

1.7 WARRANTY

- A. See Section 200000 - Mechanical General Requirements.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Maintain existing utilities in operation to the maximum extent possible during the selective demolition of mechanical systems. When utility outages are necessary, coordinate outages and their duration with Contracting Agency in accordance with Division 1. Arrange to shut off indicated utilities with utility companies.
- B. "Tag" equipment and systems to be demolished. Identify the extent to which each system will be demolished.
- C. Locate, identify, isolate, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

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

### 3.3 DEMOLITION - GENERAL

#### A. General:

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

#### B. Controls:

1. Sequence limited demolition of the controls system.
2. Coordinate outages with Contracting Authority 24 hours in advance of the scheduled outage.

#### C. Indoor Air Quality:

1. Maintain cleanliness and indoor air quality in areas adjacent to construction areas.
2. Submit a demolition and construction plan for review by the Contracting Agency prior to beginning work.
3. Reference SMACNA IAQ Guidelines for Occupied Buildings Under Construction - Second Edition - 2008.

- D. Fire Protection: Notify the Contracting Agency and the Fire Department Agencies at least 24 hours before partially or completely disabling Fire Protection Systems.
- E. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Contracting Agency.
  - 4. Transport items to Contracting Agency designated on-site storage area.
  - 5. Protect items from damage during transport and storage.
- F. Removed and Reinstalled Items:
  - 1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
  - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- G. Existing items to Remain:
  - 1. Protect construction indicated to remain against damage and soiling during selective demolition.
  - 2. When permitted by Contracting Agency, items may be removed to a suitable, protected storage location during demolition and cleaned and reinstalled in their original locations after demolition operations are complete.

### 3.4 CLEANING AND REPAIRS

- A. Plug, patch and repair surfaces, adjacent construction, and finishes damaged during demolition and new work. Restore to original condition or better. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish. Repair fire proofing.
- B. Clean construction areas after completion of the project. Wipe down new and existing surfaces including but not limited to walls, floors, ductwork, piping, and equipment. Clean adjacent equipment and systems to remain and building surfaces of dust, dirt, and debris caused by demolition operations.
- C. Return adjacent areas to the condition existing before demolition operations began.

END OF SECTION 204100

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## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes performance requirements, products, and methods of execution relating to fire suppression for the project. The contract documents have performance, materials, and installation requirements which exceed code and standard minimums. This Section is substantially a “performance” specification.
- B. Related Sections:
  - 1. Section 200000 - Mechanical General Requirements

## 1.2 REFERENCES

- A. Provide fire suppression in accordance with the provisions of the following codes and standards:
  - 1. See Section 200000 - Mechanical General Requirements.
  - 2. NFPA 13 - 2019, Installation of Sprinkler Systems.
  - 3. NFPA 25 - 2017, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
  - 4. ASCE 7 - 16, Minimum Design Loads and Associated Criteria for Building and Other Structures.
  - 5. Municipality of Anchorage Fire Department, Fire Prevention, Policy #08-014 Permitting Requirements for Fire Systems.

## 1.3 SYSTEM DESCRIPTION

- A. Provide complete and fully operational wet pipe automatic fire sprinkler system, hydraulically calculated using density/area method to protect the entire project areas. Comply with the Contract Documents requirements, applicable codes, and standards, as well as the Authority Having Jurisdiction (AHJ) requirements. The contract documents have performance, materials, and installation requirements which exceed code minimums. Work includes connection to, and modification of, existing wet pipe sprinkler system for project areas of work, and other items required for a complete and fully operational building fire suppression system.
- B. Provide sprinklers utilizing systems compatible with the specific application throughout the building, including building areas as shown and described in the contract documents. Work includes complete installation of sprinkler heads in finished ceilings.
- C. This is an Affiliated Factory Mutual, AFM, protected property. AFM is a member of the FM Global, FMG, Group. FMG density and areas shall be used for hydraulic calculations, including room method if criteria meets or exceeds NFPA 13 hydraulic requirements.

- D. Provide seismic anchoring, bracing, supports, and clearance for equipment, pipes, and sprinkler heads per NFPA 13, International Building Code, FMG, and ASCE 7; most conservative criteria shall govern.
- E. Provide labor, materials, and equipment as required to test sprinkler system as required per NFPA 25. Test shall be coordinate with Contracting Agency or specific systems and areas.
- F. Provide listed sprinkler flex hose for sprinkler heads in suspended ceiling assemblies. Other methods to maintain required clearances are not allowed.
- G. Provide provisions including isolation valves and fittings for inspection, testing, and maintenance of water-based fire protection systems identified in NFPA 13 and NFPA 25. New and modified systems in or serving area of work shall be included. Limits and criteria for testing existing systems impacted by work under this contract to be coordinated with Contracting Agency and AHJ.
- H. Work includes complete installation of pipes and sprinklers in many types of spaces and finished ceilings, architectural features, and building lines. Route pipes above ceilings where possible. Exposed pipes shall follow architectural elements/building lines for visual and symmetric appearance. Design and installation of sprinkler systems shall incorporate aesthetic review comments, including routing and concealment of lines, exposed pipe, sprinkler head finish and locations, and exterior penetrations. Verify areas and scope of work with contract documents and following general description of work areas:
  - 1. Basement: Interior parking garage area renovated to create an IFC Occupancy Group H-3 medical gas storage room.
  - 2. Level 1, renovation of dental clinic.
  - 3. Level 2, partial renovation of optometry clinic.
- I. Work may include concealment of pipes in walls and routing of pipes through structural elements, coordinate with architectural and structural drawings and requirements.
- J. Provide complete building interface with building smoke and fire alarm and detection systems including fire alarm control panels and graphical displays.
- K. Sprinkler system record shop drawings and hydraulic calculations from original building construction will be made available by the contracting agency upon request.

#### 1.4 SUBMITTALS

- A. Submittals shall be complete for review. Drawings, calculations, and product cutsheets shall be complete and submitted together in one package. See Section 200000 - General Mechanical Requirements for additional requirements not covered below.
- B. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.
  - 1. Submittals will not be checked for quantity, dimension, fit, or for proper technical design of manufactured equipment.

2. Providing a complete and satisfactory working installation is the responsibility of the Contractor.
3. Product data, shop drawings, and calculations shall be submitted together for review. Partial submittals will not be reviewed.

C. Electronic Submittals:

1. Provide electronic submittal in PDF format in addition to hard copy submittal.
2. Electronic submittals shall follow the organization and formatting required for paper submittals.
3. Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
4. If individual PDF files are provided for each product or shop drawing sheet, organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
5. PFD documents to be without security and be searchable, and copied and pasted. For scanned documents, run the optical character recognition (OCR) function to ensure the document is searchable and can be copied and pasted.
6. Reduce PDF file size by removing data and file creation elements not needed for final file presentation.

D. Product Data:

1. Submit product data for items specified in Part 2 and those products required by the performance standards of this Section. Identify catalog designation and/or model number and neatly annotate each salient characteristic and design option of the product. Identify operation characteristics, performance curves and rated capacities of products and devices to show compliance with shop drawings and calculations.
2. Provide exterior and interior signage with placement locations indicated on shop drawings.
3. Provide data on firestopped penetrations, including product being submitted, the rating of the assembly it will be used for, and the applicable Through Penetration Firestop System drawing(s) from the UL Fire Resistance Directory.

E. Shop Drawings:

1. Submit Authority Having Jurisdiction approved sets of shop drawings and calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature, or signed seal of a licensed professional engineer, and the fire suppression Contractor's Alaska specialty license number.
2. Shop drawings shall be submitted with information in compliance with NFPA 13 and other performance standards of this Section. Shop drawings shall include but not limited to the following:
  - a. Name of Contracting Agency, Occupant and Building Permit number.
  - b. Location, including street address and legal description.
  - c. Point of compass.
  - d. Fire Department connections.
  - e. Necessary controlling equipment.

- f. Location of water source, type, routing, depth of bury, and size of supply pipes. Identify location and size of city main and whether it is dead-end or circulating loop and distance to the flow data test hydrant.
- g. Distribution system pipes and outlets. Include pipe and fitting types.
- h. Sprinkler connection, drop, details including supports required for flex pipe.
- i. Supports, brackets, restraints, and seismic attachments details and schedules.
- j. Reflected ceiling plan showing ceiling heights, construction type, proposed location and type of sprinkler heads, and other ceiling devices such as HVAC diffusers, loud speakers, type and location of light fixtures, etc.
- k. Interference control between sprinkler system and other trades.
- l. Full height cross section, indicating basic building construction system, sprinkler piping arrangement, and elevation of the highest sprinkler head.
- m. Location of partitions. Identification of full height walls and draft stops.
- n. Location and size of unprotected concealed spaces.
- o. Identification of unheated areas and areas that cannot be reliably maintained above 40 degrees F.
- p. Water flow test results: Include testing agency, time, date, and location of test.
- q. Make, model, type, orifice, finish, color, and temperature rating of sprinklers and their respective locations.
- r. Sprinklers with sprinkler guards.
- s. Extended coverage sprinklers.
- t. Corrosion resistant sprinklers.
- u. Ceiling slopes greater than 2 to 12 shall be identified.
- v. Clearly identify each hydraulic remote area and associated calculations with hazard type and density.
- w. Hydraulic node points.
- x. The square footage area protected by each system.
- y. Make, model, and size of valves and equipment, including: control valves, alarm valves, check valves, hose valves, and related appurtenances.
- z. Identify drum drip drains, main drain, low point drains, drain receptors, and inspector test stations.
- aa. Indicate the type and location of pipe hangers, equipment supports, seismic movement, and seismic restraints.
- bb. Make, model, size, and locations of pipe couplings, fittings, and flanges.
- cc. Make, model, size, power requirement, and location of alarm bells, buzzers, detectors, switches, air compressors, and panels.
- dd. Provisions for flushing and backflow device system demand forward flow test and test discharge to safe location.
- ee. Name, address, and telephone number of the fire protection specialty Contractor. If design is by a separate firm, include the name address, telephone and fax numbers, and email of the design firm.
- ff. Complete legend of abbreviations and symbols indicated.
- gg. Complete schedule of room occupancies.
- hh. Location of structural penetrations and verification that structural penetrations have been coordinated and approved.
- ii. Note the size, location, and extent of "exposed" pipes.
- jj. Location of fire rated assemblies.
- kk. Hose stations and cabinets.
- ll. Standpipes, Class, fire hose connections, and drains.



## F. Design Data:

1. Submit Authority Having Jurisdiction approved sets of calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature or stamp of a licensed professional engineer and the fire suppression Contractor's Alaska specialty license number. Submit complete hydraulic calculations which were used to prepare the final design drawings. One set will be retained by the Engineer.
2. Product data, shop drawings, and calculations shall be submitted together for review; partial submittals not allowed.
3. Systems shall be limited to a maximum of 175 PSIG, unless otherwise approved. Systems requiring pressures 175 PSIG and higher shall have pressure reducing valves, controls, and related equipment incorporated.
4. Submit water flow information used for hydraulic calculations:
  - a. For the Municipality of Anchorage service area, contact AWWU and obtain hydraulic model information nearest hydrant flow for maximum day demand of year, or provide hydrant flow test and use 10% flow safety factor as minimum requirement, or as approved by the AHJ and the engineer.
  - b. For each zone hydraulic calculations shall be accomplished in compliance with the procedures established in NFPA 13.
  - c. Hydraulic calculations accomplished by computer program for submittal shall be accompanied by a complete legend of the abbreviations, nodes, and symbols utilized on the computer printout.
  - d. Fire pump flow characteristics used in the calculations.
  - e. Hydraulic calculations shall follow NFPA 13 and FMG requirements and shall clearly identify the following:
    - 1). Sprinkler type and "K" factor.
    - 2). Pipe and fittings type, size, and inside diameter.
    - 3). Fitting equivalent length chart that complies with the "C" factor and pipe type.
    - 4). NFPA or FMG hazard designation, design density, and size of the design remote area.
    - 5). The elevation of the "highest" sprinkler and standpipe hose valve.
    - 6). Extended coverage sprinklers shall include design pressure and coverage identified on the drawings and manufacturer's product information to confirm usage. Hydraulic calculations shall identify extended coverage sprinklers and operating pressure.
    - 7). The available water supply and system demand at the point of connection to the water supply, indicated on a logarithmic graph and required safety factors. Include hose and standpipe demands.
  - f. Equipment, pipe, fittings, and sprinklers used in calculations shall match installed system. Variances shall require redesign and installation by contractor.

## G. Quality Assurance/Control Submittals:

1. Design Data: Provide hydrant flow test reports or other information used for design.

2. Certificates Initial Submittal:
  - a. Submit Contractor's qualifications, proof of three years' experience under this Contractor's firm name, and references for at least five projects in Alaska of similar type, size, or complexity.
  - b. Submit a copy of designer's NICET certification and resume', Alaska Permit number and level or Alaska P.E. license number.
  - c. Submit a copy of backflow assembly tester qualifications and certificate.
  - d. Submit a copy of Contractor's State of Alaska Fire Protection Permit and Administrator's License for the appropriate type of systems provided.
3. Certificates Post Construction:
  - a. Submit a letter of certification for backflow assembly installation and testing, signed by the installer/tester.
  - b. Provide copy completed of the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Above Ground Piping.
  - c. Provide test report for hydrostatic test of piping.
  - d. Provide test report confirming proper operation of tamper, supervisory, and flow switches, and system alarms.
  - e. Provide test report for fire pump operating test.
  - f. Submit test results to AFM for acceptance.
  - g. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.
4. Provide Manufacturer's Installation Instructions, and Manufacturer's field reports.
5. Fire suppression system shall be installed, tested, as-builts completed and installation approved by the Authority Having Jurisdiction, AHJ, before substantial completion request or notification is made.
6. Structural tests and special inspections required by IBC or ASCE-07 shall be identified on the shop drawings, products submitted and coordinated during installation. Reports shall be submitted. Secure required services and pay for tests and inspections.
7. Significant changes in piping due to on site coordination with other trades and existing conditions shall require hydraulic recalculation to confirm adequate pipe sizing and be resubmitted to AHJ and Contracting Agency's Insurance agency.

#### H. Review, Approvals, and Permits Required

1. Obtain written review and/or approval of the entire fire suppression system design and arrangement from the following authorities:
  - a. Contracting Agency - (Approval).
  - b. Authority Having Jurisdiction, AHJ - (Approval).
  - c. Architect - (Review).
  - d. Mechanical Engineer - (Review).
  - e. Contracting Agency's Insurance Agency – (Review)
  - f. Affiliated Factory Mutual (AFM) - (Review).

2. Comply with the above review comments, revising the system design as required, and resubmitting in a timely manner, so as not to hinder the construction schedule.
  3. Obtain and pay for required permits, inspections, tests, and approvals as required by Authority Having Jurisdiction.
- I. Operation and Maintenance Manual Submittal:
1. Include manufacturers' descriptive literature, operating instructions, installation instructions, testing certificates, maintenance and repair data, parts listings, and spare parts list.
  2. Electronic copy of the Authority Having Jurisdiction approved hydraulic calculations, drawings, and their review letter.
  3. Table showing NFPA 25 maintenance requirements.
  4. Provide an electronic copy of operations and maintenance manual in PDF format with bookmarks matching table of contents, including as-built shop drawings with each required paper copy.
- J. Closeout Submittals:
1. Refer to Division 1 for general procedures for submittals.
  2. Project Record Documents: Record actual locations of components and locations of access doors required for access or valving.
  3. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Agency's name and registered with the manufacturer.
  4. Submit a written affidavit at the completion of the system, stating that the fire suppression system as installed complies with referenced Codes and Standards, Authority Having Jurisdiction requirements, and the Contracting Agency's Insurance recommendations.
  5. Provide written warranty as specified in Division 1. Furnish written guarantee to the Contracting Agency, that materials installations are free from mechanical defects and guaranteeing to replace and repair any and all unsatisfactory and defective work and items, to the satisfaction of the Contracting Agency, in a timely manner for a period of one year after final acceptance of the Contracting Agency, and to be responsible for any damage caused to the premises for any such unsatisfactory work.
  6. Issue a minimum one set of full size as-built drawings and maintenance data to the Contracting Agency's designated maintenance personnel, in addition to required submittals.
  7. Train the Contracting Agency's designated maintenance personnel in the operation and maintenance of the fire suppression system. Minimum 2 hours of training is required.
- K. Maintenance Information and Framed Building Plan:
1. Provide updated and revised information for a complete 1/16" scale building floor plan showing system control valves, drain stations, alarm and control panels, test valves, fire pumps and controllers, water storage tank(s) and other primary fire suppression devices. Indicate sprinkler zones, boundaries, and types of systems. Each zone shall be assigned a unique sequential identifier number. Submit this plan prior to substantial completion for review by the Contracting Agency.

