRODUCTS

2.1 MANUFACTURER REQUIREMENTS

A. The Basis of Design for all structured cabling components is listed in the individual Division 27 sections. Alternative acceptable manufacturers will be accepted for this project.

1. Exceptions:

a. CAT 3 copper (≥25-pair).
b. Optical fiber.

B. Additional acceptable manufacturers for horizontal cabling:

1. Belden
2. Systimax
3. Siemon
4. Hubbell/Mohawk
5. Berk-Tek/Leviton
6. Molex
7. Superior Essex/Ortronics

2.2 WARRANTY

A. A twenty-five (25) year Product Installation Warranty shall be provided for the structured cabling system as described in the contract documents.

B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).

C. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 27 41 00
PROFESSIONAL AUDIO/VIDEO SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. System Components
B. Audio Connectors
C. Audio Cabling
D. Video Connectors
E. Analog Video Cabling
F. Digital Video Cabling
G. Transmission Connectors
H. Transmission Cabling
I. Control Cabling
J. Horizontal Copper and Fiber Cabling and Connectors

1.2 RELATED WORK

A. Section 26 05 33 - Conduit
B. Section 26 05 13 - Wire and Cable
C. Section 27 05 00 - Basic Communications Requirements
D. Section 27 05 03 - Through Penetration Firestopping
E. Section 27 11 00 - Communication Equipment Rooms
F. Section 27 05 28 - Interior Communications Pathway
G. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

A. Manufacturer: The manufacturer of equipment shall have a complete service organization for all products in the manufacturer's line.

B. Integrator/Dealer: The Contractor shall be a factory-authorized and certified integrator/dealer specializing in each selected manufacturer's products, with demonstrated prior experience with the selected manufacturer's system installation and programming.

C. The following qualifications have been endorsed by the AudioVisual and Integrated Experience Association (AVIXA), which is formerly known as InfoComm International.

1. The Contractor shall have a Certified Technology Specialist with a specialized Installation endorsement (CTS-I) on staff and supervising the project. This service shall not be subcontracted. In addition to supervising the project, the CTS-I shall perform the following tasks on the project:

a. Review submittals and provide a letter stating the submittals are in compliance with the contract documents.

b. Provide written and dated confirmation of an observation of the contractor's installation activities no less than every 2 weeks month during the construction period.

c. Provide a final written and dated confirmation of a final construction review prior to testing.

d. Review final testing and calibration of the systems and provide a letter with the documented results or transmittal of the results stating the test results and calibration compliance with the contract documents.

D. A certification of CCENT or CCNA from CISCO. CCNP certification satisfies either of these requirements.

E. The Contractor shall have in-house or retain the services of a Microsoft Certified Systems Engineer (MCSE) or equivalent technician for the purposes of server deployment, software configuration, and system integration for those systems that reside in a Microsoft environment. This project is utilizing Microsoft 365 for all applications.

F. This project uses a video over IP AV solution and will require that the Contractor be proficient in distribution of video over an IP network. Aurora Multimedia is the basis of design. The Contractor is required to have the following certification requirements to support the system:

1. Crestron NVX certification and all applicable Crestron networking certifications.

G. Control System Dealer: The media control system shall be provided, terminated, installed, and programmed by a factory-authorized and certified dealer and integrator in good standing with the manufacturer. The dealer shall have direct purchasing and support authority. These services shall not be subcontracted.

H. Control System Programmer: The media control system shall be programmed by a factory-trained and certified programmer.

1. Should the installer of the system not employ a factory-trained and certified programmer, a representative from the equipment manufacturer or certified independent programmer shall be retained for programming services. The Contractor shall be responsible for payment of his/her services until the job is complete and signed off.

2. The Contractor shall have all certifications required by the manufacturer(s) for the installed system components on staff for the appropriate duties and responsibilities required by the manufacturer.

a. The control system programmer shall have all refresher courses completed for the latest features of the control platform prior to bidding the project to ensure that the Contractor is up to date with the latest software features.

b. The control system programmer shall have achieved the highest programmer level obtainable by the installed control manufacturer (e.g., master programmer).

3. The Contractor shall be fluent in the control systems preferred language (e.g., Python, C#, Java, JavaScript, SQL, PHP, etc.) required to complete the programing requirements of the AV system.

a. Other languages may be required to integrate with other systems, such as the HVAC and lighting system. The Contractor shall coordinate the programming services with the on-site contractor for the integrated system. The Contractor shall hire the services of a certified contractor to program these other systems as required by the manufacturer of these other systems.

I. Audio System Programmer: All digital sound processing equipment (DSP) used on the project shall be setup, programmed and calibrated by a factory-trained and certified technician. The audio system programmer shall have the following complementary certifications:

1. Associated manufacturer certifications
2. Dante Level III

J. Video System Programmer: All video distribution and processing used on the project shall be setup, programmed and calibrated by a factory-trained and certified technician.

K. The Contractor shall employ an ISF (Imaging Science Foundation) Level I certified video calibration specialist on staff to perform the calibration of the displays.

L. The Contractor shall have acquired and maintained all certifications for a minimum of one (1) month prior to the posted bid date of this project.

M. Servicing Contractor: The installer must be factory certified to provide service on the installed manufacturer's equipment and must have local service representatives within a 100 mile radius of the project site.

1.4 REFERENCES

A. ADA - Americans with Disabilities Act
B. ADAAG - Americans with Disability Accessibility Guidelines
C. ANSI - American National Standards Institute
D. AVIXA – Audiovisual and Integrated Experience Association (Formerly InfoComm)
E. ANSI/InfoComm A102.01:2017 - Audio Coverage Uniformity
F. ANSI/InfoComm 2M-2010 - Standard Guide for Audiovisual Systems Design and Coordination Processes
G. ANSI/InfoComm F501.01:2015 – Cable Labeling for Audiovisual Systems
H. ANSI/InfoComm 10:2013 – Audiovisual Systems Performance Verification
I. ANSI/AVIXA V202.01:2016 – Display Image Size for 2D Content in Audiovisual Systems
J. ANSI/InfoComm 3M-2011 – Projected Image System Contrast Ratio
K. IBC - International Building Code
L. IEC - International Electrotechnical Commission
M. NFPA 70 - National Electrical Code (NEC)
N. UL 813 - Commercial Audio Equipment
O. UL 1419 – Professional Video and Audio Equipment
P. UL 1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
Q. UL 1492 – Audio/Video Products and Accessories
R. CBC - California Building Code (Current Version)

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 27 05 00.

B. General Requirements:

1. Submittals will be submitted in multiple passes over the course of construction. Each pass will be a dedicated single submission for review as outlined in the general submittal requirements outlined in section 27 05 00.

2. Upon acceptance of an item in the submittal, the Contractor shall remove them from future resubmittals of the same submittal "pass".

3. Should the Contractor not provide shop drawings in a timely fashion, not complete requirements, or extend the time of any resubmittals so as to jeopardize schedules, cause delay, or limit access for field work, the Contractor bears responsibility for impact and delay that may occur. This includes access or lift to overhead positions and associated protection of work already in place.

C. First Pass Submittals: To be submitted after the project is awarded but before equipment is submitted, purchased and installed.

1. Contractor(s) résumé of qualifications.

2. All certifications shall be current and valid. Any certificate with expired dates will not be accepted.

3. All applicable AudioVisual and Integrated Experience Association (AVIXA) certifications. Qualifications from InfoComm that have not expired will be accepted.

4. All certifications outlined in the qualifications shall be included in this submittal. Refer to the qualifications section for additional information. Certifications include, but are not limited to:

a. All installed manufacturer certifications required by the manufacturer.
b. Control system authorized dealer certification.
c. Control system certified programmer certification(s).
d. Audio system DSP dealer certification.
e. Audio system DSP programmer certification.
f. Video system dealer certification(s).
g. All other applicable dealer, installation and programming certifications.
h. All applicable Microsoft certifications.
i. All applicable networking certifications.

5. If an alternate manufacturer(s) is submitted, the equivalent certifications to the basis of design manufacturer(s) shall be required and submitted.

6. Audio and video calibration equipment certifications.

7. Audio and video testing and calibration equipment and software procedures and manufacturer-specific equipment calibration certificates.

D. Second Pass Submittals: To be submitted after all initial submittals have been approved but before equipment is purchased, installed, configured, and programmed. This can be submitted with the first pass submittal but will require to be submitted as a separate document.

1. Alternate System Drawings: If an approved alternate manufacturer is submitted, the Contractor shall provide project-specific system CAD drawings. These will be required to be submitted with the product data.

a. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical controllers), the diagram may show one device and refer to the others as “typical” of the device shown.

2. Product Data: Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:

    a. Compliance with each requirement of these documents.
    b. All component options and accessories specific to this project.
    c. Electrical power consumption rating and voltage.
    d. Wiring requirements.
    e. Pre-terminated cable distances and requirements identified by each room where required.
    f. Product manuals are not an acceptable format and will be rejected.

3. Networking: Provide a spreadsheet that includes networking requirements for programming the AV system components. The spreadsheet shall include but not limited to:

    a. Full list of IP addresses, VLANS, and subnetworks.
    b. Power-Over-Ethernet (PoE) load requirements including each PoE power and power budget calculations.
    c. Bandwidth on a per device, per switch, and per system requirements.
        1) Calculations will include the total bandwidth required for connecting over the WAN.
    d. Usernames and Passwords for all devices.
    e. Coordinate with the owner on additional information on the spreadsheet.

4. Available wireless microphone frequencies within a 50 mile range based on the submitted system(s) and coordinated with the number of channels.

E. Final Pass Submittals: To be submitted after all initial submittals have been approved but before the equipment is installed, configured and programmed. These should not be submitted until after the pre-installation meeting outlined in Part 3.

1. System Drawings: Project-specific system drawings shall be provided as follows:

    a. Provide a system block diagram noting system components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system. When multiple pieces of equipment are required in the exact same configuration (e.g., multiple identical controllers), the diagram may show one device and refer to the others as "typical" of the device shown.

    b. Submittals shall contain shop drawings indicating physical plan locations and placement of installed devices and accessories with associated scope or field conditions for review and coordination. Provide mounting details, suspensions, and rough-in notes with trade demarcations.