2. Orient the floor plan in a manner that is consistent with the building. Rotate graphic layout as required to show North, South, East, and West, as it applies to the building.
3. Enclose the plan in a professionally fabricated metal picture frame with 1/8 inch rigid clear plastic cover. Minimum 1 inch frame width. Locate the framed plan in the fire suppression control valve room on the wall with the spare sprinkler cabinet.
4. Include step by step instructions to place the fire suppression system in service as well as to take it out of service. Provide complete maintenance information of primary fire suppression equipment, valves, fittings, sprinklers. Identify equipment indicating whether devices are replacement items or repairable. Provide parts list and suppliers for repairable items.
5. Include step by step procedures for required operational weekly/monthly/annual service and testing as required by NFPA 25. Provide a complete report of field test operations and results prior to substantial completion.

L. Record Drawings:

1. Maintain current and up-to-date As-Built prints of the fire suppression system at the job site.
2. Approved full size As-Built drawings and electronic copy of as-built drawing files in PDF and DWG formats shall be submitted with IO&M manuals.

1.5 QUALITY ASSURANCE

- A. Furnish the services of a qualified and approved fire suppression subcontractor to provide the work of this specification section. Unless otherwise noted, this is substantially a “performance” specification.
- B. Minimum qualifications of the Contractor/subcontractor shall include the following:
1. Specialist Firm: Company specializing in automatic fire suppression/sprinkler systems, possessing a minimum of three years of experience with systems similar in nature to the type specified herein. Demonstrate satisfactory completion of five projects of similar size and scope in the State of Alaska; provide references.
  2. Backflow Prevention: Installation and testing by a certified backflow assembly tester, in accordance with the Uniform Plumbing Code and Foundation for Cross-Connection Control and Hydraulic Research.
  3. Design Certification: Drawings and calculations shall be prepared by a Level III or IV Fire Sprinkler Designer, certified by the National Institute for Certification in Engineering Technologies (NICET), in Fire Protection Engineering Technology Automatic Fire Sprinkler System Layout who also have their State of Alaska Permit IIC or IIC-DO license, or an Alaskan Licensed Professional Engineer.
  4. Maintain a complete stock of replacement parts.
  5. Remain on 24 hour call for emergency service.
  6. Maintain an office and telephone, with authorized representatives of the fire suppression contractor's firm, including the Designated Project Administrator, with a physical presence and address in Alaska.
  7. Bids by wholesalers, contractors, or any firm whose principal business is not that of manufacturing and/or installing fire suppression systems are not acceptable.

## C. Material:

1. Equipment and components: Bear the "UL" label or the "FM" approval marking.
2. Equipment and components: Bear the "FM" approval marking or "UL" if FM is not available and approved by Contracting Agency.
3. Grooved joint couplings, fittings, valves, and specialties shall be from the same manufacturer, including grooving tools.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.

## 1.7 PROJECT/SITE CONDITIONS

- A. Existing portions of the building will be occupied and fully functional.
- B. Work shall be scheduled to minimize disruption of automatic fire suppression service, coordinate with Contracting Agency for shut down and maintain a fire watch when the existing system is inoperable.
- C. Check dimensions indicated on the Architectural and Structural Drawings, and verify dimensions at the site before fabricating any portion of the system. Any discrepancies in piping and head locations resulting from failure to do so shall be corrected expeditiously to provide proper coordination of trades.
- D. Coordinate work with that of other trades to make sure that adequate space is provided, including requirements for accessibility and serviceability. Locate sprinkler heads a minimum 6 inches distance from ceiling T-Bar, structural elements, devices, and other installed equipment. Adjust final location of piping and heads in field to accomplish these requirements for coordination.
- E. Identify structural penetrations for pipes, and submit details of those penetrations to the Structural Engineer for approval. Replace structural members that are damaged, cut, or penetrated without approval at no additional expense to the Contracting Agency.
- F. In addition to 200000 Mechanical General Requirements Part 3 demolition requirements, review the contract documents and any Contracting Agency furnished equipment and determine if any portion of the existing fire suppression system will be affected by the temporary or permanent implementation of any portion of this work. Provide Contracting Agency a list of the specific fire suppression and detection systems affected before proceeding with design or demolition

## 1.8 ANNUAL MAINTENANCE AGREEMENT PROPOSAL

- A. Provide upon request a cost proposal for performing annual maintenance recommended by NFPA 25.

## PART 2 - PRODUCTS

## 2.1 GENERAL

- A. Provide only products that are a standard product of a manufacturer regularly engaged in the manufacture of fire suppression equipment.
- B. Products and materials shall have a minimum working pressure of 175 PSIG and capable of withstanding a hydrostatic test pressure of 200 PSIG at 2 hours test pressure without damage, unless noted otherwise for higher pressure ratings or basis of design includes higher pressure ratings.
  - 1. Exception for approved ancillary devices that are normally isolated from the fire water and sprinkler lines shall have a minimum rated 150 PSIG working pressure.
- C. Submittals are required for all equipment, materials, and products.
- D. Glycol systems for fire suppression shall not be used.
- E. Exterior items shall be chrome finish or stainless steel.

## 2.2 LABELS, TAGS, AND APPROVALS FOR PRODUCTS

- A. Products UL or FM listed, labeled, and specifically approved for the fire suppression application where they are used.
- B. Products FM listed, labeled, and specifically approved for the fire suppression application where they are used.
- C. Label pipes, riser assemblies, and alarm valves, including zone designation; enamel on metal for valves.
- D. Tag equipment for maintenance and operations. Include in shop drawings and O&M manual.

## 2.3 MANUFACTURERS

- A. Sprinkler System and Components: Match existing equipment for areas modified.

## 2.4 PIPE

- A. Plastic pipe is not allowed.
- B. The use of pipe nipples less than 1-inch in diameter and less than schedule 40 wall thickness is not allowed.
- C. Pipe shall be identified including manufacturer's name, model designation or schedule.

## D. Wet Pipe Sprinkler Systems:

1. Metallic pipes shall be listed for the intended service by UL or FM.
2. Whenever pipes other than steel schedule 40 is utilized, submit a statement that the pipe complies with NFPA 13 standards, the pipe strength is adequate for the application, and the pipe corrosion resistance ratio (CRR) shall be equal or greater than 1.0, equivalent to schedule 40 pipe for the installed system. Include this CRR data in product submittal.

## 2.5 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS

- A. Flexible one-inch 304 stainless steel flexible sprinkler hose products shall be FM Global or UL tested and approved and submitted for the specific application. The drop system shall include required mounting brackets and appurtenances.
- B. Equivalent length of 1" schedule 40 steel pipe and pressure drop information shall be included in product submittal and hydraulic calculations.

## 2.6 FITTINGS, ABOVE GROUND

## A. Grooved Fittings, Couplings, and Mechanical Tees:

1. Grooved Fittings: ductile iron fittings with flow equal to standard pattern. Fabricated or segmented fittings are not acceptable. Couplings and mechanical tees shall be standard painted, unless indicated otherwise.
2. Grooved joint couplings shall consist of two ductile iron housing segments with pressure responsive gaskets and zinc plated, hot dipped galvanized or stainless steel hardware as required for application.
  - a. Rigid type: Couplings shall provide joint rigidity, support and hanging in accordance with NFPA 13.
  - b. Flexible type: For use in locations where vibration attenuation and stress relief or flexible connectors are required.
3. Mechanical Tee Clamp-on. Ductile iron with pressure responsive gaskets and zinc plated, hot dipped galvanized or stainless steel hardware as required for application. Threaded or grooved outlets.

B. Threaded fittings shall be compatible with piping system and include cast iron Class 125 and 250 and malleable iron Class 150 and 300 steel

C. Pipe Flanges shall be compatible with piping system and include: Cast iron Class 125 and 250 and malleable iron Class 150 and 300 steel

D. Welded Pipe Fittings for Wet Pipe Sprinkler Only: Limited to Weld-o-lets, Thread-o-lets, Gruv-o-lets, Tees, and Welded Flanges. Welding limited to shop fabrication work with approved quality control process, welding procedures, and welders for specific application.

- E. Welded pipe joints and fittings shall not be used on galvanized pipe or on pipes with wall thickness less than schedule 10.
- F. Clamp-on, saddle type, or mechanical tee are not allowed for new work.
- G. Other means of joining pipe are not permitted.

## 2.7 SPRINKLER HEADS

- A. Provide sprinklers as required by NFPA 13 standards and in compliance with the IBC Chapter 9. Sprinkler heads to match existing in areas of remodels or modifications.
  - 1. Sprinklers in waiting area room shall be concealed type with cover to accent ceiling finish. Coordinate color selection with Architectural.
  - 2. Sprinklers of correct temperature rating shall be installed according to NFPA 13.
  - 3. Provide a minimum of 2 spare sprinkler heads of each type and temperature rating, and a minimum of one sprinkler wrench for each type of installed sprinkler. Wrenches shall directly engage the wrench boss cast into the sprinkler. Spare sprinkler cabinet shall be red sheet steel manufactured by the sprinkler manufacturer. Mount cabinet on the wall within 60 inches of the main sprinkler control riser.
  - 4. Provide additional sprinklers, as requested by Authority Having Jurisdiction, at no additional cost to the Contracting Agency.

## 2.8 PIPE AND EQUIPMENT ANCHORS, BRACING, HANGERS, AND SUPPORTS

- A. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per NFPA 13, International Building Code, and ASCE 7. Most conservative criteria shall govern.
- B. Provide flexible couplings, bracing, and other components required and compatible with the piping materials and fittings.
- C. Hangers, bracing, and seismic details and locations shall be included on the shop drawings.
- D. Seismic support shall be in accordance with Factory Mutual Property Loss Prevention Data Sheet 2-8, Earthquake Protection for Water-Based Fire Protection Systems.

## 2.9 ELECTRICAL WORK

- A. Provide electrical components, equipment, wire, conduit, connections, devices, and services as required by NFPA 72 and Division 26 requirements.



## 2.10 VALVE SUPERVISION, TAMPER, SWITCHES

- A. Provide supervision of valves on water supplies, sectional control and isolation valves, floor control valves, water supplies to standpipes fire pumps, and other valves in supply pipes to sprinklers and other fixed water-based fire suppression systems.
- B. Provide valve supervision switches compatible with fire alarm system in NEMA 4 enclosure.
- C. Coordinate with Division 26 requirements.

## 2.11 PRESSURE GAUGES

- A. Pressure gauges shall be 3-1/2" corrosion resistant moving parts, polycarbonate window with connection not smaller than 1/4" NPT, and maximum limit not less than twice the normal system working pressure at the point where installed.
- B. Provide 3-way globe shutoff valve with provisions for removal and draining on each pressure gauge.

## PART 3 - EXECUTION

## 3.1 GENERAL

- A. The contract documents have performance, materials, and installation requirements which exceed code minimums.

## 3.2 COORDINATION

- A. The fire suppression contractor shall coordinate their work with the work of other trades to assure timely installation and efficient use of mechanical areas including, but not limited to, medical gas rooms, rooms, and ceiling spaces.
- B. Promptly remove any work installed without proper coordination and reinstall in a manor to allow for a good practical arrangement of items which need to be installed by other trades involved.
- C. Costs associated with coordination, arranging or rearranging of the fire suppression system shall be borne by the affected contractor, without causing any additional expense or delay to the Contracting Agency.
- D. Installation, testing, O&M manuals, record drawings, and AHJ approvals shall be completed, submitted, and approved by the Contracting Agency before beneficial occupancy.
- E. Work shall be scheduled to minimize disruption of existing fire service. Coordinate with Contracting Agency for shut down and maintain a fire watch when system is inoperable.

## 3.3 PIPING INSTALLATION

- A. Install pipes, fittings, and appurtenances in accordance with codes and recommended practices. Follow manufacturers' installation instructions.
- B. Installed system to have a corrosion resistance ratio (CRR) equal or greater than 1.0.
- C. Sprinkler pipe and fittings shall be installed to flush and drain system. Drains shall be accessible. Discharge test pipes, backflow system demand flow tests, and system main drain to safe location outside. Coordinate discharge point with Contracting Agency.
  - 1. Arrange pipes to drain to the main drain valve where practicable. Where connection to the main drain or other exterior drainage is impractical, as shown on shop drawings, install low point drain stations in accordance with NFPA 13. Route drain lines to nearest waste receptor where possible.
  - 2. Identify the location of drain and test stations with signs on access panels, ceiling panels, or walls adjacent to the station, visible from the floor.
  - 3. Provide auxiliary drain where change in piping direction prevents drainage through main drain valve.
  - 4. Coordinate routing of drain lines to waste receptors. Direct connection shall not be made between sprinkler drain lines and sewers.
- D. Provide clearance around pipes extending through walls, floors, ceilings, platforms, and foundations, including drains, fire department connections, and other auxiliary pipes. Holes shall be sized 2" larger than the pipe for pipe 1" to 3-1/2" and 4" larger for pipe 4" and larger, unless flexible couplings are located within 1 foot of each side of item penetrated, and excluding frangible construction that is not required to have a fire resistance rating.
- E. Install pipes to conserve building space and route pipes around roof hatches, electrical panels, access panels, and maintenance accesses.
- F. Minimum 3 inches clearance from structure not used to support pipes.
- G. Provide service access around equipment per manufacturer's requirements, minimum of 18 inches.
- H. Provide flexible couplings as required per NFPA 13 and at the following locations:
  - 1. Penetrated fire and smoke rated assemblies.
  - 2. Within 24 inches of building's expansion joints.
  - 3. Within 12 inches above and within 24 inches below for the floor in multistory buildings.
- I. Sprinkler pipes shall be substantially supported from the building structure, which shall support the water loaded pipe plus a minimum 250 pounds temporary point load applied at the point of hanging. Pipe hangers shall include 250 pounds and weight of 5 time pipe filled with water.
- J. Pipes shall be concealed, except at ceilings exposed to structure, or as noted. Conceal pipes in areas with finished ceilings except where otherwise specified or indicated. Coordinate with the other trades to take timely advantage of available space above ceilings, below raised floor, in pipe and duct spaces and elsewhere.

- K. Pipes shall not be concealed in walls.
- L. Pipes in exposed ceiling areas shall be limited to branches serving heads in the area. Pipe routing shall be coordinated to minimize visual impact and approved prior to installation.
- M. Connection to existing systems shall be configured and installed for flushing and draining of all pipes including, but not limited to, system supplies and risers, risers, cross and feed mains, and branches.
- N. Provide penetrations where pipes pass through walls, floors, or ceilings. Penetrations shall be in accordance with UL Fire Resistance Directory for “Through Penetration Firestop Systems (XHEZ)”.
- O. Pipes supported from manufactured structural members shall comply with truss manufacturer’s installation recommendations for hanger attachments and loading of pipe hangers.
- P. Pipes passing pre-drilled structural elements to be shown on approved shop drawings.
- Q. Fasten trapeze members to truss chords or structural members.
- R. Install “beam clamp” type fasteners with retainer straps and locking nuts. Retainer strap shall be tight to beam.
- S. Pipe size reductions by one-piece reducing fittings; bushing shall not be used.

### 3.4 GROOVED AND ROLLED FITTINGS

- A. Follow the manufacturer's suggested methods to prepare gaskets, pipes, and fittings to prevent leakage, system breakdown, and designed pipe and fitting movement.
- B. Cut grooved pipe shall be limited to schedule 40 pipe.
- C. Welding fittings shall not be used on galvanized pipe.
- D. Installers to have been trained by the coupling manufacturer in the use of grooving tools and installation of product. The manufacturer’s representative shall periodically visit the job site to ensure best practices are being followed.

### 3.5 SPRINKLER HEAD INSTALLATION

- A. Sprinkler heads to be centered per approved shop drawings. Changes due to field conditions shall be pre-approved.
- B. Sprinkler heads to be centered on acoustical lay-in panels and symmetrically 4-way on architectural drawings laid out in each separate room or space with GWB type ceiling regardless of finishes and minimum Code requirements.

- C. Partial sprinkler head layout shown on architectural drawings is for design intent only. Sprinkler heads to be centered on acoustical lay-in panels and symmetrically 2-way on architectural drawings laid out in each separate room or space with GWB type ceiling regardless of finishes and minimum Code requirements.
- D. Sprinkler heads shall be connected to system via minimum 1-inch diameter flexible stainless steel sprinkler hose in suspended ceiling areas, areas subject to tenant renovations, where indicated, and where required for seismic criteria. Ceiling systems with listed flex hose connections shall be identified on shop drawings.
- E. Escutcheons and cover plates shall be metallic and listed for the assembly.
- F. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.
- G. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.
- H. Sprinkler head temperature ratings shall be selected based upon installed distance from heat source.
- I. Provide clearance for removal of sprinkler heads and minimum 1-inch clearance from structure. Exclude concealed, recessed, and flush types, which have clearances above the ceiling.
- J. Identify sprinklers with less than 8 feet between them and include listing and NFPA 13 criteria.

### 3.6 IDENTIFICATION

- A. Valves: Control, auxiliary control, drain, and test connection valve shall have permanently secured weatherproof metal identification signs.
  - 1. Systems with more than one control valve that must be closed to work on an area shall have a sign referring to existence and location of other valves.
  - 2. Control valve identification to include its function and what it controls.
- B. Coordinate with valve, zones, and pipe identification with Framed Building Plan and fire alarm nomenclature.
- C. Rooms containing control valve, fire pump, and similar equipment requiring fire department identification or access shall have signage.
- D. Coordinate exterior and interior signage with architect and AHJ requirements.
- E. Sprinkler system hydraulic design and relevant general information. Information shall meet NFPA 13 and NFPA 25 requirements for inspection, testing, and maintenance.

## 3.7 ELECTRICAL WORK

- A. Provide electrical work, connections, routings, signals, power, and services as required by NFPA 72 and Division 26 requirements.
- B. Coordinate switches, connections, alarms, and number and type of devices with electrical work. Devices shall be compatible with Fire Alarm System requirements.

## 3.8 ACCESS DOORS

- A. Provide access doors where "Fire Suppression" valves, switches, drain valves, or other controlling or monitoring devices are concealed. Label doors for quick location and recognition of concealed devices. For rated assemblies provide rated access door to match assembly's rating. Paint door to match existing adjacent surfaces.

## 3.9 FLUSHING

- A. New and modified systems in or serving area of work shall be arranged for flushing. Cross main ends shall be provided with readily removable fittings and shall terminate with 1-1/4" or larger pipe.
- B. Flush pipes before pressure testing.

## 3.10 FIELD QUALITY CONTROL

- A. Arrange for proper witnessing of tests, as required by Authority Having Jurisdiction, and as specified elsewhere. Contracting Agency's representative may witness tests. Notify Contracting Agency a minimum of 3 days in advance of test.
- B. Arrange new and existing systems in or serving the area of work for testing. Limits and criteria for testing existing systems impacted by work under this contract to be coordinated with Contracting Agency and AHJ.
- C. Conduct tests in accordance with applicable codes and AHJ requirements.
- D. Test tamper, supervisory, flow, and system alarm actuations and alarm monitoring systems.
- E. Submit test results to Affiliated Factory Mutual for acceptance.
- F. Pipe shall not be concealed until satisfactorily pressure tested.
- G. Log of test shall be kept at the job site and shall identify:
  - 1. Who performed the test,
  - 2. Time and date of test,
  - 3. Section of system tested,
  - 4. Results of test,
  - 5. Completed Contractor's Material and Test Certification forms.

- H. Verify permanently marked weatherproof metal “Hydraulic Design Information Sign” is secured with corrosion resistant fastener at each modified system alarm valve and information matches approved shop drawings and hydraulic calculations.
- I. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.

END OF SECTION 211000

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, fittings, and connections for domestic potable water system.
2. Mechanical coupling systems.
3. Piping accessories.
4. Valves.
5. Indirect Fired Water Heater.
6. Domestic hot water thermal expansion tanks.
7. Water hammer arresters.
8. Trap primer valves.
9. Water Filters for Break Room and Hydration Room.
10. Access doors.

B. Related Sections:

1. 019100 - Commissioning
2. 200000 - Mechanical General Requirements
3. 200529 - Mechanical Hangers and Supports
4. 200548 - Mechanical Vibration and Seismic Control
5. 200553 - Mechanical Identification
6. 200700 - Mechanical Insulation
7. 204100 - Mechanical Demolition
8. 211000 - Water Based Fire Suppression Systems
9. 221300 - Sanitary Waste and Vent Piping and Specialties
10. 224000 - Plumbing Fixtures
11. 230593 - Testing, Adjusting and Balancing

1.2 REFERENCES

A. Codes and Standards:

1. See Section 200000 - Mechanical General Requirements.
2. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
3. NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
4. 2011 Reduction of Lead in Drinking Water Act.
5. NSF/ANSI 61 - Drinking Water System Components - Health Effects.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.

2. Refer to Section 200000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

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

#### B. Performance Requirements:

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

### 1.4 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

### 1.5 SUBMITTALS

- A. Refer to Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

#### B. Product Data:

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

#### C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 200000 - Mechanical General Requirements.
2. Show placement of fixtures and plumbing equipment.

- D. Certificates: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of cross contamination protection devices.



E. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manuals.

F. Test and Evaluation Reports:

1. Submit hydrostatic pressure test report.
2. Submit sterilization of system report.

1.6 CLOSEOUT SUBMITTALS:

A. Refer to Section 200000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:

1.7 QUALITY ASSURANCE

A. See Section 200000 - Mechanical General Requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. See Section 200000 - Mechanical General Requirements.

1.9 WARRANTY

A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 WATER SERVICE PIPING (ABOVE GRADE INSIDE BUILDING)

A. Copper (Hard drawn):

1. Tubing: Type L (ASTM B88).
2. Fittings:
  - a. Cast copper alloy (ASME B16.18).
  - b. Wrought copper and bronze (ASME B16.22).
3. Joints: Solder, Grade 95TA (ASTM B32).

B. Copper Press Fitting System:

1. Limited to tubing sizes 4 inch and smaller.
2. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with

the use of manufacturer's crimping tool. Fittings shall be rated for 250 degrees F and 200 PSI.

3. IAPMO UPC listing.
4. Manufacturer: Viega ProPress, NIBCO Press System, no substitutions.

## 2.2 UNIONS (STANDARD)

### A. Steel Piping (Threaded):

1. Class 150 malleable iron, ground joint, copper or copper alloy seat. AnvilStar Figure 463. (150 PSIG steam, 300 WOG).
2. Where indicated: Class 250 malleable iron ground joint, copper or copper alloy seat. AnvilStar Figure 554.

### B. Copper Piping (Sweat and Threaded): Cast bronze, ground joint, copper to copper, or copper to threaded joint. Nibco 733-LF series.

## 2.3 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

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

## 2.4 VALVES

### A. General:

1. Select valves of the best quality and type suited for the specific service and piping system used.
2. Minimum working pressure rating 125 PSIG saturated steam or 200 PSIG WOG.
3. Packing material or seals shall not contain asbestos.

### B. Ball Valves:

1. Two (2) inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 PSIG pressure/temperature rating (steam).
2. Two and one half (2-1/2) inches through four (4) inch: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, 150 PSIG

pressure/temperature rating (steam). May be substituted for gate valves except where otherwise indicated.

C. Gate Valves:

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

D. Swing Check Valves:

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

E. Drain Valves:

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

## 2.5 BALANCING VALVES

- A. Provide a balancing valve at each point shown on the domestic hot water recirculation branches. Except as indicated, balancing valves shall be full line size. Wide open pressure drop selected at one PSI (2.3 feet) (nominal).
- B. Provide calibrated plug or ball valve type balancing valves with self-sealing quick connect pressure taps, scale and locking device, NSF-61 approved for potable water use. Include schedule with submittal.
- C. Manufacturer: Bell & Gossett, or equal.
- D. Provide test kit with gauge and hoses to match balancing valves.

## 2.6 AUTOMATIC FLOW LIMITING VALVES

- A. Provide automatic flow limiting valves where shown on the Drawings.
- B. Provide valves with integral isolation valve, strainer, and pressure test ports. NFS-61 approved for potable water use.
- C. Provide valve with maximum flow set to design flow of the heat transfer device being served as scheduled.
- D. Manufacturer: Griswold Controls, or equal.

## 2.7 INDIRECT-FIRED WATER HEATER

- A. Provide an indirect-fired water heater of the size and capacity shown on the Drawings. Certify that the heater complies with the requirements of ASHRAE 90.1.
- B. Tank:
  - 1. 316L stainless steel shell.
  - 2. Maximum working pressure of 150 PSI.
  - 3. Inlet and outlet connections.
  - 4. 3/4-inch tapping for relief valve.
  - 5. Thermal heat trap to reduce standby heat loss.
  - 6. Accessories: ASME rated temperature and pressure relief valve.
- C. Polyethylene outer jacket, over CFC-free urethane foam insulation. Insulation thickness and efficiency shall be as required to meet energy efficiency requirements of ASHRAE 90.1.
- D. Heat Exchanger:
  - 1. Finned copper with Stanoguard plating.
  - 2. Inlet and outlet heating pipe connections.
- E. Controls. Provide a complete and operating control system, including the following features:
  - 1. Electro-mechanical AquaStat temperature control.
  - 2. High temperature limiting device.
  - 3. UL approved controls, factory wired.
  - 4. Provide control wiring diagram.
- F. Manufacturer: Amtrol Premier WHS Series or approved equal.

## 2.8 DOMESTIC HOT WATER CIRCULATING PUMPS

- A. Direct drive, field replaceable stainless steel cartridge, self-lubricating.
- B. Aluminum stator, non-metallic impeller, ceramic shaft, carbon bearings.
- C. O-ring and Gaskets: EPDM
- D. Flange mount, bronze construction.
- E. Manufacturers:
  - 1. Taco (Basis of Design).
  - 2. B&G.
  - 3. Approved equal.

2.9 DOMESTIC HOT WATER THERMAL EXPANSION TANKS

A. Tank:

1. ASME stamped.
2. Steel tank shell steel support stand.
3. Enamel or urethane coating.
4. NSF approved polypropylene liner.
5. FDA approved replaceable butyl rubber bladder.
6. Brass threaded system connection.
7. With manufacturer's optional seismic restraint kit.

B. Operating Characteristics:

1. Maximum Working Temperature: 200 degrees F.
2. Maximum Working Pressure: 150 PSIG.
3. Tank Precharge: 29 PSIG.
  - a. Verify static cold water pressure at penthouse level and adjust tank precharge to match.

C. Manufacturer: Amtrol Therm-X-Trol (Basis of Design), Taco, or equal.

2.10 WATER HAMMER ARRESTERS

A. Manufacturers:

1. Sioux Chief.
2. Precision Plumbing Products.
3. Mifab.
4. Zurn.
5. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

B. Pressurized Piston Type:

1. Description: ASSE 1010 certified water hammer arrester.
2. Performance:
  - a. Maximum working temperature of 250 degrees F.
  - b. Maximum working pressure of 350 PSIG.
3. Materials:
  - a. Seamless copper body.
  - b. EPDM o-rings lubricated with FDA approved compound.

C. Expansion Bellows Type:

1. Description: ASSE 1010 certified water hammer arrester.
2. Performance:
  - a. Maximum working temperature of 250 degrees F.
  - b. Maximum working pressure of 350 PSIG.
3. Materials: Stainless steel body and bellows.

#### 2.11 PRESSURE GAUGES

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Bourdon tube type with minimum 4-1/2-inch dial, accuracy plus or minus 1 percent (ANSI/ASME Grade 1A). Normal operating pressure near midpoint of range. Industrial quality.
- C. Type 304 stainless steel case and ring, acrylic lens.
- D. NSF-61 certified lead free brass.
- E. Gauge cock on gauges and pulsation damper (snubber).
- F. Manufacturers: Winters PCT-LF, or approved equal.

#### 2.12 THERMOMETERS

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Liquid in glass type: Industrial quality blue-reading with minimum nine-inch scale length. Adjustable angle connection and 360-degree rotation for easy installation and visibility.
- C. Aluminum or Valox® impact resistant case, polycarbonate lens.
- D. Accuracy plus or minus 1 percent. Normal operating temperature at scale midpoint and sufficient range to cover operating conditions.
- E. Provide separable wells of suitable material for plumbing piping. Set probe in heat transfer paste recommended by thermometer manufacturer.
- F. Manufacturers: Winters TIM-LF, or approved equal.

#### 2.13 TRAP PRIMER VALVES

- A. Manufacturers:
  1. Precision Plumbing Products.
  2. MIFAB.
  3. ProFlo.

## B. Electronic Type:

1. Description: UL listed, trap primer assembly designed to discharge a metered amount of water to floor drain traps on a timed schedule. Assembly includes electronic solenoid valve, timer box with test button, circuit breaker, 1-inch air gap, and NEMA 1 surface mounted wall box with cover.
2. Performance:
  - a. Pre-set timer opens once for 10 seconds every 24 hours.
  - b. 20-150 PSI pressure range. Minimum 2 ounces of water at 20 PSI per drain served.
  - c. 32-125 degrees F temperature range.
  - d. 120-volt, single phase electrical connection with 0.11 amps hold current and 0.23 amps inrush current.
3. Materials:
  - a. Copper with lead-free solder.
  - b. 16 gauge steel wall box and cover.
  - c. Stainless steel mesh screen.
4. Manufacturer: Precision Plumbing Products Mini-Prime MP-500-12V.

## 2.14 WATER FILTER SYSTEMS FOR BREAK ROOM AND HYDRATION ROOM (WF-1)

- A. Inline water filter designed to reduce particulate, chlorine taste, odor, and scale.
- B. NSF certified, rated to 1.5 GPM flowrate and 10,000 gallons capacity.
- C. Plastic housing with replaceable filter cartridge.
- D. Rated to 125 PSIG operating pressure and 100 degrees F operating temperature.
- E. Furnish Owner with 1 spare filter cartridge.
- F. Manufacturer: 3M BREW125-MS, or approved equal.

## 2.15 ACCESS DOORS

- A. Provide access doors for mechanical systems in accordance with Section 083113 - Access Doors and Frames.
- B. Provide UL labeled access doors and panels when required for fire resistance of surrounding construction.
- C. Provide key locks on access doors located in public areas below eight feet above finished floor.
- D. Prime coat steel.

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

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- B. Surface Preparation:
  - 1. Verify that excavations are to required grade, dry, and not over-excavated.
  - 2. Refer to Section 200556 - Interior Trench Excavation and Backfill.

#### 3.2 INSTALLATION

- A. Interface with Other Work:
  - 1. Review architectural drawings. Coordinate locations of access panels prior to piping installation.
  - 2. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
  - 3. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related work shall be completed at no additional expense to the Owner.
  - 4. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 for instructions on painting and coordination.
- B. Water Service Piping:
  - 1. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.
  - 2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 4. At fixtures, install and connect hot water on left and cold water on right, as viewed when facing the fixture.
  - 5. Use of bullhead tee with opposed flow, double inlet configuration not allowed.
- C. Valves:



1. Provide accessible ball type isolation valves at major piping branches, and on main lines as shown, and at terminal devices.
2. Install balancing valves for hot water recirculation system to be accessible and adjustable.

D. Domestic Hot Water Thermal Expansion Tanks:

1. Field verify static pressure at cold water line at penthouse level and adjust to precharge to match water pressure.
2. Provide housekeeping pad for expansion tank mounting. Coordinate pad size to accommodate tank seismic restraint anchorage and minimum anchor bold edge distance in accordance with Contractor's seismic restraint design.

E. Water Hammer Arresters: Install in accordance with manufacturer recommendations.

F. Provide finished products with protective covers during balance of construction.

G. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.

H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

I. Install water filter in accordance with manufacturer recommendations:

1. Mount filter assembly inside sink base cabinet. Coordinate mounting location in base cabinet for maintenance access. Where base cabinets include a trash receptacle, locate water filter assembly away from trash receptacle.
2. Provide shutoff valves upstream and downstream of filter assembly for servicing.
3. Connect filter to cold water supply line.
4. Route filtered water line to coffee makers, ice makers, and instant hot water dispensers as indicated on drawings.

### 3.3 REPAIR/RESTORATION

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

### 3.4 SITE QUALITY CONTROL

A. Site Tests:

1. Test water piping hydrostatically at 100 PSIG or 150 percent of working pressure, whichever is greater, for a period of four hours. Observe piping during this period and repair leaks and retest.
2. Air Test:

- a. In general, air testing is not acceptable. In the event of low temperature conditions that would subject system piping to freezing, an equivalent air pressure test may be conducted in accordance with the Uniform Plumbing Code with prior Contracting Agency approval.
  - b. Test with clean air at 150 percent of system working pressure but not less than 75 PSIG or more than 150 PSIG. System shall hold pressure for not less than four hours. Inspect joints using leak detecting fluid or soapy water. Repair leaks and retest.
  - c. Observe necessary safety procedures when testing with air including, but not limited to, use of protective goggles or face shields. Only persons directly involved in testing procedure shall be within 20 feet of a pipe under pressure.
3. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.
- B. Inspection: Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.

### 3.5 SYSTEM STARTUP

- A. Start-up and operate plumbing systems and equipment in accordance with the manufacturer's written installation and operation manual checklist.
- B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.
- C. Operationally test control and safety devices and record settings.
- D. Submit a copy of start-up report that includes final settings and that indicates that the start-up of each piece of equipment has been completed.