        1) Identify any non-standard back boxes or mounting assembly required by product or specifications and elaborate contractor means and methods for mounting.

        2) Provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project.

3) All display mounts shall be coordinated with the Design Build Architect to verify the exact vertical and horizontal positioning of the display. Coordinate in-wall stud locations for installation of recessed display mounts to install in the exact location as coordinated with the architectural drawings.

4) Recessed ceiling speakers, in-ceiling microphones, and all other above ceiling devices shall be coordinated with other trades in the field (e.g., mechanical ductwork, lights, diffusers, etc.) to minimize changes that will impact the performance of the system design.

c. Submit wiring and cable path requirements, including field wiring, path verification, signal separation, and outside diameter of cables for conduit sizing and verification that can be used for field installation and electrical coordination.

d. Reproduction of contract documents is not acceptable for submittals. Wire CAD type drawings and cable tag lists or schedules, or typical manufacturer's abbreviated single lines alone, are not complete.

2. The Contractor **shall** submit graphic or emulated representations of the control system touch panels for each unique space and layout prior to purchase, installation and programming for review and comment by the Design Build Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/icon for all pages.

3. The Contractor shall submit graphic or emulated representations of the control system keypads for each unique space and layout prior to purchase, installation and programming for review and comment by the Design Build Architect/Engineer and Owner. These shall show and describe the intended programming/macro control features and functions of each button/knob.

4. The Contractor shall submit the actual DSP audio processor files or single line audio path file diagram prior to installation for review and comment by the Design Build Architect/Engineer. Provide preliminary settings with processor blocks identified and note resources allocated.

5. Submit meeting agenda for planning/programming meetings as required in Part 3 of this specification.

6. Submit detailed description of Owner training to be conducted at project end, including specific training times and typical attendees expected.

7. Provide rack drawing(s) showing the mounting of equipment in each rack or cabinet on the project. Rack drawings shall include the following:

a. Equipment placement including mounting on the front or rear of the rack.

b. Spacing separation as required by equipment for adequate airflow and heat dissipation.

c. Signal separation based on AVIXA standards as required by the design.

d. Heating/cooling load requirements for submitted equipment to verify the heating/cooling load of the rack. This shall include Owner-provided equipment coordinated with the Owner.

e. Power requirements for each rack including plug type and loads based on the final approved products.

8. Discontinued Products and New Model Releases:

a. For each product, the Contractor shall submit (in addition to the specified product) a product cut sheet if the specified product has been replaced, improved upon, phased out or otherwise upgraded at the time of shop drawing submittal.

1) The intent of this requirement is for the Contractor to submit only direct replacements for the specified products. A direct replacement shall be defined as a product of newer release that has equal or greater capabilities, which is available for not more than a 10% premium over the specified product's bid unit cost.

2) It is not the intent of this requirement for the Contractor to submit new products or other product options that significantly differ in capability and/or cost from the specified product.

F. Coordination Drawings:

1. Include all ceiling-mounted devices in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.6 SYSTEM DESCRIPTION

A. This specification section describes the furnishing, installation, commissioning and programming of audio/video components and systems.

B. Performance Statement: This specification section and the accompanying Contract Documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made and every feature and function that must be programmed and configured. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.

C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment and other miscellaneous equipment required for proper system installation and operation shall be provided by the Contractor.

D. This document describes the major programming features and functions of the system. All additional programming, configuration and integration required for proper system installation and operation shall be provided by the Contractor.

E. When a specific manufacturer is not provided in this document for minor pieces of equipment, the Contractor shall provide only those materials considered to be of the same industry commercial and professional quality level as the major equipment manufacturers.

F. General System Description:

1. The purpose of this section is to define the overall AV system requirements for each space identified on the project drawings. This is to represent the end-user needs, applications, tasks and Functions and features for each space to assist with identifying programing requirements for each space.

G. General System Requirements:

1. The overall system will be a network-based system that is capable of communication between endpoints to allow for audio and/or video to be routed to any display (Any-in to Any-Out). The network includes all AV devices and infrastructure that connects to network switches that will support the AV needs including the network, power (PoE) and security requirements of both the AV network and the owner's internal security policy requirements. The owner will be providing the network switches for the AV network.

    a. Crestron NVX Series 3 encoder/decoders are the preferred manufacturers on this project with no alternates at this time.

    b. All data cabling will be provided and routed between the endpoints and the AV closets. All cabling will be category 6A shielded twisted pair cabling. Refer to specification section 27 15 00 for additional information.

    c. Owner provided network switches will support all features and network requirements of the NVX Crestron system.

        1) The owner plans to use Meraki MS390-48 network switches for this project.

2. The System will be connected to a cloud service that will maintain and manage the AV system. XiO cloud by Crestron is the basis of design. The cloud services will be a fully featured enterprise solution that will enable the owner to manage the AV system components and to allow for the system to monitored for usage and other analytical information that is useful for the application. The system will include management of the control system and allow the system to control rooms to manage power during off-peak hours.

3. The control platform for the system is Crestron. This includes interactive touch panels and other means to control the AV within the space. The control system will be managed by a central server in the cloud (XiO Cloud) to allow for monitoring of each AV space to allow for remove control, monitoring, auto shutdown, etc. The touch panel will have the capabilities to control the following in addition to the individual requirements outlined for each space:

    a. AV system Control.

    b. Microsoft Teams Video/Audio Control (Including a 10-key dialer interface for voice calls) for rooms that support Microsoft Teams.

4. The owner has selected Microsoft Teams as the unified communications platform for use with chat, video conferencing, and other owner policy driven applications that will integrate with the AV system. Microsoft Teams will allow for the AV in the space to seamlessly connect to a video call with a single one-touch join feature, communicate between spaces both internally and/or externally, and allow for the collaboration within each space. The owner will provide licensing for each endpoint and provide connections to other services such as voice and video call routing through their own enterprise licensing agreement with Microsoft.

5. The owner has selected Mersive Solstice Pod as the Wireless Presentation Device throughout the building. All references to the Wireless Collaboration Device herein will refer to the Solstice Pod. No other manufacturers will be considered at this time. The Solstice Pod will include the following features:

    a. The unit will be a Generation 3 Enterprise edition that will support dual screen functionality.

    b. Include a method of wirelessly providing a markup on the display from a mobile device.

    c. Include calendar integration to show the calendar for the space that matches with the rooms room scheduling panel.

    d. Provide a digital signage page in select rooms and spaces that are not being currently used as a wireless display.

    e. Allow for various mobile devices to connect including but not limited to Windows, iOS, Android, and MacOS.

    f. Provide Miracast support for extending a desktop display in a windows environment.

    g. Include a wireless connection to an in room microphone, camera, and speaker for video conferencing calls over other means that Microsoft Teams.

6. Audio throughout the space will leverage Dante Audio routing for all spaces. This will allow for the transition of audio between rooms and routing in the av-over-ip ecosystem.

H. Architectural and Infrastructure Requirements

1. Coordinate studs and mounting of equipment with furniture. Align displays with tables. Coordinate any ceiling devices with Design Build architect.

I. Electrical Requirements

1. Coordinate any power needs with electrical contractor. Many devices use power over ethernet if local power is required coordinate with electrical contractor.

2. At wall mounted display locations an in wall box will be provided behind the displays to support in wall mounts and include built in power. Provide a single 120VAC, 20A circuit to the display's backbox for display power.

3. The U-Shaped table will require additional circuits to support the additional AV at this table. Provide a minimum of (3) 120VAC, 20A circuits at the floor box on each side with an additional 120VAC, 20A circuit for AV equipment.

J. Information Technology (IT) Requirements

1. The owner will provide a WAN connection to allow for firmware updates and remote control and monitoring only.

2. The owner will provide a local LAN and WLAN for av-over-ip connectivity and allow for a network topology for the av system and connectivity wirelessly for wireless display and collaboration.

3. Each display will include (2) network drops for network connectivity.

4. Provide two (2) network drops at podium locations.

5. Refer to the project drawings for additional network requirements.

K. Acoustical Requirements

1. Verify levels zones and levels with owner for background music.

L. Conference Room (Room C) - Single Display Room with Integrated Equipment

1. The conference room will be used to collaborate with the persons with the room or be able to initiate a voice and/or video conference call with a remote location. The space will include integration with Microsoft Teams and provide a one-touch setup of the room if a user decided to initiate a conference call. The construction of the room is a 8-10 seat conference table with a display at one end to allow for a visual display of the content within the space for both the far end and near end participants. The space will include:

    a. A minimum 75” widescreen UHD display with a resolution of 3840 x 2160. The display will be mounted above the table line.

    b. Connectivity will include:

        1) A wireless presentation device (AirMedia).
        2) A connectivity faceplate on the wall to support a hard-wired connection as an alternative means to connect to the AV system.

    c. The room will include video conferencing capabilities. Video Conferencing capabilities will be handled through Microsoft teams through a one touch interface that will be initiated from the touchpanel. The system will also include a secondary connection for devices to connect wirelessly for other systems such as Zoom and WebEx Integration through the Flex connection and will include:

        1) Microphone for voice.
        2) Speakers for Audio.
        3) Camera for Video.

    d. The microphone will be integral to the Mercury unit on the table.

    e. A new USB camera will be installed at the front of the room below the display.

    f. Audio will come from the Mercury table-top unit.

g. A dedicated Table-top touch panel with microphone/speaker will be installed in the space to provide control with a simple interface with a single one touch to join junction. The unit will be connected to Microsoft Teams to initiate a conference call through a single button touch-to-join interface or able to dial out and used as a standard audio call. The panel will include a feature that will know when someone is present within the space and a meeting is being held to assist with automating the setup of the room in addition to shutting down the room when not in use. The panel will be used to control the following:

1) Display control (on/off) and source switching.
2) Video Camera Control for use with video conferencing.
3) Audio and microphone levels in the space.
4) Full featured phone interface with Teams Integration and a 10-key call feature.

h. The system will include the ability to initiate a Microsoft teams video call without the requirement of additional hardware using a UC platform.