### 3.6 CLEANING

- A. Sterilization of Domestic Water Systems:
  1. Sterilize each unit of completed supply line and distribution system with chlorine before acceptance for domestic operation.
  2. Sterilization as described below or by the system prescribed by the American Water Works Association Standard C-651. Apply the amount of chlorine to provide a dosage of not less than 50 PPM (parts per million). Provide chlorine manufactured in conformance to the following standards:
    - a. Liquid Chlorine: Federal Specification BB-C-120.
    - b. Hypochlorite: General Specification O-C-114a, type 11, Grade B or Federal Specification O-X-602.
  3. Introduce the chlorinating material to the water lines and distribution system after piping system has been thoroughly flushed. Maintain a contact period of not less than 24 hours.

Flush the system with clean water until the residual chlorine content is not greater than 1.0 part per million.

4. Open and close valves in the lines being sterilized several times during above chlorination.
  5. Certify in writing that sterilization has been completed in accordance with these requirements.
- B. After construction is completed, clean and wipe down exposed surfaces of pumps, piping and appurtenances.

END OF SECTION 221100

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## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

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

## B. Related Sections:

1. 200000 - Mechanical General Requirements
2. 200529 - Mechanical Hangers and Supports
3. 200548 - Mechanical Vibration and Seismic Control
4. 200553 - Mechanical Identification
5. 200700 - Mechanical Insulation
6. 204100 - Mechanical Demolition
7. 221100 - Domestic Water Piping and Specialties
8. 224000 - Plumbing Fixtures

## 1.2 REFERENCES

## A. Codes and Standards: See Section 200000 - Mechanical General Requirements.

## B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 200000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
4. ASA - American Supply Association.
5. ASTM - American Society for Testing and Materials
6. CISPI - Cast Iron Soil Pipe Institute.

## 1.3 SYSTEM DESCRIPTION

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

## B. Performance Requirements:

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

3. Provide products with performance, output or salient features indicated or scheduled on the drawings.

#### 1.4 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

#### 1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:

- B. Product Data:

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

- C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 200000 - Mechanical General Requirements.
2. Indicate pipe grade and direction of slope. Indicate elevation of piping at the beginning and end of each main, and at branch connections.
3. Coordinate exact locations of drains, floor penetrations and structural penetrations with applicable trades.

- D. Manufacturer's Installation, Operation and Maintenance Manuals.

- E. Test and Evaluation Reports:

1. Submit pressure test report.
2. Submit system flushing report.

#### 1.6 CLOSEOUT SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:

- B. Warranty Documentation.

- C. Record Documentation:

1. Record actual dimensioned locations for buried or inaccessible piping.
2. Show actual cleanout locations and types.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

## 1.8 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.

## 1.10 WARRANTY

- A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements for general mechanical warranty requirements.

## PART 2 - PRODUCTS

## 2.1 DRAINAGE PIPING, ABOVE GRADE

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

- 1. Manufacturers:

- a. Charlotte Pipe and Foundry.
- b. Tyler Pipe and Coupling.
- c. AB&I Foundry.
- d. Equal.

- 2. Pipe: CISPI 301, ASA group 022.

- 3. Fittings: Cast iron.

- 4. Couplings:

- a. Manufacturers:

- 1). Husky Series 2000.
- 2). MG Coupling.
- 3). Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

- b. Description: No-hub cast iron pipe couplings conforming to standard CISPI 310.

- c. Materials:

- 1). Gaskets conforming to ASTM C564.

2). Stainless steel clamp-and-shield assemblies.

- B. Copper Pipe, DWV: ASTM B75, ASTM B251, ASTM B302, ASTM B306.
  - 1. Fittings: ASME B16.23 cast bronze, or ASME B16.29 wrought copper.
  - 2. Joints: ASTM B32, lead-free solder, Grade 50B.
- C. Copper Pipe, pumped application: Type L, ASTM B88.
  - 1. Fittings: ASME B16.23 cast bronze, or ASME B16.29 wrought copper.
  - 2. Joints: ASTM B32, lead-free solder, Grade 50B.

## 2.2 ADAPTERS

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

## 2.3 CLEANOUTS

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



## PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Interface with Other Work:
  - 1. Review architectural and millwork shop drawings.
  - 2. Confirm location of cleanouts and access panels prior to installation.
- B. Protection: Cover equipment and plug piping connections to protect components from construction dirt and debris.

## 3.2 INSTALLATION

- A. Install plumbing systems in accordance with manufacturer's instructions and listing.
- B. Provide finished products with protective covers during balance of construction.
- C. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.
- D. Piping:
  - 1. Grading: Minimum 1/4 inch per foot unless indicated otherwise on drawings and approved by AHJ for shallower slopes.
  - 2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
  - 3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
  - 4. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
  - 5. Where pipe support members are welded to structural building framing; scrape, brush clean, and apply one coat of zinc rich primer to welding.
  - 6. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes.
  - 7. Connections:
    - a. Thread Joints: Assemble with TFE tape or approved non-hardening joint compound.
    - b. Solder Joints: Assemble with lead free solder.
    - c. Grooved and other joints: Assemble in accordance with manufacturer instructions.
- E. Vents:
  - 1. Install vents as indicated and as required by plumbing code. Add vents when field conditions increase the length of a trap arm or cause other changes in venting requirements.
  - 2. Unless otherwise indicated, the portion of the vent extending through roof shall be increased in size from one foot below roof assembly to termination as defined below. Increase as follows:

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

### 3.3 REPAIR/RESTORATION

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

### 3.4 FIELD QUALITY CONTROL

- A. Inspections: Arrange for inspections and provide notice to the Contracting Agency when the entire Work, or logical portions thereof, is ready for inspection.
- B. Maintain current as-built drawings on-site recording including invert elevations, connections to fixtures, cleanouts, slopes, pipe sizes, and routing of pipes. Annotate sections of lines with dates when pressure tests have been approved by AHJ.
- C. Pressure Tests:
  1. Water Test: Test waste and vent system with water in accordance with the Uniform Plumbing Code.
  2. Air Test:
    - a. In general, air testing is not acceptable. In the event of low temperature conditions that would subject system piping to freezing, an equivalent air pressure test may be conducted in accordance with the Uniform Plumbing Code with prior Contracting Agency approval.
    - b. Observe necessary safety procedures when testing with air including, but not limited to, use of protective goggles or face shields. Only persons directly involved in testing procedure shall be with 20 feet of a pipe under pressure.

3. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.

D. Verify penetrations are installed to maintain assembly integrity.

E. Coordinate with Divisions 26, 27 and 28 for power, disconnects, and related electrical items.

### 3.5 ADJUSTING

A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.

### 3.6 CLEANING

A. Clean and flush drain piping to remove dirt and foreign debris from systems.

B. Clean exposed pipes, fittings, and materials.

C. Provide written certification which documents that the complete sanitary sewer system has been flushed of foreign debris. Include date and printed names and signatures of person(s) performing the flush and Contracting Agency witnessing the flush.

### 3.7 CLOSEOUT ACTIVITIES

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

B. Document start-up and operational checks using the checklist and submit in accordance with submittal requirements.

END OF SECTION 221300

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Supply and drain boxes.
6. Emergency fixtures.
7. Drinking fountains.
8. ADA plumbing fixture piping insulation.

B. Related Sections:

1. 019100 - Commissioning
2. 200000 - Mechanical General Requirements
3. 200548 - Mechanical Vibration and Seismic Control
4. 200553 - Mechanical Identification
5. 200700 - Mechanical Insulation
6. 204100 - Mechanical Demolition
7. 221100 - Domestic Water Piping and Specialties
8. 221300 - Sanitary Waste and Vent Piping and Specialties

1.2 REFERENCES

A. Codes and Standards:

1. See Section 200000 - Mechanical General Requirements.
2. American Society of Safety Engineers (ASSE).

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. See Section 200000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
4. GPF - Gallons Per Flush.
5. PSI - Pounds per Square Inch.
6. PSIG - Pounds per Square Inch Gauge.
7. "Handicap", "handicapped", or "ADA compliant": Refers to fixtures that comply with the requirements of ANSI A117.1.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for plumbing fixtures.
2. Plumbing fixtures in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

B. Performance Requirements:

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

1.4 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.
2. Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Shop Drawings:

1. This Section shop drawings to be submitted under Section 200000 - Mechanical General Requirements.
2. Indicate dimensions and weights of fixtures and equipment, and placement of openings and holes.

- D. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manual.

1.6 CLOSEOUT SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

1.8 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.

1.9 DELIVERY, STORAGE AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.

1.10 WARRANTY

- A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. Traps, Stops and Supplies:
  - 1. Provide traps, stops and supplies for fixtures.
  - 2. Sink/lavatory P-Traps: 17 gauge chrome-plated tubular brass or cast brass.
  - 3. Supplies: Flexible, stainless steel.
  - 4. Stops: Quarter-turn, removable key type. Commercial quality metal components only; no plastic parts.
- B. Escutcheons: Provide chrome plated wall escutcheons for pipe penetrations into walls.
- C. Flush Valve Manufacturers: Sloan, Zurn, no substitutions.
- D. Lavatory Faucet Manufacturers: Delta, Chicago Faucets, no substitutions.
- E. Carriers:
  - 1. Manufacturer: J.R. Smith, Josam, Zurn, MIFAB.
  - 2. Provide carriers for wall mounted fixtures.
- F. Fixtures specified elsewhere, or otherwise furnished:
  - 1. Provide appropriate strainer, tailpiece, trap, waste and supplies.
  - 2. Rough in and connect only.
- G. Handicapped Fixtures:
  - 1. Provide fixtures in compliance with the appropriate standard listed in Part 1.
  - 2. Provide fixtures operable with one hand without grasping, pinching or twisting of the wrist, and requiring not more than five pounds of operating force.
  - 3. Handicap accessible lavatories and sinks: Where piping is exposed, provide fixture insulation assembly. Refer to Section 200700 - Mechanical Insulation.

- H. Sensors operated fixtures: In addition to features described in the Fixture list, provide the following features:
1. General:
    - a. Provide with Infra-red sensors, solid state circuitry, 24 VDC operation.
    - b. Provide battery operated fixtures.
    - c. Adjustable sensor range, variable time-out adjustment.
    - d. Filtered solenoid valves.
  2. Flush valves:
    - a. Wall mounted sensors.
    - b. Over-ride button.
  3. Hand faucet:
    - a. ADA compliant.
    - b. Splash proof electronic circuitry.
    - c. Aerator/spray head with pressure compensating flow control.
    - d. Trim plate for 4-inch center-set sink.
    - e. Under-counter control module.
  4. Manufacturer: Sloan, Zurn, Symmons.

## 2.2 WATER CLOSETS

### A. P-1HS - Water Closet:

1. Fixture: Floor mount, floor outlet, 16.5-inch height, siphon jet, elongated bowl, low consumption (1.6 gpf), 1-1/2 inch top spud. Color: White. American Standard Madera FloWise.
2. Flush valve: Sloan Solis model 8110, chrome plated, with automatic sensor actuation, over-ride button and battery backup.
3. Seat: Open front, commercial weight, heavy duty, solid plastic, stainless steel check hinge, without cover, white.
4. ADA: ADA compliant. Handicapped mounting height.

## 2.3 URINALS

### A. P-11HS - Urinal:

1. Fixture: Siphon jet, vitreous china, low consumption (1.0 gpf). Integral flush rim, wall hangers, 3/4 inch top spud. Color: White. American Standard model Trimbrook 1.0.
2. Flush valve: Sloan Solis model 8180, chrome plated, with automatic sensor actuation, over-ride button and battery backup.
3. Carrier: Floor mounted. No residential.
4. ADA: ADA compliant. Handicapped mounting height.



## 2.4 LAVATORIES

## A. P-2HS - Wall Lavatory:

1. Fixture: Wall mounted, vitreous china, 20-1/2 inch by 18-1/4 inch, front overflow, single faucet hole. Color: White. American Standard model Lucerne 0356.421.
2. Faucet: Electronic proximity, battery powered, deck mounted. American Standard Selectronic 6055.105.
3. Mixing Valve: Thermostatic, ASSE 1070 listed and labeled. Leonard 270-LF or equal.
4. Drain: Metal grid strainer.
5. Floor mounted carrier. No residential.
6. ADA: ADA compliant. Handicapped mounting height.

## B. P-10HS - Counter Lavatory:

1. Fixture: Counter mounted, vitreous china, self-rimming, 20-3/8 inch by 17-3/8 inch oval, front overflow, faucet ledge, single faucet hole. Color: White. American Standard model Aqualyn 0475.047.
2. Faucet: Electronic proximity, battery powered, deck mounted. American Standard Selectronic 6055.105.
3. Mixing Valve: Thermostatic, ASSE 1070 listed and labeled. Leonard 270-LF or equal.
4. Drain: Metal grid strainer.
5. ADA: ADA compliant. Pipe drain for handicapped access.

## 2.5 SINKS

## A. D-1 - Dental Treatment Room Sink:

1. Fixture is furnished by others.
2. Rough-in and connect. Provide traps, stops, supplies, and accessories. Coordinate with Owner furnished equipment.

## B. D-2 - Dental Treatment Room Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 15 inch by 17-1/2 inch by 10 inch deep, self rimming, sound deadened, with strainer. 2 holes at 4 inches on center. Elkay model DLR151710.
2. Faucet: 8 inch gooseneck swing spout with vacuum breaker, 4 inch wrist blade handles, 2.2 GPM outlet, 4-inch fixed centers. Chicago Faucets 895-317GN8BVBE3MAB.
3. Foot pedal controls: Tapmaster Model 1750 Hands Free Faucet Kick Plate Controller.

## C. P-3H - Single Compartment Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 19-1/2 inch by 19 inch by 6-1/2 inch deep, self rimming, sound deadened, with strainer. 2 holes at 4 inches on center. Elkay model LRAD191965.
2. Faucet: Delta HDF Commercial model 2529LF-LGHDF, 4 inch centers.
3. ADA: ADA compliant. Pipe drain for handicapped access.

## D. P-4 - Meds Room Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 17 inch by 20 inch by 10-1/8 inch deep, 3 holes for faucet, self-rimming, sound deadened, with strainer. Elkay model DLR172010.
2. Faucet: Faucet with integrated eyewash, 5-1/2 inch gooseneck spout, 4 inch wrist blade handles, 2.2 GPM faucet flowrate, ANSI Z358.1 certified eyewash integrated into spout with pull handle activator, eyewash flip top dust caps, separate supplies for eyewash and faucet. Speakman
3. Eyewash Thermostatic Mixing Valve: ASSE-1071 certified, integral check stops with filters, cold water bypass. Speakman SE-TW-EW with STW-370 mixing valve.

## E. P-5 - Single Compartment Lab Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 22 inch by 22 inch by 10-1/8 inch deep, 2 holes for faucet, self-rimming, sound deadened, with strainer. Elkay model DLR222210.
2. Faucet: 6 inch gooseneck swing spout with vacuum breaker, 4 inch wrist blade handles, 2.2 GPM outlet, 4-inch fixed centers. Chicago Faucets 895-300845AB.
3. Foot pedal controls: Tapmaster Model 1750 Hands Free Faucet Kick Plate Controller.
4. For Lab Sinks Only: With Owner Furnished Contractor Installed (OFCI) Plaster Trap PT-1: 64 oz replaceable bottle, Gleco GT-64 (Basis of Design), or approved equal.

## F. P-6 - Wash Down Sink:

1. Fixture: Custom fabricated, 14 gauge, type 304 stainless steel sink, 36 inches tall, double bowls at 24" x 24" x 16" deep each, rounded interior corners, with an approximate 12 inch drain board between the two bowls, 8 inch high backsplash. Floor mounted. Two faucets. See Sjoquist Architects EQ drawings for elevation view and additional details. Elkay Model LK50-5656 Custom.
2. Faucet: Wall mount, pre-rinse style with ceramic quarter-turn cartridges, check stops, 24 inch stainless steel spring hose, self-closing 1.6 GPM hand held valve control with spray head, pipe support, and hook. Zurn Z841X1.
3. ADA: ADA compliant.

## G. P-7 - Break Room Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 33 inch by 22 inch by 10-1/2 inch deep bowl, self rimming, sound deadened, with strainer. Coordinate faucet hole punching locations for faucet, instant hot water dispenser, and dishwasher airgap fitting. Elkay model DLRS332210.
2. Faucet: Single hole, single handle, with pull down sprayer. ADA compliant. Delta 9159-DST.
3. Hot water dispenser: In-Sink-Erator Model H-HOT100; 200 degrees F, 115 volt, 750 watts.

## H. P-7H - Break Room Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 31 inch by 22 inch by 5-1/2 inch deep bowl, self rimming, sound deadened, with strainer. Coordinate faucet hole punching locations for faucet, instant hot water dispenser, and dishwasher airgap fitting. ADA compliant. Elkay model DLRS332210.

2. Faucet: Single hole, single handle, with pull down sprayer. ADA compliant. Delta 9159-DST.
3. Hot water dispenser: In-Sink-Erator Model H-HOT100; 200 degrees F, 115 volt, 750 watts.

I. P-8 - Service Sink:

1. Fixture: Single compartment, floor mounted, structural plastic polymer, 23 inch by 23-1/2 inch by 13 inch deep. Mustee model 17F.
2. Faucet: Chicago Faucets 786-GN2BVBE3-2ABCP.

J. P-12 - Pot Fill Faucet:

1. Faucet: Single hole, wall mount, chrome plated, double-jointed swing spout, 21 inches center-to-center. Full-flow outlet with single-screen design; 2-3/8 inch metal, vandal-proof, lever handle with sixteen-point, tapered broach and secured. Rebuildable compression cartridge, opens and closes 90 degrees, closes with water pressure, features square, tapered stem. 1/2 inch NPT female thread inlet. Meets ADA ANSI/ICC A117.1. Meets and is tested and certified to industry standards: ASME A112.18.1/CSA B125.1, NSF/ANSI 61.
2. Faucet: Chicago Faucets 332-DJ21ABCP.

K. P-13 - Single Compartment Clean Supply Handwash Sink:

1. Fixture: Wall mount single compartment, 20 gauge, type 304 stainless steel, 16.75 inches by 15.5 inches by 13 inches deep, 2 holes for faucet, self-rimming, sound deadened, with strainer. Elkay model LRQ2022.
2. Faucet: 8 inch center set wall mount faucet with 4 inch gooseneck spout, 2 inch lever handles, 1/2 inch offset inlets. Faucet has a flow rate of 1.5 GPM, and is made of chrome-plated brass material, with a quarter turn ceramic disk valve. Faucet requires 2 faucet holes. Ekay model LK940GN04L2H.
3. Foot pedal controls: Tapmaster Model 1750 Hands Free Faucet Kick Plate Controller.

## 2.6 SUPPLY BOXES

A. P-9 - Icemaker, Coffee Maker, and Refrigerator Outlet Box:

1. Fixture: 18 gage steel box and cover, bottom water supply
2. Piping: Bottom water supply, 1/4-inch compression outlet, 1/2-inch NPT or 5/8-inch OD sweat combo connection inlet.
3. Guy Gray MIB1HAAB.

## 2.7 PLASTER TRAP

A. PT-1 - Plaster Trap:

1. Fixture: Poly bottle, 64-ounce size, extra bottle with lid, 1-1/2" x 8" tailpiece, 1-1/2" slip joint washers, 1-1/2" slip joint nuts, 1-1/2" flat washer, extra O-ring.
2. Gleco Trap GT64, marketed by Liquid Assets, Inc.

## 2.8 EMERGENCY FIXTURES

## A. EWS-1 - Emergency Eyewash Station:

1. Fixture: Counter mounted, in-line strainer, 90 degree swivel activation. Guardian model G1805.
2. With ASSE 1071 rated tempering valve. Guardian model G3600LF tempering valve.
3. ADA: ADA compliant.

## 2.9 DRINKING FOUNTAINS AND BOTTLE FILLER STATIONS

## A. DF-1H - Drinking Fountain/Bottle Fill:

1. Fixture: Wall mounted, single station with bottle filling station, polished stainless steel, hooded stream projector with push-button controls, perforated strainer, back panel, 1.1-1.5 GPM fill rate. 120 V power connection.
2. Carrier: Floor mounted. No residential.
3. ADA: ADA compliant. Handicapped mounting height.
4. Elkay model LZSDWSLK or approved equal.

## B. DF-2H - Bottle Filler Station:

1. Fixture: Wall mounted bottle filling station, surface mounted, polished satin finish stainless steel, filtered, non-refrigerated, sensor operated, laminar flow, piped drain outlet, LED visual filter status indicator, LCD ticker display indicating water bottles saved, 1.5 GPM fill rate, 120 V power connection.
2. Furnish Owner with one spare filter assembly.
3. ADA: ADA compliant.
4. Elkay Model LZWSSM, or approved equal.

## 2.10 TEMPERING VALVES

## A. TV-1 - Thermostatic Tempering Valve:

1. Pressure regulating valve, integral check stops, supply and outlet pressure gauges.
2. Rough bronze finish.
3. Wall mount, no cabinet.
4. Maximum pressure drop 10 psi at 91 GPM.
5. Bradley TMV200 model S59-2200.

## 2.11 FLOOR DRAINS

## A. FS-1 - Floor Sink:

1. Fixture: Cast iron, 16-1/2 inch square top, 12-inch deep, flanged receptor with acid resistant coated interior, nickel bronze rim. Dome bottom strainer. No-hub outlet.
2. Grate: No grate.
3. Trap primer connection.
4. J.R. Smith 3200Y.

- B. Manufacturers: J.R. Smith, Zurn, Josam, MIFAB.

## 2.12 ADA PLUMBING FIXTURE PIPING INSULATION ASSEMBLY

- A. Manufacturer: Skal+Gard, Model SG-100B, TCI Products, or approved equal.
- B. Description: Protective, molded, fire-resistant foam, single piece insulation manufactured specifically for plumbing fixture supplies and drains.
- C. Performance/Design Criteria: Insulation R factor 2.
- D. Materials:
  - 1. Foam: 4.5 pounds per cubic foot.
  - 2. Skin: White fire retardant polyurethane.
  - 3. Twist fasteners.

## PART 3 - EXECUTION

### 3.1 INSTALLERS

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

### 3.2 PREPARATION

- A. Confirm location and size of fixtures and openings before piping rough-in and installation.
- B. Verify that rough-ins have been provided, are correctly sized and are located within dimensional tolerances for fixtures to be installed prior to installation of fixtures.
- C. Interface with other Work: Review Architectural drawings and millwork shop drawings to verify correct fixture locations.

### 3.3 INSTALLATION

- A. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping, and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.
- B. Provide permanent metal and wire positioners, supports, and carriers to secure fixtures and piping rigidly in proper alignment without sway or sideplay.
- C. Anchor fixtures securely to withstand applied vertical load of not less than 250 pounds on the front of the fixture, without noticeable movement.

- D. Install fixtures plumb, level and to the finished architectural surface, so that the maximum gap between the fixture and the surface does not exceed 3/16 inch. Caulk the edge of the joint between fixture and surface with silicone or butyl type waterproof caulking compound.
- E. Install and connect hot water on left and cold water on right, as viewed when facing the fixture.
- F. Locate flush valve handles on handicapped accessible water closets on the wide side of the stall. Mount Accessible fixtures shown in the ADA guidelines to the heights indicated.
- G. ADA Plumbing Fixture Insulation Assembly:
  - 1. Insulate hot water supply and waste piping exposed beneath sink and lavatory fixtures designated on drawings or specified in this section, as intended for use by the handicapped.
  - 2. Install in accordance with ANSI A117.1.
- H. Coordinate plumbing rough-in with Owner Furnished equipment and fixtures.

### 3.4 REPAIR/RESTORATION

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

### 3.5 SITE QUALITY CONTROL

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

### 3.6 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturers' recommendations, or as otherwise directed.

### 3.7 CLEANING

- A. Clean fixtures and trim to a clean condition. Obtain a written certification from the Owner that this has been accomplished and accepted.

### 3.8 CLOSEOUT ACTIVITIES

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

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

END OF SECTION 224000

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## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Furnish and install complete piped and wired Category 3 medical gas system.
- B. Section includes Medical Gas Systems consisting of Oxygen (O<sub>2</sub>), Nitrous Oxide (N<sub>2</sub>O), Dental Compressed Air (DA, CA), and Dental Vacuum (DV) systems. These systems shall be installed complete, ready for operation and certified, including necessary piping, fittings, purge ports, valves, cabinets, station outlets and inlets, rough-ins, ceiling services, gauges, alarms (including low voltage wiring) and all necessary parts, accessories, connections and equipment in accordance with NFPA 99.
- C. Related Sections:
  - 1. 019100 - Commissioning
  - 2. 200000 - Mechanical General Requirements
  - 3. 200529 - Mechanical Hangers and Supports
  - 4. 200548 - Mechanical Vibration and Seismic Control
  - 5. 200553 - Mechanical Identification
  - 6. 204100 - Mechanical Demolition
  - 7. 253000 - Building Automation System Field Devices
  - 8. 255000 - Building Automation Systems
  - 9. 259000 - Sequence of Operations

## 1.2 PRODUCTS NOT FURNISHED BUT CONNECTED BY THIS SECTION

- A. Scope: Make connection to Owner furnished equipment. Pressure test and certify Owner-furnished device. If leaks are detected coordinate repair with manufacturer and Owner. The actual repair of Owner furnished equipment is not in the scope of this section.

## 1.3 REFERENCES

- A. Provide medical gas systems in accordance with the minimum provisions of the following codes and standards:
  - 1. See Section 200000 - Mechanical General Requirements.
  - 2. ASTM B88 Seamless Copper Water Tube.
  - 3. ASTM B280 Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service.
  - 4. ASTM B819 Seamless Copper Tube for Medical Gas Systems.
  - 5. American Welding Society (AWS) B2.2 Brazing Procedure and Performance Qualifications.
  - 6. NFPA 99 - 2015, Health Care Facilities Code.
  - 7. NFPA 101 - 2012, Life Safety Code (LSC).

8. Facilities Guideline Institute, FGI - 2018 Guidelines for Design and Construction of Health Care Facilities

#### 1.4 SYSTEM DESCRIPTION

- A. Provide complete medical gas system for the facility, complete and fully operational. Comply with the Contract Documents requirements, applicable codes and standards, as well as the Authority Having Jurisdiction requirements.
- B. Final location of outlets and inlets shall be field coordinated and approved by Owner.
- C. Systems to be compatible with, and extension of, existing system, or new, as indicated.
- D. Contractor shall coordinate with phasing and temporary services as required for maintaining existing healthcare facility operational services, temporary connections, and routing. Service disruptions shall be coordinated with Owner.
- E. System Operating Pressures:
  1. Nitrous oxide: N<sub>2</sub>O deliver 50-55 PSIG at outlets.
  2. Oxygen: O<sub>2</sub> deliver 50-55 PSIG at outlets.
  3. Dental Air: DA. Field verify with existing equipment.
  4. Dental Vacuum: DV. Field verify with equipment.
- F. Gas Sources:
  1. Gas for purging and testing shall be NF nitrogen only.
  2. Gas for final purging shall be provided from the Owner's supply source and shall be paid for by the Owner.

#### 1.5 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

#### 1.6 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Submit product data for items and materials listed in Part 2.
- C. Materials Cleaned for Oxygen Service: Documentation certifying that piping components for all pressure gas systems (except dental vacuum) has been cleaned as if for oxygen service. This includes tubes, valves, fittings, and station outlets.
- D. Brazing procedures.
- E. Brazer Performance Qualification: Test records for each brazer used on the installation.

- F. System Certification Agency and Test Agenda:
  - 1. Submit Certification Agency's and verifier's qualifications for approval.
  - 2. Submit the Certification Agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequences, procedures for cross connection test, valve test, flow test, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- G. Pre-certification Report: Submit the Pre-certification report as required by the Quality Assurance Article below.
- H. Test Reports: At the completion of the project submit pressure test reports with the signature of the witness.
- I. System Certification: Submit a document that certifies that the completed systems have been installed, purged, tested, and documented in accordance with the requirements of this specification and NFPA 99.
- J. As-built drawings.
- K. Closeout Submittals
  - 1. Project Record Documents: Record actual locations of valves, strainers, air vents, flexible pipe connectors, expansion joints, other components, and locations of access doors required for access.
  - 2. Operation and Maintenance (O&M) Manuals.
    - a. Refer to Section 200000 - Mechanical General Requirements, for O&M Manual formatting requirements and number of copies required.
    - b. Provide copies of approved submittal information for inclusion within the project O&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, parts listings, and spare parts list.

#### 1.7 CLOSEOUT SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.
- B. Record Drawings:
  - 1. Submit under provision of 200000 Mechanical General Requirements
  - 2. Maintain current and up-to-date red-lines, As-Built, prints of the medical gas system at the job site.
  - 3. Approved full size As-Built drawings and electronic copy of as-built drawing files in PDF and DWG formats shall be submitted with IO&M manuals.
- C. Operation and Maintenance Data:
  - 1. Submit under provision of 200000 Mechanical General Requirements

2. Maintenance Data: Submit a copy of submittal product data, the manufacturer's installation and O&M information.
3. Final Verifier test results and certification.
4. Valve and equipment schedules.
5. Copy of zone valve box and area alarm maps.
6. As-built drawings.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

1.9 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.
- B. Perform work in accordance with NFPA 99.
- C. Pre-certification Report: Prior to any installation work the Medical Gas System Certification Agency shall review the plans and report any conditions which would prevent them from certifying the system. Any suggested modifications should be included.
- D. Brazing Qualifications: Brazing shall be performed by individuals who are qualified per AWS B2.2 or ASME Section IX as modified by NFPA 99.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.

1.11 WARRANTY

- A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements, for general mechanical warranty requirements.

1.12 PRE-BRAZING MEETING

- A. Requirements: Prior to the start of brazing conduct a job walk thru with the Owners representative and demonstrate the following:
  1. System materials are carefully stored and protected from contamination.
  2. Valves and fittings are prewashed and bagged.
  3. Procedures for cutting pipe and preparing ends.
  4. Installed piping runs have ends capped.
  5. The brazing purge connection and the plan for purging and brazing the piping system.
  6. The plan for pressure testing the piping system.
  7. The plan for testing the piping system with outlets attached.
  8. The location of purge ports at main shutoff valves.

## 1.13 COORDINATION

- A. Coordinate work under the provisions of Divisions 20, 21, 22, 23, 25.
- B. Coordinate the work with the structural system, wall framing and device installations, and above ceiling installations of other trades.

## PART 2 - PRODUCTS

## 2.1 MATERIALS AND PRODUCTS

- A. Materials and products shall be new unless otherwise noted.
- B. Materials designated or required to be "Oxygen Clean" shall be purchased as "Oxygen Clean" and delivered to the project site in the original packing.
  - 1. This material shall be stored in such a manner as to remain "Oxygen Clean".
  - 2. Contractor is not allowed to clean "Oxygen Clean" material which has been contaminated, except as allowed in this specification and with Owner pre-approval.
- C. Provide products, equipment, and components by a single manufacturer.

## 2.2 PIPE AND FITTINGS

- A. Pipe (except DV): Pipe shall be hard drawn seamless medical gas tubing, ATM B819, factory prewashed and capped for oxygen service. Use type L for medical gases and dental compressed air. All piping shall be labeled with the ASTM number. Category 3 gas powered, nonmedical air, devices shall meet the above requirements for medical air.
- B. Fittings (except DV): Fittings shall be wrought copper brazed fittings ASTM B16.50 or cut ASTM B16.22 solder fittings for brazing, cleaned and bagged for oxygen service. Soldered connections are not allowed. Cast copper alloy fittings shall not be permitted.
- C. Mechanically formed, drilled, or extruded tree-branch connections are not allowed.
- D. Pipe - Dental Vacuum (DV):
  - 1. Category 3 Dental Vacuum wet systems:
    - a. CPVC plastic piping iron pipe size (IPS) schedule 40 or schedule 80, ASTM F 441.
      - 1). Pipe and fittings shall be suitable for installation in return air plenums per the IMC, shall meet the 25/50 flame and smoke requirements in accordance with ASTM E84 or UL 723.
    - b. CPVC plastic piping copper tube size (CTS) 1/2" through 2" SDR 11, ASTM D 2846.

- 1). Pipe and fittings shall be suitable for installation in return air plenums per the IMC, and shall meet the 25/50 flame and smoke requirements in accordance with ASTM E84 or UL 723.
  - c. Manufacturer: Spears Manufacturing, EVERTUFF CPVC pipe and fittings, or approved equal.
- E. Fittings - DV:
1. Level III wet systems: Piping meeting Level I or Level II requirements and the following for corrosive resistant system segments:
    - a. CPVC plastic pipe fittings to match pipe schedule/diameter.
      - 1). Pipe and fittings shall be suitable for installation in return air plenums per the IMC, and shall meet the 25/50 flame and smoke requirements in accordance with ASTM E84 or UL 723.
    - b. Manufacturer: Spears Manufacturing, EVERTUFF CPVC pipe and fittings, or approved equal.
- F. Joints:
1. Brazed joints shall use Sil-Fos or other self-fluxing silver brazing alloy with a 1,190 degrees F minimum melting point per ANSI/AWS A5.8 and NFPA 99. All brazing shall be done utilizing a nitrogen purge.
  2. Where threaded joints are required for connection of equipment and or gauges, a Teflon tape shall be used; pipe thread dope is not allowed. The tape shall be a special oil free PTFE oxygen thread green seal tape as manufactured by the Mill Rose Company.
  3. Stainless tube shall be welded using metal inert gas (MIG) welding, or tungsten inert gas (TIG) welding. Welders shall be qualified to ASME BPVC Section IX.
  4. Plastic pipe joints shall be made with solvent cement.
- G. Pipe and Fittings for Dental Air Compressor Intake and Dental Vacuum Exhaust to Exterior Building Penetration:
1. Pipe 3" and under: Provide type L copper tubing and fittings with brazed joints.
  2. Pipe 4" and over: Provide type L copper tubing, copper fittings with mechanical joints or brazed joints.
- H. Dielectric Fittings shall be permitted only required by the manufacturer of special medical equipment to electrically isolate the equipment from the system distribution piping.