M. Multipurpose Room

1. The multipurpose room includes (2) individual rooms (Labeled Room A and Room B) that can be configured into a combined and/or un-combined state. The rooms are divided by a manual partition that is stored in an in-room storage room. The room will be primarily used in a combined state to allow for various meeting and will be flexible to allow for the re-arranging of furniture.

2. The following is an overview for each space that is used individually as a dedicated conference space:

a. Room B is primarily used when the room is combined. The following is an outline of the equipment in this room:

1) (2) 75” widescreen UHD display with a resolution of 3840 x 2160. The display will be mounted above the table line.

2) Connectivity will include:

a) A Wireless Presentation Device (Mersive).
b) A wall box installed in the room that will include:
(1) HDMI input
(2) Audio Connection input.

3) The room will include video conferencing capabilities. Video Conferencing capabilities will be handled from an owner provided PC that will be capable of providing Video Conference call either through Teams, Zoom, WebEx, Bluejeans, or any other UC platform and integrate with the room AV. The PC will be installed in the AV control room. Integration will include:

a) All in room microphones for voice.
b) In room speakers for Audio.
c) The capability to stream one of the cameras.

4) The space will include wireless microphones. Wireless microphones will include batteries and capable of being recharged for future use. Wireless microphones will be installed in the AV control room to recharge. Provide the following wireless microphones:

a) (20) push to talk gooseneck microphones.
b) (2) lanyard microphones.
c) (2) handheld microphones.

5) Audio will include ceiling speakers in the space to provide amplified audio form the primary display source, program audio and video conferencing audio.

6) A dedicated wall mounted touch panel will be installed in the space to provide control with a simple interface with a single one touch to join junction. The unit will be connected to the wireless collaboration system to initiate a conference call through a common interface to allow for video conference in the room. The panel will include a feature that will know when someone is present within the space and a meeting is being held to assist with automating the setup of the room in addition to shutting down the room when not in use. The panel will be used to control the following:

a) Display control (on/off) and source switching.
b) Video Camera Control for use with video conferencing.
c) Audio and microphone levels in the space.
d) Room status and configuration (Combined/Divided).
e) Configuration Control based on board members and full control of the AV equipment in the room.

b. Room A is primarily used as a classroom configuration when in a partitioned state and is combined with Room B when being used for the board meetings. The following is an outline of the equipment in this room:

1) (4) minimum 75” widescreen UHD display with a resolution of 3840 x 2160. The display will be mounted above the table line.

2) Connectivity will include:

a) A Wireless Presentation Device (Mersive).
b) A wall box installed in the room that will include:
(1) HDMI input
(2) Audio Connection input.

3) Video conferencing capabilities will primarily use the wireless presentation device (Mersive) when used in a partition state. The wireless presentation device will provide wireless connectivity to the in-room equipment for video conferencing. In a combined state with Room B, the room will utilize the Room B computer system to allow for full video conferencing capabilities. Integration with the in-room solution will include:

a) Wireless microphones.
b) In room speakers for Audio.

c) The capability to stream from the in-room camera.

4) The space will include wireless microphones. Wireless microphones will include batteries and capable of being recharged for future use. Provide the following wireless microphones:

a) (2) lanyard microphones.
b) (2) handheld microphones.

5) Audio will include ceiling speakers in the space to provide amplified audio form the primary display source, program audio and video conferencing audio.

6) A dedicated wall mounted touch panel will be installed in the space to provide control with a simple interface with a single one touch to join junction. The unit will be connected to the wireless collaboration system to initiate a conference call through a common interface to allow for video conference in the room. The panel will include a feature that will know when someone is present within the space and a meeting is being held to assist with automating the setup of the room in addition to shutting down the room when not in use. The panel will be used to control the following:

a) Display control (on/off) and source switching.
b) Video Camera Control for use with video conferencing.
c) Audio and microphone levels in the space.
d) Room status and configuration (Combined/Divided).
e) Configuration Control based on the presenter at the front of the room.
f) This will be a secondary touch panel and will be disabled when in a combined state. The master touch panel will re-enable this touch panel when the status has changed.

c. When Room A and Room B are in a combined state, the following will apply to the equipment in each of the rooms:

1) All displays in both rooms will display the same content.
2) The touch panel in Room B will be the primary touch panel and the touch panel in Room A will be disabled.
   a) A message on the touch panel in Room A will be shown to indicate this state.
3) The cameras in both rooms be under full control in the AV Control room.
4) The speakers in both rooms will be combined and use a combined DSP profile.
5) The microphones in room A and room B will be combined for use in the space.
6) Wireless presentation will use the wireless presentation system in Room B. The wireless presentation system in Room A will be muted.

d. There will be (1) PTZ and (1) fixed wide angle camera that will push video through NDI protocol, the av-over-ip system and allow to be used for both livestream applications (to an owner PC) and video conferencing based on the configuration of the room. The cameras will be fully controllable via an owner provided tablet and a workstation in the AV Booth Room. Additional software may be required to be installed on the owner PC to allow NDI communications for both Microsoft Teams and Zoom.

e. The Audio coverage will be based on the configuration of the room. When in a combined configuration, the room will be configured to provide program audio through both spaces. When in a individual room state, each room will be able to control each rooms audio separately. DPS settings will vary based on the configuration of the room.

f. The U-Shaped table will include various monitors which will mirror the content on the primary displays. These will tie to AV system to allow flexibility to change the number of displays and/or disconnect the table to allow the table to move. There will be no control at this location.

g. The AV Booth will include an owner provided wireless tablet to allow for full control of the AV system in both rooms.

1) The contractor shall provide programming for up to (2) tablets and the tables shall have the following (but not limited to) control:

a) Full DSP control of the audio in the room including the in room speakers, microphones, source audio, conferencing audio, etc. This will include adjustments to the full DSP profile in an advanced options area with presets in a general area.
b) Full source switching control for both rooms. Allows for any-in to any-out to any of the displays and source equipment. By default, the displays in both rooms will support the in room wall plate/wireless collaboration device mirrored on the in room displays.
c) Full control of the PTZ camera. This includes when in a combined and/or non-combined state.
d) Additional control for individual components such as system on/off, general volume up/down, etc. as outlined in the individual rooms.

1.7 LICENSING REQUIREMENTS

A. All user licenses required for system operation shall be included in the Contractor's bid. User licenses shall include, but not be limited to, server and workstation software and any other licensing that is required by the manufacturer for operation of any system component.

1. Licenses shall be provided on a one-to-one basis. One license shall be provided for each server, workstation, and device requiring a license. In the event the manufacturer requires the purchase of a block of licenses, the minimum standard licensing package to support all devices shall be provided.

1.8 INTELLECTUAL PROPERTY OWNERSHIP

A. All supporting documentation, programming, uncompiled source code, graphic files, DSP code and diagrams, written and electronic files, including all latest versions of the documentation and software necessary to edit and adapt the system(s), shall be provided to the Owner for all spaces and all systems. The integrator and/or programmer shall also maintain a current copy to be provided at the Owner's request.

1. The Owner shall have the right to modify the intellectual property directly, or to have the intellectual property modified by any party of the Owner's choosing.

1.9 PROJECT RECORD DOCUMENTS

A. Submit documents under the provisions of Section 27 05 00.

B. Provide all applicable certifications.

C. Provide statement that system checkout test, as outlined in the shop drawing submittal, is complete and satisfactory.

D. Provide schedules documenting all terminal block wiring, including cable numbers.

E. Warranty: Submit written warranty and complete all Owner registration forms.

F. Complete all operation and maintenance manuals as described below.

G. The Contractor shall include all factory-provided test results for equipment installed on the project.

H. The Contractor shall include all test results from system demonstration and performance testing specified in this document.

I. Record Drawings shall minimally include:

1. All revisions to, or deviations from the original drawings, as well as final dimensions, cable routes, connector panel drawings, cable numbering charts, and control system programming documentation. A complete as-installed equipment list, listed by room, and with manufacturers' names, model numbers, serial numbers, and quantities of each item.

2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and programming code.

3. Complete equipment rack layouts showing locations of all rack-mounted equipment items.

4. Additional information, diagrams or explanations as designated under respective equipment or systems specification section.

J. Within each equipment room, the appropriate floor plan for which that equipment room serves shall be laminated and mounted for use by the Owner. Functional drawings shall be posted at each AV closet or included at every AV rack within a room.

K. Upon completion and final acceptance of the project, the Contractor shall provide the Owner a copy of the programming code for any and all AV systems and devices programmed by the Contractor.

1. For any subsequent modifications to the programming code, an updated copy of the code shall be provided to the Owner.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit documents under the provisions of Section 27 05 00.

B. Manuals: Final copies of the manuals shall be delivered after completing the installation. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of the Contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation shall include all modifications made during installation, checkout, and acceptance. Manuals shall be submitted in electronic format. The manuals shall consist of the following:

1. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.

2. Hardware Manual: The manual shall describe all equipment furnished including:

a. General description and specifications.
b. Installation and checkout procedures.
c. Equipment layout and electrical schematics to the component level.
d. System layout drawings and schematics.
e. Alignment and calibration procedures.
f. Manufacturers repair parts list indicating sources of supply.

3. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

a. Definition of terms and functions.
b. System use and application software.
c. Initializations, startup, and shutdown.
d. Reports generation.
e. Details on forms customization and field parameters.

4. Operator's Manual: The operator's manual shall fully explain all procedures and instructions for the operation of the system including:

a. Computers and peripherals.
b. System startup and shutdown procedures.
c. Use of system, command, and applications software.
d. Recovery and restart procedures.
e. Use of report generator and generation of reports.
f. Data entry.
g. Operator commands.
h. Alarm messages and reprinting formats.
i. System permissions functions and requirements.

5. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

C. Video Calibration Data: Provide documentation of all calibrated settings for each display.

D. Audio Calibration Data: Provide documentation on all EQ settings, crossover points, limiter settings, gate settings and all other applicable settings.