## 2.3 VALVES

- A. Manufacturers: Hill-Rom, Allied Health Care, Tri-Tech Medical, Beacon Medical Products, Nibco, Stockham, Grinnell, Milwaukee, and Apollo.
- B. Ball Valves (4" and under) (Except DV): Brass or bronze body 3 piece bolted construction, full port, 600 PSIG WOG, dual bleed ports, TFE seats and seals, chrome plated brass ball with brass

blow-out proof stem. Handles shall be equipped with mechanism to lock valve open utilizing an Owner-furnished padlock. Valves shall be cleaned for oxygen service. Valves shall have copper tubing extensions brazed to valve sweat connection ends. The downstream tubing extension bleed port shall have a FPT gauge port with plug.

- C. Ball Valve for DV: CPVC full port ball valve compatible with piping system and suitable for vacuum service.
- D. Dental air shutoff valve for dental equipment connection at treatment rooms: Provide full port ball isolation valve with threaded outlet at each level 1 stub up for connection to dental equipment. Coordinate outlet connection type, valve type, and valve orientation with dental equipment supplier.
- E. Oxygen and Nitrous Oxide shutoff valves for dental equipment connection: Shut-off valves for connection to dental equipment at each level 1 stub up in closed dental treatment rooms are furnished by dental equipment supplier and installed by plumbing contractor. Valves shall meet 2012 NFPA-99 criteria for category 1 medical gas systems and shall include demand check and DISS threaded outlet for connection to dental equipment hose connection; coordinate with dental equipment supplier and include the proposed shut-off valves in medical gas product submittals.
- F. Zone Valve Box (OFCI):
  - 1. Manufacturers: Parker/Porter.
  - 2. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.

#### 2.4 LAB AIR OUTLETS

- A. At each compressed air outlet in the dental lab, provide a three-outlet manifold with quarter-turn isolation valve on each outlet. Coordinate with lab equipment requirements for equipment connection types; provide fittings, quick connect couplers, and threaded connectors to connect equipment to compressed air outlets. Provide cap or plug for any unused outlets not connected to lab equipment.
- B. Basis of design for lab compressed air outlets: Amflo, or approved equal.

#### 2.5 MEDICAL GAS OUTLETS AND INLETS, TERMINAL DEVICES

- A. Medical gas outlets and inlets are furnished and installed by dental equipment supplier. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.

#### 2.6 MEDICAL GAS MANIFOLD (OFCI)

- A. Combination Oxygen and Nitrous Oxide medical gas manifold is furnished by dental equipment supplier and installed by Contractor. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.
- B. Manufacturer: Parker/Porter.

2.7 MEDICAL GAS ALARM PANEL (OFCI)

- A. Combination Oxygen and Nitrous Oxide medical gas alarm panel is furnished by dental equipment supplier and installed by Contractor. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.
- B. Manufacturer: Parker/Porter.

2.8 DENTAL COMPRESSED AIR SOURCE EQUIPMENT (OFCI)

- A. Project includes addition of one new dental air compressor to the two existing units to serve the dental clinic. The two existing dental air compressors will be reconfigured. Dental compressed air system equipment is Owner Furnished, Contractor Installed (OFCI).
- B. Dental compressed air system equipment to be added under this project includes: One dental air compressor unit. Remote alarm/monitoring panel to be relocated to the dental clinic reception area on level 1.
- C. Provide all required piping, fittings, and appurtenances for a complete and operating system. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.
- D. Manufacturer: Ramvac, No substitutions. Refer to schedules for equipment model numbers.

2.9 DENTAL VACUUM SOURCE EQUIPMENT (OFCI)

- A. Project includes addition of new dental vacuum system equipment to serve the new dental clinic. Dental vacuum system equipment is Owner Furnished, Contractor Installed (OFCI).
- B. Dental vacuum system equipment to be added under this project includes: Three dental vacuum pumps with vacuum pump exhaust filters, one separator tank, one infini-tank with washdown, one amalgam separator, and one dental vacuum system main controller. Main control panel is located in basement dental utilities room and remote alarm/monitoring panel to be relocated in the dental clinic reception area on level 1.
- C. Provide all required piping, fittings, and appurtenances for a complete and operating system. Refer to Sjoquist Architects Dental Equipment 'EQ' Drawings for additional information.
- D. Manufacturer: Ramvac, No substitutions. Refer to schedules for equipment model numbers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cleaning: Handle piping to prevent entry of dirt and contaminants. Factory-cleaned and sealed piping, cleaned as specified herein, shall have ends kept sealed until immediately ready for use. Provide temporary caps for pipes and stations during construction. Comply with NFPA 99 regarding special washing, cleaning, and flushing required before installation.



B. System Installation:

1. Install medical oxygen and medical nitrous oxide systems in accordance with 2015 NFPA-99 criteria for Category 2 medical gases.
2. Install dental air systems in accordance with 2015 NFPA-99 criteria for Category 3 Gas Powered Device Supply Systems (Dental Compressed Air). Joints shall be brazed utilizing a nitrogen purge.
3. Install dental vacuum systems in accordance with 2015 NFPA-99 criteria for Category 3 Dental Vacuum Systems.
4. Cutting and Fitting: Cut tubing with a tubing cutter (sawing is not permitted), ream end of tubing and deburr any chips. Blow out tube with nitrogen prior to assembly into the system.
5. Pipe Bending: Field bends in piping are not permitted.
6. Pipe Isolation: Isolate copper tubing from contact with dis-similar metal contact using tape or plastic grommets. Medical gas piping shall not be used as a part of an electrical grounding system.
7. Hanger Spacing: Tubing shall be hung on the following hanger spacing dimensions.

1/2"	6 feet
3/4"	7 feet
1"	8 feet
1-1/4"	9 feet
1-1/2" & larger	10 feet

8. Riser Supports: Tubing risers shall be supported at each floor but in no case shall the support distance exceed 15 feet. In such cases provide additional support.
9. Joint Preparation: Clean surfaces to be brazed with a clean stainless steel brush or emery cloth. Do not use steel wool as it may contain oil. After mechanical cleaning the surfaces shall be wiped using a clean, lint-free white cloth. Joints shall be brazed within one hour of being cleaned.
10. Brazing: Joints shall be brazed by qualified brazers. A nitrogen purge shall be used during brazing and until the joints are cool to the touch. After brazing wash the outside of each joint with a wet rag and a wire brush. The use of flux is prohibited.
11. Dielectric Fittings shall be permitted only required by the manufacturer of special medical equipment to electrically isolate the equipment from the system distribution piping.
12. The following joins shall not be used throughout the medial gas and vacuum distribution system:
  - a. Flared and compression type connections, including connections to station outlets, inlets, alarm devices, and other components.
  - b. Other straight threaded connections, including unions.
  - c. Pipe-crimping tools used to permanently stop the flow.
  - d. Removable and nonremovable push-fit fittings that employ a quick assembly push fit connector.
13. Plastic pipe shall not be installed in air plenums unless it meets the 25/50 flame and smoke ratings required by the IMC or the pipe is protected by an approved 1-hour fire barrier.
14. Pipe sizes shall meet the minimum requirements:

- a. Mains and branches in medical gas piping systems - 1/2".
  - b. Drops to individual station inlets and outlets - 1/2".
15. Two or more medical gas or vacuum piping systems shall not be interconnected for installation, testing, or any other reason.
  16. After installation of the piping and before installation of outlets, pipes shall be blown clean with nitrogen.
  17. Piping Identification: Apply pipe labeling during installation process and not after installation is completed.
  18. Purge Ports: At mainline shutoff valves which serve more than 1 room, and which are not located in a zone valve box, install a 1/2" tee with ball valve just downstream of the shutoff valve to facilitate purging during initial installation of future system changes. Finish open end of purge valve with a female adapter and a brass plug.
  19. Shutoff and service valves installed in ceiling space shall be provided with handle locks to secure valve in open position. Handle lock shall be provide with means to be padlocked.
  20. Shutoff and service valves shall be accessible when installed in ceiling spaces. Accessible is defined as immediately adjacent to an access panel or above suspended acoustic tile system on which the tiles are not secured or restricted in removal.
  21. Terminal Support: Provide backing as required to firmly attach outlets to wall and/or ceiling framing. Ceiling backing shall be sturdy enough to support a 10 pound load on the outlet without noticeable deflection of the ceiling or the outlet.
  22. Piping protection: Exposed piping in areas subject to physical damage by carts, stretchers, portable equipment, or vehicles shall be protected with stainless steel barriers. Piping shall be protected against freezing, corrosion, and physical damage.
  23. Shutdowns: Prior to submitting a shutdown request determine the areas affected by the valves(s) being shut down. Submit the shutdown request for approval.
  24. Install equipment in accordance with manufacturer's recommendations.
  25. Connections to existing systems: Final tie-in connections to existing systems shall be leak tested with source gas at normal operating pressures. Maintain pressure while each new joint is examined for leakage with soapy water. Do not connect to existing system until the installer's tests are complete and verification are complete up to and including piping purity test.
  26. Coordinate pipe floor and wall penetrations and provide materials to maintain assembly fire ratings.

### 3.2 LABELING AND IDENTIFICATION

- A. Piping labels shall be provided during installation, before testing.
  1. Piping, both exposed and concealed, shall be labeled with the gas/vacuum system name or chemical system and color code per NFPA 99. Medical gas piping shall not be painted. Labels shall be located as follows:
    - a. Operating pressure shall be include with gas name where positive pressure gas operate at pressures other than NFPA 99 standards.
    - b. At intervals of not more than 20 feet.
    - c. At least once in or above every room.
    - d. On both sides of walls, partitions, or floors penetrated by the piping.
    - e. At least once in every story height on risers.

- B. Valve and equipment tags shall be provided during installation, before testing.
  - 1. Shutoff valves shall be identified with the following:
    - a. Name or symbol of the specific system.
    - b. Name of the room(s) or area(s) served.
    - c. Caution to not close (or open) the valve except in an emergency.
- C. Outlets and inlets shall be identified with the name or symbol of the specific system.
  - 1. Operating pressure shall be included with gas name where positive pressure gas operate at pressures other than NFPA 99 standards.
- D. Zone Valve Box Map: Provide a medical gas zone valve box control floor plan area drawing located at each zone valve box. Obtain an ACAD background of the area served by the zone valves. Draw as-built locations of rooms served and the zone valve box location. Symbols shall be colored to match existing placards. Install zone valve box control floor plan area drawing in 8-1/2" x 11" clear sign holder next to the zone valve.
  - 1. Provide nameplate next to area drawing (or below if insufficient space) which says, "Warning: Medical Gas Valves In case of fire or other emergency, these valves may be closed to shut off medical gases to rooms: (see map above).
- E. Area Alarm Panel Map: Provide a drawing (similar to zone valve box) showing the zone valves and the rooms covered by that alarm. Install the drawing in an 8-1/2" x 11" sign holder next to the area alarm panel. If the zone valve box and area alarm panel are installed in the same location only one map is required showing zone valve box and area alarm panel.
- F. Valves: Provide a typed list of the areas served and the valve number. Chain the tag to the valve with a metallic chain.

### 3.3 CONTRACTOR'S INSTALLER TESTS

- A. Do not interconnect medical gas pipelines. Perform pressure testing with individual charging and measurement for each system.
- B. Provide testing in accordance with NFPA 99 requirements.
- C. After installation of shutoff valves and outlets, but before installation of system components (switches, gauges, alarms, manifolds, etc.) each section of the piping system shall be subjected to a test pressure of 1.5 times the working pressure, but not less than 150 PSIG, by means of oil free, dry nitrogen. This test pressure shall be maintained until each joint has been examined for leakage by means of soapy water. Leaks shall be repaired and the section retested.
- D. After completion of the above test procedure, the finishing assemblies of station outlets, alarms, and other components (e.g. pressure switches, gauges, relief valves, etc.), except those for Vacuum, shall be installed and medical gas piping systems shall be subjected to a 24 hour standing pressure test at 20 percent above the normal operating line pressure. Use oil free, dry nitrogen for test gas. The source shutoff valve shall be closed during this test. Pressure gas systems are to remain leak free. Vacuum is to be subjected to a test pressure of 60 PSIG. Vacuum test

pressure at the end of 24 hours is to be within 5 PSIG of initial test pressure. Any leaks shall be located, repaired, and systems retested.

- E. Blowdown each pressure gas system in order to remove particulate matter in pipelines. A high flow, intermittent purge shall be put on each outlet using appropriate adapters. Continue until purge produces no discoloration in a white cloth.
- F. Determine that no cross connections to other pipeline systems exist, reduce systems to atmospheric pressure. Disconnect sources of test gas from of the system with the exception of the one system to be checked. Pressure this system with oil-free dry nitrogen to a pressure of 50 PSIG. With appropriate adapters matching outlet labels, check each individual station outlet of all systems installed to determine that test gas is being dispensed from only the outlets of this system.
- G. Disconnect the source of test gas and reduce the system tested to atmospheric pressure. Proceed to test each additional pipeline system in accordance with the procedure outlined above. Vacuum systems can be tested with vacuum instead of pressure.
- H. Pressure tests should be witnessed by an Owner's representative. The installing contractor shall supply written documentation that the pressure tests have been completed and the systems meet these specifications.
- I. After 24 hour standing leakage testing is completed, allow piping to remain pressurized with test gas until certification agency performs final tests.
- J. Vacuum Vent Pipe Test: Cap pipes at the vacuum pumps and fill with water to the roof terminus. There shall be no perceptible drop in water level over a 2 hour period.
- K. Dental Air Compressor suction piping test: Test with nitrogen at 25 PSIG for 24 hours with no perceptible drop in pressure.

### 3.4 SYSTEM VERIFICATION, CERTIFICATION, AGENCY TESTS

- A. System verification shall be performed by the approved medical gas certification agency. Verify that systems as installed, meet or exceed the requirements of NFPA 99 and this specification and operate as required. Contractor's installer tests shall have been successfully completed as required by NFPA before verification activities start.
- B. Certification shall be performed by an independent testing agent. Certification shall be performed after closing of walls and after completion of required testing. Coordinate timing of system verification activities with Owner; notify Owner a minimum of 2 weeks prior to readiness.
- C. Hoses are to be installed in rail systems and hose drops for certifier's outlet tests.
- D. Medical gas concentration analysis is to be performed with instruments designed to measure the specific gas dispensed.
- E. Perform and document tests and verification requirements per NFPA 99 including:
  - 1. Cross connection.

2. Valve test.
  3. Outlet flow and pressure drop.
  4. Master alarms.
  5. Area alarms.
  6. Piping purge with a 0.45-micron filter.
  7. Piping purity.
  8. Final tie-in and blowdown of existing piping.
  9. Operational pressure test with source gas.
  10. Medical gas concentration.
  11. Labeling of outlets, valves, and alarms.
  12. Source equipment operation.
- F. Discrepancies discovered during the inspection shall be noted and corrected. All portions of the system affected by corrective action shall be retested and findings recorded after retest.
- G. Installer and verifier test reports shall be submitted for review prior to use of medical gas systems. Systems shall not be considered in service until satisfactory test results are obtained.
- H. Verified final results shall be incorporated in the operations and maintenance manuals as separate indexed item.

END OF SECTION 226300

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Ductwork and ventilation system equipment cleaning, servicing, and adjustment.
- B. Related Sections:
  - 1. 200000 - Mechanical General Requirements
  - 2. 200700 - Mechanical Insulation
  - 3. 233100 - Ducts and Accessories
  - 4. 233400 - HVAC Fans
  - 5. 233600 - Air Terminal Units
  - 6. 233700 - Air Outlets and Inlets
  - 7. 237413 - Packaged Rooftop Units

1.2 REFERENCES

- A. Codes and Standards:
  - 1. See Section 200000 - Mechanical General Requirements.
  - 2. ACR the National Air Duct Cleaners Association (NADCA) Standard for Assessment, Cleaning and Restoration of HVAC Systems, 2013.
  - 3. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements and methods for cleaning existing ventilation ductwork and equipment.
- B. Performance Requirements:
  - 1. Install new and replace existing duct access doors as required.
  - 2. Clean supply air diffusers and return air grilles to remain.
  - 3. Clean existing terminal air units to include fans and reheat coils.
  - 4. Clean supply, return and exhaust ductwork from fan connection points to each air discharge point.
  - 5. Clean central air handling unit internal surfaces and components.
  - 6. Clean outside air louvers, plenums, and dampers.