E. Intellectual Property Ownership: Provide all uncompiled source code and DSP programming for all systems and spaces as described in Part 3 of this specification section.

1.11 WARRANTY

A. Unless otherwise noted, provide warranty for one (1) year after Date of Substantial Completion for all materials and labor.

B. Onsite Work During Warranty Period: This work shall be included in the Contractor's bid and performed during regular working hours, Monday through Friday.

1. Inspections: The Contractor shall perform two (2) minor inspections at even intervals (or more often if required by the manufacturer), and two (2) major inspections offset equally between the minor inspections.

2. Minor Inspections: These inspections shall include:

a. Visual checks and operational tests of all equipment, field hardware, and electrical and mechanical controls.

b. Mechanical adjustments if required on any mechanical or electromechanical devices.

3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:

a. Clean all equipment, including filters, interior and exterior surfaces.

b. Perform diagnostics on all equipment.

c. Check, test, and calibrate (if required) any sensors or other equipment that contain settings.

d. Run all system software diagnostics and correct all diagnosed problems.

C. Operation: Upon the performance of any scheduled adjustments or repairs, Contractor shall verify operation of the systems.

D. Emergency Service: The Owner will initiate service calls when the systems are not functioning properly. Qualified personnel shall be available to provide service within the distance defined within this specification section. The Owner shall be furnished with telephone number(s) where service personnel can be reached 24/7/365. Service personnel shall be at site within 24 hours after receiving a request for service.

E. Records and Logs: The Contractor shall keep records and logs of each task completed under warranty. The log shall contain all initial settings at substantial completion. Complete logs shall be kept and shall be available for review on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the systems.

F. Work Requests: The Contractor shall separately record each service call request on a service request form. The form shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what must be done, the amount and nature of the materials used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within five (5) business days after work is accomplished.

G. System Modifications: The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications shall be made without prior approval of the Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected. To the fullest extent possible, the Owner shall be provided with electronic restorable versions of all configurations prior to the modifications being made.

H. Software: The Contractor shall provide all software and firmware updates during the period of the warranty and verify operation of the system upon installation. These updates shall be accomplished in a timely manner, fully coordinated with system operators, shall include training for the new changes/features, and shall be incorporated into the operations and maintenance manuals, and software documentation.

I. Refer to the individual product sections for further warranty requirements of individual system components.

PART 2 - PRODUCTS

2.1 OWNER FURNISHED PRODUCTS

A. Network switches hubs and routers.

B. Workstations with keyboard, mice, and monitors.

C. Refer to the project drawings for additional information.

2.2 SYSTEM COMPONENTS

A. Refer to the project drawings for basis of design system components. Equivalent products shall meet or exceed all requirements defined on the project drawings. The following product information represents the minimum additional requirements for equivalent products:

B. Audio/Video GUI Control Systems:

1. Contractor shall furnish a programmable software-based audio/video control system. The system shall be field configurable and programmable by the factory and/or a factory-trained programmer.

2. The control system shall be TCP/IP based allowing direct connection of the system processors to a 10/100BaseT compatible Ethernet network.

3. The control system(s) shall connect to a centralized software-based management system for central control, monitoring and statistical information.

4. Virtual touch panel and keypad control shall be provided for remote trouble shooting and control.

5. Refer to project drawings for required central processors, touch panels, keypads and additional information.

C. Microphone Systems:

1. Wireless Microphones:

a. Wireless microphones shall not operate in the 614 to 806 MHz band (channels 38 to 69).

b. Features:

1) Dual antenna reception with true diversity reception.

c. Microphone systems that are common (shared) by multiple spaces or when the receivers are in a remote area shall include a compatible wireless antenna distribution system by the same manufacturer as the wireless microphone system.

D. Audio Amplifiers:

1. Power Amplifier(s), 25, 70.7 and 100 Volt:

a. Power: The following calculation shall be used to determine the minimum required output of the amplifier(s):

1) Calculate the total power tap value of each transformer with insertion loss using the following equation:

a) Tap wattage x 10^(xdB/10) where x = the rated insertion loss at 1,000Hz.

2) Calculate the total wattage loss based on cable distance, cable gauge and cable resistance.

3) Add together all the speaker taps' total power values that will be on a single channel of the amplifier. Multiply that total by 1.2 which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.

E. Assisted Listening Systems (ALS):

1. Assisted listening requirements for this project shall follow the local jurisdiction's requirements to quantify the number of devices for use on this project.

2. All spaces with amplified audible communications require an ALS. The Contractor shall refer to the ADA and ADAAG guidelines, as well as IBC Section 1108.2.7 for ALS rules, regulations and guidelines. Refer to the table below for the required number of receivers to be provided for each space (*Source: IBC, Table 1108.2.7.1)*. Alternatively, if the building is managed by a single entity and all systems are fully compatible and interoperable, the total number of seats for all areas can be used in accordance with the table below.

Capacity of Seating in Assemble Areas	Minimum Required Number of Receivers	Minimum Number of Receivers to be Hearing-aid (T-coil) Compatible
50 or less	2	2
51 to 200	2, plus 1 per 25 seats over 50 seats	2
201 to 500	2, plus 1 per 25 seats over 50 seats	1 per 4 receivers
501 to 1,000	20, plus 1 per 33 seats over 500 seats	1 per 4 receivers
1,101 to 2,000	35, plus 1 per 50 seats over 1,000 seats	1 per 4 receivers
Over 2,000	55, plus 1 per 100 seats over 2,000 seats	1 per 4 receivers

3. Receivers required to be hearing-aid compatible shall interface with telecoils in hearing aids through the provision of neckloops and shall be over-the-ear type headphones. Earbuds are not acceptable for this use.

4. Receivers shall include a 1/8” (3.2mm) standard mono output jack.

5. Refer to the Access Board Research "Large Area Assistive Listening Systems: Review and Recommendations" ALS report for additional recommendations.

F. Power Conditioning and Surge Protective Devices:

1. All equipment shall be plugged in through a power conditioning surge arrestor.

2. Provide a minimum of 50 dB noise attenuation.

3. Provide a minimum of 1,500 joules of surge protection.

4. UL 1449 – Standard for Safety for Surge Protective Devices listed to 330 volt clamping voltage.

5. Power sequencers shall be equipped bi-directional RS-232 Ethernet control for remote turn on and off.

6. Refer to the project drawings for additional information.

G. Refer to project drawings for all other equipment not listed.

2.3 AUDIO CONNECTORS

A. This article includes minimum requirements for all connectors that are acceptable on this project. Should the Contractor request an alternative connector, it shall be submitted with the product submittals and clearly identified with which connector it will be replaced.

B. Phono Jack:

1. Panel Mount:

a. Professional grade, three conductor, stereo, 0.375" hole diameter mounting, self-locking, double-open circuit.

b. Approved Manufacturers:

1) Switchcraft
2) Neutrik

2. Cable Mount:

a. Professional grade, three conductor, stereo, all-metal construction, integral cable clamp, nickel body, cable strain relief.

b. Approved Manufacturers:

1) Switchcraft
2) Neutrik

C. Loudspeaker Connector:

1. Panel Mount: Twist-lock type, 4-conductor.

2. Approved Manufacturers:

a. Neutrik

2.4 AUDIO CABLING

A. Refer to Section 27 05 00 for cable rating requirements.

B. Microphone Level Audio Cabling:

1. For patch cables less than or equal to 25 feet:

a. 24 AWG 2-conductor, twisted, stranded (19x36) tinned bare copper.

b. Single Layer Shield:

1) Shield: 100% aluminum foil shield

c. Nominal Capacitance: 30.0 pF/Ft

1) Belden
2) West Penn
3) Liberty

2. For cable runs greater than or equal to 25 feet:

a. 22 AWG 2-conductor, twisted, stranded (16x34) tinned bare copper.

b. Dual Layer Shield:

1) Shield: 85% total tinned copper braid shield

c. Nominal Capacitance: 18.0 pF/Ft

d. Acceptable Manufacturers:

1) Belden
2) West Penn
3) Liberty

C. Line Level Audio Cabling:

1. For patch cables less than or equal to 25 feet:

a. 22 AWG 2-conductor, twisted, stranded (7x30) tinned bare copper.

b. Single Layer Shield:

1) Shield: 100% aluminum foil shield

c. Nominal Capacitance for non-plenum cable: 24.0pF/Ft

d. Nominal Capacitance for plenum cable: 35.0 pF/Ft

e. Acceptable Manufacturers:

1) Belden
2) West Penn
3) Liberty

2. For cable runs greater than or equal to 25 feet:

a. 18 AWG 2-conductor, twisted, stranded (16x30) tinned bare copper.

b. Single Layer Shield:

1) Shield: 100% aluminum foil shield

c. Acceptable Manufacturers:

1) Belden
2) West Penn
3) Liberty

D. Constant Voltage Speaker Cabling:

1. Class 2, stranded, twisted, 2-conductor, minimum of 16-gauge wire for all 25/70.7/100-volt applications unless noted otherwise.

2. The Contractor shall size cabling as required for distance power and shall provide larger gauge cable as required.

3. Acceptable Manufacturers:

a. Belden
b. Liberty
c. Or pre-approved equal

E. Low Capacitance Speaker/Subwoofer Cabling:

1. Class 2, high strand count (65x34), oxygen free copper, low capacitance (19.9 pF/Ft), twisted, 2-conductor, 16-gauge wire for all 2/4/8/16 ohm low impedance applications where amplifier output is 150 watts or less and/or the distance is less than 50', unless noted otherwise.

2. The Contractor shall size cabling as required for distance power and shall provide larger gauge cable as required.

3. Cable shall be installed in conduit within plenum areas.

4. Acceptable Manufacturers:

   a. Belden
   b. Liberty
   c. Or pre-approved equal

2.5 ANALOG VIDEO CONNECTORS

A. RF Video F-Connector:

1. 75 ohm, broadcast quality, two-piece compression type. Return Loss: < -36 dB to 1 GHz, -25 dB to 2 GHz, -23 dB to 3 GHz. Twist-on and crimp connectors are not acceptable.