1.4 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

## 1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Submit material safety data sheets (MSDS) for chemical products proposed to be used in cleaning process
- C. Shop Drawings:
  - 1. Select and document new duct access point/door locations and sizes on a clean set of Contract Drawings during cleaning preparation, using the access door symbol provided in the Legend.
  - 2. Submit for approval by the Contracting Agency prior to installing duct access points/doors.
- D. Test and Evaluation Reports:
  - 1. Preliminary Report:
    - a. Prior to any cleaning or duct repair work, provide a formal written preliminary report which:
      - 1). Defines the physical limits/boundaries of the existing central air distribution system ductwork and equipment to be cleaned.
      - 2). Provides a general assessment of the condition of the existing ductwork and equipment to be cleaned.
      - 3). Includes “before” digital photographs for each section of ductwork and equipment to be cleaned which clearly documents the existing condition of the ductwork. Include a key map (floor plan(s)) which clearly shows the location and direction of each photograph taken.
      - 4). Includes official laboratory analysis report of representative duct contamination samples. Indicate where samples were taken on key map (floor plans).
      - 5). Provides recommendations regarding the most appropriate cleaning method(s) for each portion of the duct system and equipment to be cleaned. Use cleaning methods selected from the National Air Duct Cleaners Association (NADCA) Industry Standard for Mechanical Cleaning of Non-Porous Air Conveyance System Components.
      - 6). Includes a copy of the specific recommended cleaning procedures to be implemented.
  - 2. Final Condition Report:
    - a. Within 15 days of completed duct and equipment cleaning, provide a formal written final condition report which:
      - 1). Demonstrates that there is no visible dirt, contamination, or bacterial growth, at any point within the systems which were cleaned.
      - 2). Includes “after” digital photographs next to each “before” digital photograph for each section of ductwork and each piece of equipment which clearly



documents the cleaning process. Take the “after” photograph from the same orientation as the previously submitted “before” photograph.

- E. Quality Control Submittals: Submit references for a minimum of five recently successfully duct cleaning projects.

#### 1.6 CLOSEOUT SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

#### 1.7 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.
- B. Qualifications: Duct cleaning work shall be performed by a firm with three years of continuous, documented experience with similar work.
- C. Certifications: The HVAC system cleaning contractor shall have a minimum of one Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

### PART 2 - PRODUCTS

#### 2.1 CLEANING EQUIPMENT AND CLEANING PERSONNEL

- A. Provide equipment and materials for cleaning, inspection and repair work including scaffolding, wire brushes, rotary brushes, filters, air lances, mechanical agitators, fiber-optic bore scopes, vacuums, and other equipment and materials necessary for workmen to perform the specified work.
- B. Cleaning personnel shall be properly supervised by a qualified, experienced foreman. Foreman shall be prepared to discuss work in progress, at any time with the Contracting Agency.
- C. Provide HEPA systems which are self-contained units with appropriate components and appurtenances, to adequately prevent dirt and debris loosed from duct mains and branches during cleaning operations from entering sensitive locations. Utilize industrial grade HEPA filter elements labeled and certified for 99.9 percent efficiency (0.3 micron particles at rated air flow). Wherever practicable, do not discharge air from HEPA systems to clean spaces. Size volumetric capacity of HEPA filter system to match CFM rating of diffuser, mixing box, ductwork section or device to which unit is being connected.

#### 2.2 ACCESS DOORS

- A. Refer to Section 233100 - Ducts and Accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Study the Contract Documents and facility record drawings provided by the Contracting Agency to become familiar with the general layout of the existing systems to be cleaned.
2. Conduct site visit(s) to verify the scope of work, accessibility to ductwork and equipment and existing conditions.

3.2 PREPARATION

A. Protection of In-Place Conditions:

1. Prior to cleaning, provide temporary 30 percent filters fitted and sealed at supply grilles and diffusers.
2. Protect openings to avoid particulate contamination and debris from falling into conditioned air spaces.

3.3 INSTALLATION

- A. Install access points/doors as needed at locations throughout supply, return and exhaust air ductwork to clean systems.
- B. Where existing access doors are missing or poorly fitted, report condition to the Contracting Agency.

3.4 DUCT CLEANING

- A. Control access for cleaning personnel and equipment through installed access points, existing ceiling tiles, access doors, diffusers or grilles. Replace items removed for access to their original state upon completion of work.
- B. Upon satisfactory laboratory analyses of duct contamination samples and with temporary filters installed, remove loose contaminants from the interior ductwork surfaces. Perform visual inspections throughout the entire process to ensure that no area(s) are left untreated.
- C. By inserting special air lances, mechanical agitators and rotary brushes through the installed access points, gently loosen and remove contaminants from the interior surfaces of the ductwork. Utilize temporary filters and blanking pieces to protect areas that are not currently being treated.
- D. Utilize specialized fan-powered, HEPA filtered dust and particulate collection systems in areas designated as being sensitive and as directed by the Contracting Agency. Take precautions to prevent dirt and debris greater or equal to 0.5 microns from entering these sensitive areas.

- E. Hand wash duct mounted coils (using air or water) on both coil faces carefully to avoid damage to tubes and fins. Hand brush and vacuum clean coil frames to remove corrosion from around coil frames. Paint exposed metal frame surfaces to match existing coatings. Comb coil fins to restore them to original alignment.
- F. Mark duct mounted dampers at their current setting. Then inspect and clean dampers by manually hand scraping, sanding or wire brushing. Lubricate external moving parts with an approved dry lubricant material (Aerolox Dry Moly or equal). After cleaning, repair damaged dampers to provide proper operation and return and lock dampers at original setting positions.
- G. Whenever supply/diffusers and return/exhaust grilles are removable, mark existing damper settings (as applicable) and remove them prior to cleaning. Vacuum clean, wash, dry and reinstall diffusers and grilles. Clean welded grilles in place. Return dampers to original setting positions after reinstallation.

### 3.5 ROOF TOP AIR HANDLING UNITS

- A. Shutdown/restart central roof top air handling systems based upon a pre-arranged schedule approved in advance by the Contracting Agency. Once cleaning is complete, restore central air handling equipment to their normal operating mode.
- B. Clean and repair central air handling units located in mechanical rooms or equipment areas as follows:
  - 1. Remove existing filter bank elements.
  - 2. Hand wire brush interior sides, ceiling and floor areas to loosen surface contaminants and vacuum clean.
  - 3. Hand scrape/wire brush, vacuum clean, prime and paint filter holding frames with a chromate based primer and a gray epoxy paint top coat. Replace holding frame rubber seals.
  - 4. Utilizing a high pressure water cleaning system with a suitable cleaning agent to thoroughly clean heating/cooling coil faces.
  - 5. Hand scrape/wire brush, vacuum clean, prime and paint coil frames and drain pans with a chromate based primer and a gray epoxy paint top coat. Replace holding frame rubber seals.
  - 6. Vacuum clean and hand wash control dampers. Replace damaged rubber seals.
  - 7. Vacuum clean and hand wash fan casing and motors to remove grease debris.
  - 8. Hand scrape/wire brush, vacuum clean, fan impellers and casings.
  - 9. Repair/replace existing damaged duct insulation. If existing insulation is exposed without neoprene, foil or approved facing, coat surface with sealer. See Section 20 0700 - Mechanical Insulation, for sealer requirements.
  - 10. After interior surfaces and equipment are cleaned and refurbished, sanitize the air handling unit interiors with an approved broad spectrum biocide.
  - 11. Grease and repack fan bearings. Provide new belts. Align drive belts and adjust tension.
  - 12. Provide new filter bank elements.
  - 13. Hand wash and rinse exterior air handler surfaces.
- C. Prior to reactivating of air handler system:
  - 1. Verify that painted surfaces are properly dried and cured.

2. Verify that air handler surfaces are thoroughly cleaned and dried.
3. Filter elements are installed.
4. Fan belt guards are installed.
5. Notify the Contracting Agency prior to restart of air handler and coordinate system restart with facility operation.

### 3.6 REPAIR/RESTORATION

- A. Upon completion of the ductwork and equipment cleaning, carefully remove filters from the ceiling diffusers to avoid spilling loose contamination onto room surfaces. Dispose of filters in sealed containers.
- B. Shut and latch access doors. Adjust as necessary for a tight air seal.

### 3.7 CLEANING

- A. Upon completion of work, and at the end of each shift, clean work area of trash, rubble, rags, containers, materials and equipment resulting from the work and remove from site. Broom clean Contracting Agency designated work/storage areas.
- B. When cleaning procedures are completed, return electrical switches, detection devices and system components to an operable state by qualified personnel.
- C. Plug access ports with plugs specifically designed for the intended purpose.

### 3.8 SITE TESTS AND INSPECTIONS

- A. Provide Contracting Agency with 48 hours advanced notice prior to site inspection.
- B. Visually inspect cleaned duct interior surfaces, ductwork accessories and air handlers as identified in the project's scope of work.
- C. Inspect ductwork interior surfaces and non-accessible ductwork components within the air stream via the installed access points/doors, utilizing the fiber optic bore scope with dedicated light source.
- D. Photo document post cleaning conditions and submit with Final Condition Report. See Submittals - Test and Evaluation Reports for specific report requirements.

END OF SECTION 230131

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements and methods of execution relating to the testing and balancing of the mechanical systems provided on this project.
- B. Related Sections:
  - 1. 019100 - Commissioning
  - 2. 200000 - Mechanical General Requirements
  - 3. 221100 - Domestic Water Piping and Specialties
  - 4. 232113 - Hydronic Piping and Specialties
  - 5. 232123 - Hydronic Pumps
  - 6. 233100 - Ducts and Accessories
  - 7. 233400 - HVAC Fans
  - 8. 233600 - Air Terminal Units
  - 9. 233700 - Air Outlets and Inlets
  - 10. 238200 - Terminal Heating Units
  - 11. 259000 - Sequence of Operations

1.2 REFERENCES

- A. Codes and Standards:
  - 1. See Section 200000 - Mechanical General Requirements.
  - 2. National Environmental Balancing Bureau - Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
  - 3. National Environmental Balancing Bureau - Testing, Adjusting, Balancing Manual for Technicians.
  - 4. SMACNA - HVAC SYSTEMS Testing, Adjusting, and Balancing.
- B. Abbreviations and Acronyms:
  - 1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
  - 2. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
  - 3. TAB: Testing, Adjusting, and Balancing.
  - 4. NEBB: National Environmental Balancing Bureau
- C. Definitions:
  - 1. Refer to Section 200000 - Mechanical General Requirements for general mechanical related definitions.
  - 2. Accuracy: Capability of an instrument to indicate the true value of a measured quantity.

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

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements, products and methods of execution for the testing, adjusting and balancing of the project.

- B. Performance Requirements: Furnish the services of a qualified and approved TAB Firm to perform the work of this specification section.
- C. The work of this section includes but is not necessarily limited to:
  - 1. Test and balance fans and supply, exhaust, and relief ventilating systems.
  - 2. Test and balance hydronic heating systems.
  - 3. Test and balance domestic hot water recirculation flow rate.
  - 4. Test and balance room air pressure relationships.
  - 5. Work directly with the control subcontractor to obtain proper system adjustments. This includes, but is not limited to:
    - a. VAV box controller airflow coefficient adjustments.
    - b. Airflow measuring device calibration adjustments.
    - c. Fluid flow measuring device calibration adjustments.
  - 6. Measure sound power levels if so directed.
  - 7. Provide a final report.
- D. The work of this section does not include:
  - 1. Adjusting burners for proper combustion operation.
  - 2. Liquid waste transfer system adjustment.
  - 3. Refrigeration work.
  - 4. Control system adjustments, unless noted otherwise herein.

#### 1.4 PRE-BALANCING MEETING

- A. Coordinate TAB work with other trades and requirements of other related sections of the Project Manual prior to commencing work.
- B. Schedule a pre-balancing meeting one week prior to commencing work of this Section. Refer to Section 200000 - Mechanical General Requirements.

#### 1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Sample report forms and outlines indicating adjusting, balancing, and equipment data required prior to commencing work.
- C. Certificates:
  - 1. Submit the name and qualifications of TAB Firm for approval with general product submittals. Submit copy of TAB Firm's NEBB certification.
  - 2. Submit the names and certifications of the Firm's NEBB Qualified TAB Supervisor and NEBB Certified Technician.

## D. Balancing Report:

1. Submit a complete report of the testing and balancing of all devices in a format equivalent to that shown in the SMACNA HVAC Systems Testing, Adjusting and Balancing manual. Compile the test data and submit eight copies of the complete test data for acceptance and/or analysis and recommendations.
2. Provide report in soft cover, letter size, comb bound binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include drawings within report.
3. Report Cover Sheet. Include the following data:
  - a. Project Name.
  - b. Project Address.
  - c. Names of Architect and Engineer.
  - d. Names of General Contractor and HVAC Contractor.
  - e. Report date.
  - f. Names of TAB technicians responsible for the measurements and report.
4. System Review Sheet:
  - a. List air and hydronic systems balanced, with systems highlighted that were found to be performing outside design tolerances.
  - b. Include a summary of problems encountered, deviations from design, deficiencies in performance, remaining problems, recommendations, and comments.
5. Instrument Calibration Report:
  - a. Include a complete list of test equipment used, including apparatus manufacturer's name, model number, serial number, and date last calibrated.
  - b. List the instruments used on the project during the balancing work, on a NEBB "Instrument Calibration Report" form, or equivalent form. This includes flow measuring hoods and other related devices.
6. Air Systems Report: Prepare a report for each air system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
  - a. System Diagram: Include locations of air terminal units and pitot tube traverses. Include appropriate notes, static pressure reading locations, etc., taken during testing and balancing.
  - b. Air Apparatus or Fan Test Report: Include pertinent data on the test report forms. If test data could not be measured, or is not applicable, indicate such on report forms. List how each actual cfm measurement was obtained (duct traverse, total of outlet airflows, or a combination).
  - c. Duct Pitot Tube Traverse Reports: Include actual temperature and pressure readings recorded at the time of testing and balancing.
  - d. Air Outlet Test Reports: Include applicable  $A_k$  factors and terminal device sizes. If flow measuring hoods are used, indicate their use in the remarks column.



- e. Include complete identification of elements. Identify by box number, room name and number, air outlet symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.
7. Hydronic Heating System Reports. Prepare a report for each hydronic system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
    - a. Schematic Diagram: Include heat exchange equipment and locations of flow measuring devices.
    - b. Pump Test Report: Confirm test data was recorded and properly entered on form. Attach manufacturer's pump capacity curves, with the actual pump operating point plotted, to the test report form. List how the actual pump flow rate was determined (flow meter, pump curve, etc.).
    - c. Primary Heat Exchange Equipment: Confirm that appropriate test data has been recorded for the boilers, heat exchangers, chillers, and other primary heat exchange equipment. List how the actual flow rate(s) of each item was determined.
    - d. Terminal Heat Exchange Equipment: Confirm that heating coil and terminal unit temperatures and pressures were recorded and properly entered on form. List how each terminal unit flow rate was determined.
    - e. Include complete identification of elements. Identify by equipment tag number, room name and number, baseboard symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.
  8. Reduced Size Drawings: Provide with air outlets and equipment identified to correspond with data sheets. Record actual locations of thermostats, flow measuring stations, and balancing valves with settings.
  9. Reduced Sized Pressure Maps and/or Environmental Drawings: Provide marked up record drawings, recording actual room by room airflows, pressure relationships, and /or equipment offsets as indicated on contract drawings.

## 1.6 QUALITY ASSURANCE

### A. Qualifications:

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

### B. Balancing Standards:

1. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

2. Maintain one copy of balancing procedural document on site.
3. Use standard NEBB forms.

C. Timing of Work:

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

D. Construction team responsibility to TAB Agency: Refer to 200000 - Mechanical General Conditions.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL SUMMARY OF BALANCING WORK

A. Provide TAB for the systems and equipment revised under this project including, but not limited to:

1. RTU-1.
2. Existing glycol heating loop serving RTU heating coils, including replacement piping.
3. Hydronic balancing for revised and new terminal heating units and air terminal units.
4. Hydronic heating system circulation pump balancing and revised performance verification.
5. New exhaust fan system for level 1 dental clinic and general building.
6. New exhaust fan system for and medical gas storage room.
7. Existing, new, and revised exhaust air inlets, connected to existing exhaust fan systems, in the areas of work.
8. Existing, new, and revised supply air terminal units and air outlets in the areas of work.
9. Domestic hot water circulation system. Entire system to be rebalanced to accommodate project revisions.
10. Provide room pressure measurements for the following spaces:
  - a. Closed dental treatment rooms (rooms designed to be negative pressure).
  - b. Sterile supply/Hygiene Supply (room designed to be positive pressure).
  - c. Lab (room designed to be negative pressure).

B. Commissioning Support:

1. TAB Agency shall provide support for commissioning services including office and field support; refer to Section 019100 Commissioning.
2. TAB Agency shall provide commissioning support for field support for verification/spot checking of TAB report values and commissioning field adjustments.
3. Upon completion of commissioning activities, TAB Agency shall provide an updated and final TAB report incorporating any field adjustments during commissioning.