2. Approved Manufacturers:

   a. Corning Gilbert
   b. King
   c. Amphenol

2.6 DIGITAL VIDEO CABLING

A. All digital video cabling shall be pre-assembled and tested in a factory and not field terminated. The contractor shall field verify the cable distance and provide the proper cable type and length.

B. High Definition Multi-Media Interface (HDMI) “High Speed” Cable:

1. For any cable run that exceeds the manufacturer-recommended distances or fails to transmit video or audio due to cable length, the Contractor shall provide and install am HDCP-compliant signal equalizer at the far end (sink).

2. For cable runs less than or equal to 25 feet:

   a. Four (4) 28AWG solid bonded twisted pairs for clock and data, and seven (7) 28AWG solid conductors for control.

   b. Two Layer Shield:

      1) Inner shield: non-bonded aluminum foil tape.
      2) Outer shield: 85% tinned copper braid shield.

   c. Nominal attenuation of clock and data pairs (per 100 feet):

      1) at 100-MHz: 9.6 dB
      2) at 400-MHz: 19.3 dB
      3) at 825-MHz: 28.9 dB
      4) at 1200-MHz: 36.1 dB

   d. Nominal capacitance between shielded pairs: 15.3 pF/ft nominal.

   e. Nominal capacitance between control pairs: 16.5 pF/ft nominal.

   f. Nominal return loss of shielded pairs: 15 dB, 1-1200 MHZ.

g. Nominal shield DC resistance of individual shield: 24.4 ohms/1000 ft.

h. Nominal shield DC resistance of overall shield: 3.7 ohms/1000 ft.

i. The cable shall be HDMI 1.3a Category 1 certified to 25 feet, and HDMI 1.3a Category 2 certified to 15 feet.

j. Supports a maximum digital data rate of 10.2 Gbit/s.

k. Supports up to eight (8) channels of HD audio.

l. HDCP compliant.

m. Acceptable Manufacturers:

1) Belden
2) Or pre-approved equal

3. For cable runs greater than 25 feet:

a. Four (4) 24AWG solid bonded twisted pairs for clock and data, and seven (7) 24AWG solid conductors for control.

b. Two Layer Shield:

1) Inner shield: non-bonded aluminum foil tape.
2) Outer shield: 82% tinned copper braid shield.

c. Nominal attenuation of clock and data pairs (per 100 feet):

1) at 100-MHz: 6.0 dB
2) at 400-MHz: 13.5 dB
3) at 825-MHz: 19.8 dB
4) at 1200-MHz: 24.1 dB

d. Nominal capacitance between shielded pairs: 15.3 pF/ft nominal.

e. Nominal capacitance between control pairs: 16.5 pF/ft nominal.

f. Nominal return loss of shielded pairs: 15 dB, 1-1200 MHZ.

g. Nominal shield DC resistance of individual shield: 15.0 ohms/1000 ft.

h. Nominal shield DC resistance of overall shield: 1.75 ohms/1000 ft.

i. The cable shall be HDMI 1.3a Category 1 certified to 45 feet, and HDMI 1.3a Category 2 certified to 25 feet.

j. Supports a maximum digital data rate of 10.2 Gbit/s.

k. Supports up to eight (8) channels of HD audio.

l. HDCP compliant.

m. Acceptable Manufacturers:

1) Belden
2) Or pre-approved equal

C. Display Port Cable:

1. For any cable run that exceeds the manufacturer-recommended distances, the Contractor shall provide and install an HDCP and DPCP compliant signal equalizer at the far end (sink).

2. Supports a maximum digital data rate of 8.64 Gbit/s.

3. Supports HDCP and DPCP.

4. Acceptable Manufacturers:

a. Blue Jeans Cable
b. Or pre-approved equal

2.7 CONTROL CABLING

A. Control:

1. For Bidding Purposes: Two-pair, twisted, shielded, one (1) #18 AWG pair and one (1) #22 AWG pair. Provide with plenum-rated jacket where used in a plenum space without conduit.

2. Size conductors as required for distance and voltage drop.

3. Coordinate exact requirements with selected manufacturer and system prior to submitting bid.

B. Other Control Circuits:

1. #20 AWG, stranded, shielded cable, number of conductors as required for the applications. Provide with plenum-rated jacket where used in a plenum space without conduit. Provide PVC jacket where installed in conduit or non-plenum areas.

2. Coordinate exact requirements with selected manufacturers prior to submitting bid.

2.8 HORIZONTAL COPPER DATA AND CONNECTORS

A. All horizontal network cabling shall be category 6A shielded cabling.

B. Refer to Section 27 15 00 - Horizontal Cabling Requirements, for telecommunications cabling and connector requirements including fiber optics being utilized for A/V systems.

C. Refer to Section 27 17 10 - Testing, for telecommunications cabling testing requirements including fiber optics being utilized for A/V systems.

D. All category-rated copper data cabling and fiber optic cabling shall be installed, terminated, tested and certified by the Division 27 Telecommunications contractor certified by the selected manufacturers for the copper and fiber optic cabling plant. The Contractor shall submit all cabling and certifications to the Design Build Architect/Engineer for approval in the shop drawings.

E. The A/V contractor shall coordinate purchase, installation, testing and certification with the telecommunications contractor for all required category-rated copper data cabling and fiber optic cabling required for A/V system operation prior to bid.

2.9 FIBER OPTIC PATCH CABLES

A. Optical Fiber Patch Cords (Singlemode):

1. The optical fiber patch cord shall be 8.3/3 μm singlemode (SM) optical fiber, utilizing tight buffer construction. The optical fiber patch cords shall be a minimum of 15 feet (1.5m) in length.

2. Provide 8.3/3 μm singlemode (SM) optical fiber utilizing tight buffer construction for 50% of all assigned ports on the fiber distribution cabinet. These patch cords shall be the cross-connect between the backbone fiber distribution cabinet and the Owner's network electronics (hub/switch). Optical fiber patch cords shall be equipped with a ceramic tipped LC-type connector on each end and shall be a minimum of 5 feet (1.5m) in length. Connector body shall be of materials similar to that used in the proposed couplings. Provide required lengths as determined on the plans.

3. Channels shall be of equal length.

4. Basis of Design (Refer to 27 17 20 for Acceptable Manufacturers):

a. Corning

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field dimensions and coordinate physical size of all equipment with the design build architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing conditions.

3.2 PRE-INSTALLATION

A. A pre-installation meeting shall be held after the project has been awarded but before any submittals or work has been conducted. The purpose of this meeting is to review the drawings and specifications to assist with the construction and installation process that will occur during construction. The meeting will include the Design Build Engineer, Architect, Owner's Representative, and all relevant installing contractors for this system. The meeting will be chaired by the project manager for the AV contract and will work with the owner on the agenda of the meeting prior.

B. The Contractor shall be responsible for submitting all requested submittals and holding the pre-installation meeting prior to any purchasing, installation, programming, and construction coordination. Any delays or changes to the project as a result of meeting this requirement will be at the Contractor's expense.

3.3 INSTALLATION

A. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Provide all system wiring between all components as directed by the manufacturer or required for proper system operation.

C. Mount all touch screen and keypad devices where shown on plans in accordance with Americans with Disabilities Act (ADA) requirements for both side reach and front reach.

D. Cabling Requirements:

1. Non-plenum rated cabling may be used instead of plenum when installed with-in conduit in plenum rated areas.

2. All cabling shall route according to function. Cabling shall be grouped and bundled by groups, such as: microphone and line level audio, control, video and speaker. In no case shall cabling from different functional groups be intermixed. No cabling shall be routed parallel to 120 VAC or higher power circuits unless separated by a minimum of 6" and the 120 VAC or higher power is installed in conduit.

3. When cabling is installed in conduit, a separate conduit shall be provided for each cabling functional type.

4. Cable bundles shall be loosely bundled to allow the visual following of individual cables within the bundle and to permit the easy removal and addition of cables as necessary.

5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10’ intervals with hook-and-loop tie wraps. The use of plastic cable zip ties is strictly prohibited in any situation.

6. Cabling shall not be spliced under any circumstances.

7. Each cable shall be appropriately identified (as defined on the record documents) at each end’s termination point using pressure sensitive label strips.

8. Audio Cabling:

a. All amplified audio cabling shall not be in the same enclosed pathway as any other type of cabling as required by the NEC. Refer to the NEC for definitions and additional requirements.

b. The polarity of all cabling shall remain consistent throughout the project, on all equipment. Red conductors shall be used for the positive "+" side, and black used for the negative "-" side.

c. Cable shield length shall be equal to the cable’s conductor length.

d. All shielded cables drain wire SHALL be grounded and continuous throughout the entire length of the system, including splices where speakers are installed.

e. Balanced audio connections shall be used whenever the mating equipment allows.

f. Do not run unbalanced cables longer than 3m. For interconnecting of unbalanced equipment in lengths longer than 3m, the Contractor shall provide a line driver located at the source.

E. Grounding Requirements:

1. Provide a minimum of #6 AWG conductor from the nearest electrical service ground bus or nearest telecommunications room ground bus bar to the A/V equipment racks and cabinets regardless of location. Size cable as required by the NEC.

2. Cables containing shields shall not have the shields grounded at conduits, boxes, racks, etc. Ground the shield only at the equipment end.

3. Audio cable shields for line-level signals shall be connected to the metal equipment chassis at both ends of the cable.

4. Audio cables connected to transformers shall have the cable shield connected to the transformer shield and transformer case ground.

5. The Contractor shall not connect cable shields together from differing cables.

6. Signal-grounded balanced shields are not acceptable and shall not be installed. All balanced shields shall be chassis grounded.

F. Rack and Cabinet Requirements:

1. Provide one (1) RU of space between adjacent pieces of equipment with top and/or bottom vents, above the topmost piece of equipment, and below the bottommost piece of equipment. Provide a vented cover panel covering each rack space.

2. Terminate all speaker cabling on individual barrier strips for positive "+", negative "-", and shield. The shield barrier strip shall be grounded.

3. Provide a power conditioning surge arrestor in the rack for distribution of AC power from the wall receptacles indicated on the plans. The quantity of plugs shall be adequate so that no equipment in the rack shall require plugging into an AC source outside the rack.

4. Power sequencing shall be provided in the racks where shown on the drawings. All amplifiers located in the racks shall be sequenced “last on – first off”. Power sequencers shall provide power conditioning and surge protection.

G. Audio System Installation Requirements:

1. The Contractor shall perform calculations for the optimal speaker tap settings to reach the desired SPL level and coverage without overloading the amplifier(s).

   a. At a minimum, the following calculations shall be used:

      1) Add together all speaker taps that will be on a single channel of the amplifier. Multiply that total by 1.2 which will allow for a 20% future expansion. Multiply that number by 1.25 to ensure the amplifier never exceeds 75% of its total output. Utilize the final number to determine the minimum amplifier power requirements.

      2) For direct coupled systems (low impedance), allow a minimum of 10 dB headroom before any distortion occurs at the amplifier input indicator when beginning gain stage tests are set up. Increase headroom as appropriate for high impact and clarity needs, typically exceeding 12 to 15 dB during continuous operation.

2. Connections of balanced to unbalanced equipment shall only be done through an active converter at the unbalanced side.

3. Connections of unbalanced to balanced equipment shall only be done through an active converter at the unbalanced side.

4. Connections from stereo balanced or unbalanced equipment to mono equipment of the same signal type shall only be done through a passive combiner.

5. Connections from mono balanced or unbalanced equipment to stereo equipment of the same signal type shall only be done through a passive divider.

6. The Contractor shall provide an isolation transformer for any balanced or unbalanced audio line that exhibits a hum, noise from EMI or RFI, power line noise, or ground loops.

7. The Contractor shall provide an active audio line driver for all balanced and unbalanced signals that exceed the distance limitations of the cabling.

H. Control System Installation Requirements:

1. The Contractor shall perform calculations for the required wire AWG size based on distance for system power for touch panels, keypads and other devices being powered. A minimum of a 15% overhead is required.

3.4 VIDEO SYSTEM TESTING AND CALIBRATION

A. All video equipment shall receive proper testing and configuration.

B. Color Space Optimization:

1. The Contractor shall set the color space of each source and display device to a uniform color space to optimize the switching speed and compatibility of a digital video system. Each device shall be set to an RGB or YCbCr color space depending on the systems primary function and compatibility of the devices.

2. If the primary function of the space is video and other digital media, the color space of each device shall be set to a YCbCr color space. If the primary function of the space is computer-based graphics and presentations, the color space of each device shall be set to an RGB color space.

3. Chroma subsampling shall be set to a consistent 4:4:4 or 4:2:2 across all devices. Set to 4:4:4 when all equipment is capable.

4. If all devices are not capable of displaying a certain color space, all devices shall be set to a common shared color space.

C. Extended Display Identification Data (EDID) Management:

1. The Contractor shall set the EDID management tables in capable equipment so all sources output the highest common EDID table of the displays (sinks).

2. For systems with capable matrix switches, the matrix shall dynamically adjust its EDID tables so any source will output the highest common EDID table of the displays (sinks) being outputted to.

3. If any source or Owner-furnished equipment (OFE) is not outputting properly, the Contractor shall provide and install an EDID Emulator and set it to the highest common EDID table of the displays (sinks) being outputted to.

D. Monitors and receivers shall be tested and adjusted for proper signal sync, convergence, brightness, contrast, and color level. The Contractor shall adjust all other parameters necessary to achieve a proper video image.

E. All video source selections shall be tested and verified.

F. All displays shall have a minimum burn-in time of 96 hours prior to any adjustments are made and the completion of the project.

G. All displays shall have their hue/tint and color/saturation calibrated with a video signal test generator and blue lens filter after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each display in the final documentation.

H. All displays shall have their brightness, contrast and sharpness calibrated with a video signal test generator after a minimum warmup time of 20 minutes. Provide all calibrated settings results for each display in the final documentation.

I. All dynamic contrast functions shall be turned off.

J. The Contractor shall utilize a portable oscilloscope to set video output gain and peaking levels on all line drivers and receivers for analog signals.

1. The Contractor shall submit screen shots of the fixed signal.

2. Calibration by eye is not acceptable.

3.5 AUDIO SYSTEM TESTING AND CALIBRATION:

A. This Contractor shall field adjust any surface-mounted or flown loudspeaker orientation to achieve the necessary coverage pattern to the intended listening plane. Loudspeakers always face listeners and minimize coverage on walls. The contractor shall be familiar with the named and specified nominal coverage angle of all speakers above its crossover point or for speech range, (500-4,000 Hz).

B. All speakers shall be tested for polarity prior to high work and a table of test results shall be included for A/E inspection. All loudspeakers shall be connected with uniform polarity, where a positive pressure pulse at the input corresponds to a positive driver excursion, and all drivers are uniform always moving in the same direction. Main speakers shall not be lifted or hoisted into high access areas without polarity testing.

C. The Contractor shall make incremental adjustments on the equipment output and input tolerances to achieve matching signal levels while preserving +10 dB minimum headroom and also unity gain. Insert all broadband or high pass filters first for system protection after review of manufacturers specifications for power and bandpass.

D. The Contractor shall utilize a Real Time Audio (RTA) spectrum analyzer with AES2 Broadband pink noise at a minimum of 1/3 octave, capable of providing detailed plots and reports.

1. The Contractor shall have and own a calibrated Type 1 or Type 1.5 microphone for all measurements, that is recently calibrated within the last year.

2. Calibration by ear, tablets and portable phones with integrated microphones are never acceptable. All software analysis tools require a calibrated interface and calibrated microphone. No Android devices are used for metering or calibration. IOS devices with calibrated software and interfaces may be used.

E. Provide high quality media with full bandpass program material for critical listening. MP3 or streaming audio is not acceptable. Testing shall illustrate WAV file quality playback for impact and clarity.

F. The Contractor shall provide graphic plots of the reference ambient noise for each space at the time of the calibration and submit with the calibration results. Test signal shall be 10dB minimum above ambient noise levels during testing.

G. The contractor shall use a listener sitting height of four (4) feet ± 1" for rooms where the primary function will be sitting. The contractor shall use a listener standing height of five feet three inches (5.25') ± 1" for rooms where the primary function will be standing audio system performance requirements.

H. The Contractor shall test and provide documents verifying all the following performance criteria. The Architect/Engineer shall be informed when the testing will take place and have the option to witness the testing and ask for additional testing for any reason.

I. The Contractor shall develop an Audio Coverage Uniformity Measurement Location (ACUML) plan for each required space based on the project floor plans, and submit to the Design Build Architect/Engineer for review and approval prior to testing. The plan shall represent the majority of the listening area and perimeter seating in the direct field of main speakers.

J. The tests shall be performed at the multiple locations defined on the ACUML plan representing the majority of the listening area(s). The Contractor shall indicate on the floor plan drawings where each test was performed, with the corresponding graphic plot, and submit with the final documentation for review and approval by the Design Build Architect/Engineer.

K. The test shall be taken with AES2 Broadband pink noise at a minimum of 15 dB above the reference ambient noise level, taking caution to not overdrive and clip any component of the system beyond 0.5% Total Harmonic Distortion (THD), with a maximum system THD of 1.0%.

L. The audio system(s) shall meet the following minimum requirements:

1. Achieve a total average SPL of 95 dBA in the majority of seating area with additional headroom. Use dBC for levels above 95 dBA.

2. The system's total SPL frequency response shall be within ± 4 dB from 500 Hz to 8000 Hz. All efforts shall be made to equalize the system's frequency response possible throughout the system's entire 100 Hz to 16kHz spectrum.

3. All vocal microphones shall have high and low pass filters set to minimize rumble, pop and hiss. The high pass filter cutoff frequency shall be set between 125 and 160 Hz, with a 12 dB per octave slope, minimum. The low pass filter cutoff frequency shall be set at 12,000 Hz, with a 6 dB per octave slope. Adjust frequency and slope as required to maximize performance for both male and female voices.

4. The subwoofer/speaker low/high crossover points shall be a Butterworth (BW) filter set at 80 Hz with a 24 dB per octave slope. This crossover point shall be adjusted as needed to achieve a smooth frequency response. The subwoofer high-pass filter shall be set to manufacturer's recommended half-power point or 40 Hz, whichever is higher.

5. Achieve a minimum RaSTI value of 0.63.

3.6 ASSISTED LISTENING SYSTEM (ALS) PERFORMANCE REQUIREMENTS

A. The Contractor shall verify that the ALS system(s) meets the following minimum performance requirements at the earphone or headset:

1. Reach a minimum total SPL of 75 dBA and no greater than 95 dBA, with a minimum of a 50dB dynamic range volume control.

2. Achieve a minimum signal-to-noise (S/N) ratio of 18dB. It is recommended to achieve a minimum signal-to-noise (S/N) ratio of 25dB to accommodate children.

3. Ensure the peak clipping levels do not exceed 18dB down from the peak input signal level.

B. FM-based systems shall operate within the FCC-reserved assisted listening frequencies of 72 to 76 MHz or the 216 to 217 MHz (preferred) range and comply with the FCC transmitter power requirements.

3.7 DSP-BASED AUDIO PROCESSOR PROGRAMMING

A. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.

B. DSP pathfile with initial settings shall be provided by the Contractor for review by the Design Build Architect/Engineer before installation.

C. The IP-based audio (IEEE AVB, Dante, etc.) and components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.

D. A parametric EQ shall be provided after each crossover point or as approved in the DSP pathfile during shop submittal review. These shall be utilized to set the speaker output as defined in the Audio System Calibration section within this specification. These equalizers should not be made available to the user to adjust.

E. Levelers, compressor/limiters, duckers, gates and delays shall be preset during testing and commissioning and are not available for user adjustment following commissioning.

1. Adjust delays for time of flight plus 8 to 10 ms, typical.

F. Provide each microphone input with high-pass filter, 5-band parametric EQ, auto-leveler and volume module. Provide line level inputs with high-pass filter, 3-band parametric EQ, compressor/limiter, and volume module.

G. Acoustic Echo Cancelation (AEC) shall be provided for each conference microphone input.

H. A broadband pink noise generator shall be provided with a selectable on/off control button within the DSP pathfile. The noise shall be routable through all processing EQs and speaker outputs during testing.

I. Provide volume meters with labeling for each input and each output.

J. Provide with user control software to be installed on Owner-provided and installed computer.

K. The Contractor shall utilize the latest version of the programming software.

L. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.

3.8 DSP-BASED AUDIO PROCESSOR CONTROL SOFTWARE PROGRAMMING

A. Full system software programming shall be provided for the system. Programming shall be performed by a factory-trained and certified programmer or an employee of the equipment manufacturer.

B. The Contractor shall schedule a series of meetings with the Owner and Design Build Architect/Engineer to define and determine the exact page layout requirements prior to the final configuration of the audio system. An Owner sign-off of the final layouts shall be required.

C. The Contractor shall use the latest version of the software.

D. At a minimum, there shall be password-protected pages for zone combining, input/output volume control with meters, speaker output volume control with meters, signal routing, signal processing (EQ's, feedback suppression, etc.), and supervision/maintenance for all spaces and combined zones.

E. A 15% programming dollar allowance shall be included for Owner and Design Build Architect/Engineer comments on additional system functionality as construction progresses. This shall be shown as a separate line item in the bid (include hours).

3.9 MULTIMEDIA CONTROL SYSTEM INTEGRATION AND PROGRAMMING

A. Programming and Integration for Control Systems:

1. Full system programming shall be provided for the system. Programming shall be performed by a factory trained and certified programmer or an employee of the equipment manufacturer.

2. The Contractor shall schedule a series of meetings with the Owner and Design Build Architect/Engineer to define and determine the exact integration requirements of the control system prior to the installation of the control system and components. An Owner sign-off of the final configuration shall be required.

3. This section only defines the minimum requirements. The programmer shall provide complete programming for a fully functional system.

4. The Contractor shall utilize the latest version of the programming software.

5. The Contractor shall ensure that all components are updated to the latest firmware at the completion of the project.

6. The IP-based control system and controlled components shall be on a dedicated Virtual LAN (VLAN) for the A/V systems. These components shall be on a dedicated subnetwork of the VLAN. The Contractor shall coordinate these requirements with the Owner prior to installation.

7. Integration and programming of the following pieces of equipment shall be provided, with the following minimum features and functions:

   a. All equipment shall include on/off control, except for equipment that must remain active for system functionality.

   b. Integration of HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) protected content and sources:

      1) No protected sources or content shall be allowed to be selected to route through non-protected devices and displays. A warning shall be displayed stating this information to the user.

   c. Matrix Switcher Integration:

      1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:

         a) On/off control of the matrix switcher.

         b) Allow for independent video routing of individual video inputs to any audio number of audio outputs.

         c) Allow for independent audio routing of individual audio inputs to any audio number of audio outputs.

         d) Provide source detection of video inputs.

         e) HDCP (High-bandwidth Digital Content Protection) and DPCP (Display Port Content Protection) Protection:

            (1) HDCP-compliant switchers shall allow HDCP source devices to only route to HDCP compliant devices.

            (2) Room Combining/Uncombining features shall allow for complete audio and/or video devices to be connected to the system using simplified interface.

   d. DSP Audio Processor Integration:

      1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:

         a) On/off control of all microphones.
         b) Volume and mute control of all microphones and input sources.
         c) Volume and mute control of all outputs.

d) Independent volume and mute control of all assisted listening outputs.
e) On/off and reset control of feedback eliminators and suppressors.
f) Advanced routing of audio signals.
g) Audio conferencing dialer keypad with speed dials.
h) Audio conferencing CallerID display on touchpanel and/or workstation.
i) Acoustic Echo Cancelation (AEC) control.

e. Audio Conference Integration:

1) Refer to DSP Audio Processor Integration for requirements.

f. Display Integration:

1) The displays shall be integrated into the A/V control system via bi-directional RS-232 or Ethernet control. Provide with the following minimum functions:

a) On/off control.
b) Display status feedback.
c) Source switching control.
d) Audio volume control with mute.
e) Video mute.
f) Tuner channel control with direct channel access.
g) Station presets with station icons.

g. Video Conference/Telepresence Integration:

1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:

a) Refer to DSP Audio Processor Integration for audio requirements.

b) Video conferencing dialer keypad with speed dials.

c) PTZ near end camera control.

d) PTZ far end camera control with lockout control at the far end.

e) Multi-window control with multiple presets.

(1) The Contractor shall coordinate with the Owner and users on desired layouts.

(2) All system inputs shall be selectable for each window.

h. Pan/Tilt/Zoom (PTZ) Camera Integration:

1) The Contractor shall provide bi-directional RS-232 or Ethernet control system connections and programming with the following minimum functions:

a) Provide full pan, tilt and zoom control.

b) Provide presets for fixed camera positions.

(1) The Contractor shall coordinate with the Owner for desired preset positions.

i. Divisible Room Integration and Programming:

1) The following represents the minimum integration and programming requirements for divisible rooms.

a) The touch panel shall show a grid or map of the rooms and spaces that are combinable.

b) The user shall be able to highlight a group of rooms or spaces in any combination and hit combine.

(1) Once combined, all functions shall operate as a single space including, but not limited to, master audio volume control and lighting.

(2) All input sources shall be selectable to be output to any combination of displays.

c) Once rooms are combined all speaker volume levels shall normalize and all volume controls shall adjust the system as a whole.

d) Once rooms are combined all lighting levels shall normalize and all lighting controls shall adjust the system as a whole.

B. Programming and Configuration for Touch Panels:

1. This section only defines the minimum requirements. The programmer shall provide complete touch panel layouts and programming for a fully functional system.

2. The Contractor shall schedule a series of meetings with the Owner and Design Build Architect/Engineer to define and determine the exact touch panel layout requirements prior to the purchase and installation of the touch panels. An Owner sign-off of the final layouts shall be required.

a. Some tabs, pages, buttons and functions may be required to have a password at the Owner’s discretion. This shall be coordinated during the meetings.

3. Contractor logos are not allowed on the touch panels. The Contractor shall coordinate with the Owner on desired logos to be displayed.

4. All programming for interface and control of all devices shown on the drawings shall be provided. Programming shall be provided for the following minimum functionality:

    a. The main screen shall include graphical buttons for the primary room functions.

        1) Upon selection of the graphical button, all the required functions shall be displayed on the screen. All required equipment shall turn on.

    b. Master System On/Off Control:

        1) When the master system off button is selected, all capable components within the system shall be turned off or placed on standby, except for equipment that is required to remain on for the system to function like the control system processor.

    c. The main screen shall include graphical buttons for the selection of individual source selections.

        1) Upon selection of the graphical button for a source selection, all functional controls for the pieces of equipment, as well as all status indicators, shall be provided in graphical format on the screen.

        2) Rooms with multiple independent outputs and displays shall have a source routing matrix to allow any input to be routed to any output.

    d. The main screen shall include a button for advanced equipment status and monitoring.

        1) Upon selection of the graphical button, the page shall display the on/off status of all monitored equipment and all other features listed within this section that require monitoring.

    e. The main screen shall include a button for microphone volume control and muting.

        1) Upon selection of the graphical button, it shall display the individual volume level of each wired and wireless microphone, with a mute for each.

        2) Rooms with multiple independent audio outputs and zones shall have a source routing matrix to allow any input to be routed to any output or zone.

    f. At all times, on all screens, a button shall be provided to return to the main screen, except for modal pop-ups.

    g. A master volume control and mute shall be provided at all times on all screens, except for modal pop-ups.

    h. A master video mute shall be provided at all times on all screens, except for modal pop-ups and audio-only functions.

i. All unused hard buttons shall not be labeled. A blank touch panel bezel shall be provided if no hard buttons are used.

C. Touch Panel Layout Principles, Considerations and Guidelines:

1. Icons and Buttons:

a. Icons shall not be used solely as a button but can be embedded in a button.

b. Icons shall appear to be flat and unpressable.

c. Status bars or text windows for time, date, room number, and similar information shall appear to be slightly depressed into the screen and appear to be unpressable.

d. Buttons shall appear to be pressable by appearing to come off the screen with beveled edges, lighting gradients, and shadows. When pressed, the button shall appear to be depressed into the screen.

1) Buttons that are momentary shall change color when pressed, appear to depress, then pop back up and revert to the original button color and state.

2) Buttons that are not momentary shall change color when pressed, appear to depress, remain depressed, then pop back up, and revert to the original button color and state when pressed again.

e. Buttons and icons shall appear to be lit from the top left corner of the screen.

f. Buttons shall be grouped together according to general function.

g. Button size shall be based on the ratio of Phi (1:1.618) and be sized appropriately based on the screen area and dpi (pixel pitch).

h. Maintain a minimum of 5 to 10 pixels between buttons on small to medium touch panels, and a minimum of 10 to 15 pixels between buttons on medium to large touch panels.

i. Telephone dialer keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout and include the a-z letters below each appropriate number.

j. TV and radio tuner keypads shall be based on the ITU-T E.161/ANSI TI-703 standard telephone layout, except for the asterisk (*) being replaced by a dot (.) and the pound (#) being replaced with Enter.

k. IP-address keypads shall be based on the standard computer keyboard 10-key numeric keypad typically found on the right side of the keyboard.

l. Buttons such as Power, Play, Stop, Record, Rewind, Previous, Forward, Eject, Return, Next, Up, Down, Left, Right, Plus, Minus, etc. shall use standard industry symbols. Record shall always be a solid red circle.

2. Text and Fonts:

   a. The Contractor shall use a standard sans-serif bold **Arial** or **Calibri** font style unless the Owner dictates otherwise.

   b. Words shall have the first letter capitalized and the rest of the word lower case. No words shall be all capitals or all lower case. Follow standard grammatically correct sentence structure where the first word is capitalized and the rest of the sentence is lower case, followed by the appropriate punctuation mark with accurate syntax and correct verbs.

   c. All font size in a single group or cluster shall maintain the same font size. Headers to a group or cluster shall have a slightly enlarged font size. and footers shall have a slightly smaller font size in comparison to the group font size to maintain a visual hierarchy.

3. Color Considerations:

   a. Colors shall be selected so that, when converted to monochrome, all text, buttons, icons, groups, clusters, borders, etc. are clearly visible to accommodate all color blind or color-impaired individuals and ADA requirements.

   b. Background colors shall be cool low saturation colors such as grey, blue, or green and their analogous colors, and be a gradient from top down or top left to bottom right.

   c. Base colors shall be analogous to the background color but be of a higher saturation to stand out more clearly.

   d. Button colors shall be analogous to the background color, stand out clearly from the base colors, and be of a higher saturation cool color, gray, or a low saturation black.

   e. Icon, symbols, and text color shall be a neutral white or black, or a low saturation grey, and shall clearly stand out from the background or button it is placed on.

   f. Buttons for modal acknowledgement, exit or return, or other modal action shall be a warm color such as red or yellow and their analogous colors.

   g. Buttons, icons, symbols or text for emergency or urgent notifications shall be bright red.

4. Pages and Background:

   a. Groups and clusters shall have clearly defined borders, with spacing between adjacent groups.

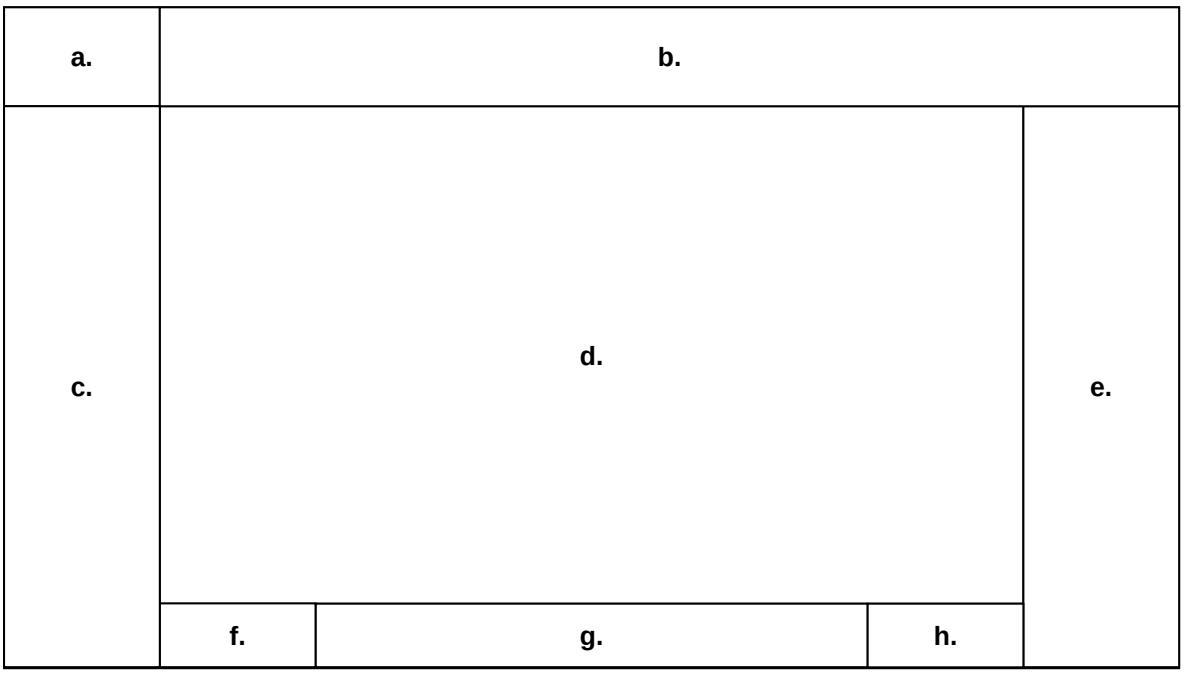
   b. Modal pop-up windows or pages shall be required when a command requires user input before it is executed or when a button has multiple nested elements to control, such as microphone volumes, zone control, lighting and environment control, advanced system controls, etc.

1) The modal pop-up pages shall dim and grey out the background and buttons, overlay the main page, and have a clear back or exit button to bring the user back into the active page the user was on before the modal pop-up.

2) Model pop-ups shall not replace or completely overlay the background.

c. Images or pictures shall never be used as backgrounds to any page other than a master start page, if appropriate.

5. Medium to Large Format Touch Panel Layout Guideline Template:



a. Client Logo – Static Window

b. A/V Source Selection – Static Window

c. Display Power, Screen Controls, Light Controls, Shade Controls, and other Environmental Controls – Static Window

d. Controls for Selected Source and Status or Home Page – Dynamic Window

e. Master Volume and Mute, Video Mute, and Microphone Volume – Static Window

f. Home Button – Static Window

g. Date, Time, and Room Number – Static Window

h. Master System Off – Static Window

D. A 15% programming dollar allowance shall be included for Owner and Design Build Architect/Engineer comments on additional system functionality as construction progresses. This shall be shown as a separate line item in the bid (include hours).

3.10 CENTRALIZED CONTROL SYSTEM ASSET MANAGEMENT SOFTWARE PROGRAMMING

A. A Centralized Control Asset Management System shall be provided to integrate all IP-based control systems for remote control, monitoring, troubleshooting and statistics.

B. The workstation(s) and/or server(s) shall be Owner provided and Owner installed. The Contractor shall provide, install, and program all software specified and required. The Contractor shall coordinate with the Owner on the Owner's preferred operating system, antivirus, and all other required software to be installed on the workstation(s) and/or server(s). Refer to manufacturer recommendations for computer workstation and server requirements and ensure the Owner is aware of and complies to these recommendations.

C. The Contractor shall coordinate with the Owner on the location of the preferred file server for the central database files to which the workstations will connect.

D. The Centralized Control Asset Management System shall be on the same dedicated Virtual LAN and subnetwork as the control systems. The Contractor shall coordinate these requirements with the Owner prior to installation.

E. The Contractor shall provide, install and configure the software on up to three (3) workstations of the Owner's choosing.

F. Integration to Microsoft Active Directory/LDAP shall be provided, installed, configured, and programmed.

1. The Contractor shall train and assist the Owner in creating user access levels.

G. The system shall be based on latest version of server/cloud-based software.

H. A series of meetings shall be scheduled by the Contractor with the Owner, Design Build Architect/Engineer, and control system manufacturer to determine all required functions, reports and statistics to be utilized. An Owner sign-off of the final layouts and configuration shall be required. At a minimum, provide the following:

1. Hardware polling for system diagnostics.
2. Processor "on line" status.
3. Rooms system on/off status.
4. Display on/off status.
5. On/off switching capabilities with log of devices used.
6. Which devices are in use.
7. Event/error codes.
8. Equipment fault or out of tolerance status
9. Room scheduling with on/off control of system.
10. Log of audio and video conference numbers and IP addresses.
11. Reporting features would be included for the following:
    a. Room system usage statistics.
    b. Device usage statistics.

3.11 SYSTEM COMMISSIONING

A. The Contractor shall notify the Design Build Architect/Engineer and Owner prior to conducting final system commissioning.

B. Contractor shall demonstrate system performance of all equipment and adjust settings as directed by the Design Build Architect/Engineer and/or Owner.

1. All system settings, software options and other parameters shall be simulated and tested by the Contractor.

3.12 FIELD QUALITY CONTROL

A. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product that meets the requirements of the specifications, as supplied and warranted by the system vendor. If the product or assembly is not available from the system vendor, provide product or assembly as recommended by the system vendor.

B. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the Contract Documents.

3.13 FIELD SERVICES

A. The installer shall conduct a planning meeting with the Owner. The purpose of this meeting shall be to determine all equipment settings that are considered preferences (where proper system operation does not depend on the setting).

B. The installer shall include labor for all planning and all programming activities required to implement the Owner's preferences for equipment settings.

C. It shall be the responsibility of the Contractor/installer to provide a complete, functional system as described by the design documents. These responsibilities include:

1. Complete hardware setup, installation and wiring and software configuration.

2. Complete programming of software in accordance with the Owner's desires determined by the planning meeting.

3. Complete system diagnostic verification.

4. Complete system commissioning.

3.14 SYSTEM ACCEPTANCE

A. The Contractor shall submit for review a formal acceptance and system checkout procedure. The system checkout procedures shall include all system components and software. The Contractor shall perform the tests and settings and document all results.

3.15 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided for the system. The documentation shall describe:

1. All operational parameters of the system.
2. Complete documentation of programming and features.
3. Complete operating instructions for all hardware and software.

B. The following sections shall be provided in the system documentation:

1. User Manual: A step-by-step guide and instructions detailing all system user functions.

2. Technical Manual: A comprehensive document providing all system operations, troubleshooting flowcharts, functional system layout, wiring diagrams, block diagrams and schematic diagrams.

3. Maintenance Manual: A comprehensive document on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning, filter changing and UPS maintenance.

3.16 SYSTEM TRAINING

A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.

1. Provide two week's advanced notice of training to the Owner and Design Build Architect/Engineer.

2. The Design Build Architect/Engineer shall be presented with the option to attend the training.

3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.

B. At a minimum, the following training shall be conducted:

1. User Manual: A course detailing the system functions and operations that a daily user will encounter.

2. Technical User: Provide configuration training on all aspects of the system(s), including equipment and software.

3. Maintenance User: Provide training on all aspects of physical maintenance of the systems, including cleaning of the displays, bulb changes, filter cleaning and filter changing.

C. Minimum on-site training times shall be:

1. User Manual: One (1) day.

2. Technical user: One (1) day.

3. Maintenance user: Four (4) hours.

4. The Contractor shall include in his/her bid one (1) additional day of training each quarter for the 12-month period of the project warranty. The Contractor shall return to the site for additional follow-up training during this period.

5. The owner will have the ability to record the training on request.

END OF SECTION