3.2 EXAMINATION

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

3.3 PREPARATION

- A. Schedule work under the provisions of Section 200000 - Mechanical General Conditions.
- B. Provide calibrated instruments required for testing, adjusting, and balancing operations.
- C. Prior to starting work, review drawings and actual field conditions for additional balancing devices or components required for correct balance. Coordinate provision of additional balancing devices as required elsewhere in these specifications. Refer to Related Sections above.
- D. Preliminarily adjust grille, register, and diffuser blades or pattern controllers per drawings. If airflow blow patterns are not shown on drawings, adjust for uniform diffusion pattern(s) or diffusion into long dimension of room.

3.4 SPECIAL TECHNIQUES:

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

3.5 ACCEPTABLE CRITERIA

- A. Systems will be considered balanced in accordance with NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* when the following conditions are satisfied:
  - 1. Air Handling Systems:
    - a. Measured airflow quantities are within plus or minus 10 percent of design quantities. Deficiencies shall be noted in the TAB report.
    - b. There is at least one direct path with fully open dampers from the fan or terminal unit device to an air inlet or outlet. Additionally, if a system contains branch dampers, there will be at least one wide open path downstream of every adjusted branch damper.

2. Air Outlets and Inlets:
    - a. Measured airflow quantities total to within plus or minus 10 percent of design to space and individual outlets and inlets in space to within plus or minus 10 percent of design.
    - b. Grilles, registers, and diffusers blades or pattern controllers are adjusted for uniform diffusion in the space. Re-adjust airflow patterns that result in airflow velocities greater than 50 FPM (feet per minute) at 5 feet above finish floor (AFF).
  3. Hydronic Systems:
    - a. Manually balanced systems:
      - 1). Measured fluid flow quantities are within plus or minus 10 percent of design.
      - 2). There is at least on direct path with fully open balancing valves from the pump discharge balancing valve (if present) to a terminal device. Additionally, if a system contains branch balancing valves, there will be at least one wide open path downstream of every adjusted branch balancing valve.
    - b. Automatically balanced systems: Pressure drops across a sample of system's automatic balance valves are within the manufacturer's recommended operating range for the device.
- B. If systems or components cannot be adjusted to within specified tolerances:
1. Coordinate the replacement of sheaves, belts, or other components or devices needed for correct balance as required elsewhere in these specifications.
  2. Note deficiencies in the TAB report.

### 3.6 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on equipment sheaves, belts, dampers, valves, air outlets and inlets and each system according to the procedures contained in the current edition of the NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* and this section.
- B. Adjustments shall be made with air handler filters blanked off to create a filter pressure drop of 60 percent of the manufacturer's recommended filter final pressure. Where multiple filters are encountered each set shall be individually blanked off, for a cumulated pressure drop of 60 percent of each filters final pressure.
- C. Ensure recorded data represents actual measured or observed conditions.
- D. Permanently mark final settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Contracting Agency.
- H. Schedule and provide assistance in final adjustment and test of fire alarm system with Authority Having Jurisdiction.

3.7 SITE QUALITY CONTROL

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

END OF SECTION 230593

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## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes: Specific requirements, products, and methods of execution relating to the provision of fuel gas systems for the project.
- B. Related Sections:
  - 1. 200000 - Mechanical General Requirements
  - 2. 200529 - Mechanical Hangers and Supports
  - 3. 200553 - Mechanical Identification
  - 4. 225216 - Condensing Boilers and accessories

## 1.2 REFERENCES

- A. Codes and Standards:
  - 1. See Section 200000 - Mechanical General Requirements.
  - 2. NFPA 54 - National Fuel Gas Code.
- B. Abbreviations, Acronyms and Definitions:
  - 1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
  - 2. Refer to Section 200000 - Mechanical General Requirements for general mechanical related definitions.
  - 3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

## 1.3 SYSTEM DESCRIPTION

- A. Design Requirements:
  - 1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the distribution of natural gas within the building.
  - 2. Provide products including above and below ground piping, connections to gas burning apparatus, and work at the gas source to provide complete fuel gas systems where required. Provide gas equipment pressure regulator vents to outside the building at fuel gas trains.
- B. Performance Requirements:
  - 1. Gas service and meter are existing to remain.
  - 2. Verify natural gas service volume and pressure to the building as shown on drawings.

## 1.4 PRE-INSTALLATION MEETINGS

- A. See Section 200000 - Mechanical General Requirements.

## 1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Provide manufacturers' product literature for items specified in Part 2 and those products required by the performance standards of this section, clearly annotated to indicate specified salient features and performance criteria.
- C. Shop Drawings: Submit dimensioned shop drawings of gas piping size and routing as part of the plumbing shop drawings, with callouts indicating deviations from layout shown.
- D. Test and Evaluation Reports:
  - 1. Obtain a certificate of final inspection from the Contracting Agency.
  - 2. Submit a letter of certification with copy of certificate of final inspection, indicating that the gas piping has been completed, tested, and inspected.
- E. Quality Control Submittals: Provide a certified test report showing the system has been tested in accordance with Code requirements and is in compliance.

## 1.6 CLOSEOUT SUBMITTALS:

- A. See Section 200000 - Mechanical General Requirements.
- B. Record Documentation: Record actual locations of equipment, piping, and components, and areas required for maintenance access.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

## 1.8 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.
- B. Regulatory Requirements: NFPA 54.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.



## 1.10 WARRANTY

- A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements, for general mechanical warranty requirements.

## PART 2 - PRODUCTS

## 2.1 PIPING

- A. Above ground, pressure less than 14 inches water column:
  - 1. Schedule 40 black steel pipe.
  - 2. Welded or threaded black malleable iron fittings.
  - 3. Corrugated Stainless Steel Tubing (CSST):
    - a. CSST complying with ASTM A 240, 125 PSIG maximum operating pressure and 200 degrees F maximum operating temperature.
    - b. Fittings and appurtenances by same manufacturer as CSST product.
    - c. Manufacturer: OmegaFlex TracPipe PS-II, or approved equal.
- B. Above ground, pressure greater than or equal to 14 inches water column:
  - 1. Welded schedule 40 black steel pipe.
  - 2. Welded schedule 40 steel fittings.

## 2.2 BALL VALVES

- A. Brass or bronze construction, threaded ends, 600 PSIG rating, listed for natural gas service.

## 2.3 ZONE VALVE BOX

- A. Provide 18 gauge steel box with white epoxy finish and brackets to mount box to studs. Size of box shall be specifically designed to house the natural gas isolation valve. The valve box shall have an opaque cover with pull ring for easy removal. The cover shall have view ports to observe the valve and label. Valves shall be oriented so cover cannot be installed with any valve closed. The valves inside and the cover shall be labeled per NFPA 99.
- B. Manufacturers: Tri-Tech Medical Z Series, Parker/Porter, or equal.

## PART 3 - EXECUTION

## 3.1 INSTALLERS

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

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

- A. Special Techniques:
  - 1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
  - 2. Arrange products to be readily accessible for inspection, testing, and shutting off gas supply.
  - 3. Install pipe and fittings clean and free from cuttings, burrs, and defects in structure of threading, and thoroughly brushed and scale blown.
  - 4. Do not install any piping in concrete, in masonry, or below grade inside the building.
  - 5. Provide connection to gas consuming appliances. Connect gas appliances and fixtures with flexible connectors in accordance with the requirements of the appliance listing and manufacturer's instructions.
  - 6. Provide independent gas pressure relief pipes to outside the building from each fuel gas train. Size and install reliefs in accordance with the written UL listing installation instructions. Gang piping to penetrate exterior building skin at a common location. Terminate relief vents not less than 10 feet from openings to the building and not less than 25 feet from building outside air intakes.
- B. Interface with Other Work: Coordinate and sequence installation of gas piping and equipment with trades responsible for portions of this and other related sections of the Project Manual.

### 3.4 REPAIR/RESTORATION

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

### 3.5 RE-INSTALLATION

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

### 3.6 SITE QUALITY CONTROL

- A. Site Test and Inspections:

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

3.7 CLEANING

- A. Clean gas piping, fittings, valves, etc., of grease, rust, dust and dirt.

END OF SECTION 231123

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## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Pipe and fittings for:
  - a. Hydronic heating piping.
  - b. Equipment drains and overflows.
2. Piping accessories.
3. Flexible pipe connectors.
4. Pipe loops, offsets, alignment guides.
5. Hydronic Specialties:
  - a. Expansion tanks.
  - b. Air vents.
  - c. Air separators.
  - d. Strainers.
  - e. Flow indicators, controls, meters.
  - f. Flushing agents.
  - g. Water treatment chemicals.
  - h. Glycol specialties.

## B. Related Sections:

1. 019100 - Commissioning
2. 200000 - Mechanical General Requirements
3. 200529 - Mechanical Hangers and Supports
4. 200548 - Mechanical Vibration and Seismic Control
5. 200553 - Mechanical Identification
6. 200700 - Mechanical Insulation
7. 204100 - Mechanical Demolition
8. 230593 - Testing, Adjusting and Balancing
9. 232123 - Hydronic Pumps
10. 233600 - Air Terminal Units
11. 235216 - Condensing Boilers and Accessories
12. 237413 - Packaged Rooftop Units
13. 238132 - Storage Vault HVAC Equipment
14. 238200 - Terminal Heating and Cooling Units
15. 253000 - Building Automation System Field Devices
16. 255000 - Building Automation System
17. 259000 - Sequence of Operations

## 1.2 REFERENCES

## A. Codes and Standards:

1. See Section 200000 - Mechanical General Requirements.
2. ANSI/ASHRAE/IESNA Standard 90.1-2001 Energy Standard for Buildings Except Low-Rise Residential Buildings.
3. ASME Boilers and Pressure Vessel Code (1998), Sections IV & VI.

## B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 200000 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

## 1.3 SYSTEM DESCRIPTION

## A. Design Requirements:

1. This section describes specific requirements, products, and methods of execution for the system of liquid heat transfer throughout the project. The system of heat generation is specified elsewhere.
2. Design expansion compensation system to adequately protect piping and structure from thermal expansion and contraction forces.

## B. Performance Requirements:

1. Provide performance and output shown or scheduled on drawings.
2. Provide loops, pipe offsets, and swing joints, or expansion joints where required or indicated.
3. Pipes shall be capable of thermal expansion movement without disengagement of supports or forces on equipment connections.
4. Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.
5. Expansion Calculations:
  - a. Installation Temperature: 40 degrees F.
  - b. Hot Water Heating: 210 degrees F.
  - c. Domestic Hot Water: 140 degrees F.
  - d. Safety Factor: 30 percent.

## 1.4 PRE-INSTALLATION MEETINGS

- A. See section 200000 - Mechanical General Requirements.

## 1.5 SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.
  2. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
  3. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
  4. Submit selection calculations for expansion joints and compensators.
  5. Design Data: Submit calculations for performance specified products and systems.
- C. Shop Drawings:
1. Submit shop drawings for performance-specified products and systems.
  2. Submit shop drawings for piping systems to demonstrate proper layout and coordination.
  3. Provide shop drawings to show system layout with location and detail of flexible pipe connectors and expansion joints.
  4. Drawings of boiler room, fan rooms, and other areas with high-density piping, shall be shown at 1/4-inch scale or larger.
  5. Indicate elevation of piping above finish floor.
  6. Indicate dimensions and weights of equipment, and placement of openings and holes.
  7. Include reference to ductwork and other equipment where space coordination is necessary to avoid conflicts.
  8. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer Reports:
1. Certificates, Manufacturer's Instructions, and Manufacturer's Field Reports:
    - a. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
    - b. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:
      - 1). Printed names and signatures of the installers.
      - 2). Documentation from Manufacturer's representative and Contracting Agency that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
  2. Test reports:
    - a. Provide certificate that cleaning of hydronic systems has been accomplished.

- b. Provide certificate listing satisfactory results for the hydrostatic pressure tests.
    - c. Provide certificate listing satisfactory results for the operational tests.
  3. Submit a letter to document that the training was conducted. Include in the letter the date, start/stop times for the training, list of attendees and signature/title of the person(s) providing the training.
- E. Quality Control Submittals: Refer to Section 019100 - Commissioning for submittal requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.
- B. Operation and Maintenance (IO&M) Manuals:
  1. Refer to Section 200000 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
  2. Include the following:
    - a. Copies of approved submittal information.
    - b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Annotate the manual to indicate applicable information for the specific equipment model(s) installed.
    - c. Computer software manuals and applicable licenses.
    - d. Completed start-up and operational test report as required to validate equipment warranty.
    - e. Start-up and operational test reports for each piece of equipment. Report shall include printed names and signatures of the installers and documentation that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
- C. Record Documentation: Record actual locations of equipment, valves, strainers, air vents, flexible pipe connectors, expansion joints, other components, and locations of access doors required for maintenance access in accordance with Section 200000 - Mechanical General Requirements.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 200000 - Mechanical General Requirements.

#### 1.8 QUALITY ASSURANCE

- A. See Section 200000 - Mechanical General Requirements.



## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. See Section 200000 - Mechanical General Requirements.

## 1.10 WARRANTY

- A. Manufacturer Warranty: See Section 200000 - Mechanical General Requirements, for general mechanical warranty requirements.

## PART 2 - PRODUCTS

## 2.1 PIPE AND FITTINGS

## A. Water Systems:

1. Copper pipe three inches and smaller:
  - a. Type L copper, wrought copper fittings.
  - b. Fit joints using 430 silver solder, 95-5 tin-antimony or other approved lead-free solder. Solder type must be compatible with pipe and fittings. Solder containing lead shall not be allowed on the job site.
  - c. Soldering flux: Water flushable, low corrosivity type meeting the requirements of ASTM B813. Flux shall have label indicating it meets these requirements.
  - d. Extracted branch joints (T-Drill) may be approved when Contractor can demonstrate satisfactory experience with this method. Joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using B-Cup series filler metal.
2. Steel pipe four inches and larger: Welded pipe and fittings.
  - a. Grade B, seamless, ASTM A53 or A106.
  - b. Schedule 40 black with ANSI B16 butt weld fittings of type and wall thickness to suit pipe.
3. Galvanized piping is not permitted.

## B. Glycol Systems (Copper or Steel Option):

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

with the Copper Development Association Copper Tube Handbook using B-Cup series filler metal.

2. Steel pipe four inches and larger: Welded pipe and fittings. No threaded pipe allowed.
  - a. Grade B, seamless, ASTM A53 or A106.
  - b. Schedule 40 black with ANSI B16 butt weld fittings of type and wall thickness to suit pipe.
3. Viega ProPress copper press-fit joint-type pipe systems are not permitted.
4. Victaulic mechanical joint-type pipe systems are not permitted.
5. Galvanized piping is not permitted.

C. Copper Press Fitting System:

1. Limited to tubing sizes 4 inch and smaller.
2. Cast or wrought copper fittings, ASME B16.51. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
3. IAPMO UPC listing.
4. Manufacturer: Viega ProPress, NIBCO Press System, no substitutions.

D. Equipment drains and overflows: Type L copper pipe, wrought copper fittings.

## 2.2 VALVES

- A. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 PSIG saturated steam or 200 PSIG WOG. Packing material or seals shall not contain asbestos.
- A. Manufacturers: Crane, Nibco, Hammond, Jenkins, Grinnell, Milwaukee, Stockham.
- B. Ball Valves 2 inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 PSIG pressure/temperature rating (steam).
- C. Ball Valves 2-1/2 inches through 4 inch: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, 150 PSIG pressure/temperature rating (steam). May be substituted for gate valves except where otherwise indicated.
- B. Gate Valves, two inch and smaller: Bronze body and trim, rising stem, solid wedge. Use only where shown on drawings.
- C. Gate valves, six inch and larger: Iron body bronze trim, flanged. Rising stem: OS&Y, or non-rising stem with solid wedge.
- D. Globe Valve two inch and smaller: Bronze body, renewable disc suitable for service.
- E. Globe or Angle Valve 2-1/2 inch and larger: Iron body, bronze trim, flanged, bronze disc. Bronze valves optional for 2-1/2 inch and three-inch.

- F. Swing Check Valves two inch and smaller: Bronze body, horizontal swing, Y-pattern, Buna-N-disc for water, oil and gas. TFE disc for steam.
- G. Swing Check Valves 2-1/2 inch and larger: Iron body, horizontal swing, bolted bonnet, renewable bronze seat and disc, flanged or grooved. Bronze valves optional for 2-1/2 inch and three-inch.
- H. Drain Valves: Full port ball valve with threaded hose adapter with bronze end cap. Do not use sillcocks or butterfly valves as drain valves.
- I. Valves Specified Elsewhere: Provide special valves such as motor-operated valves, relief valves, temperature regulating valves, etc., as specified under the individual system, or as indicated on the drawings.

### 2.3 UNIONS (STANDARD)

- A. Steel Piping (Threaded):
  - 1. Class 150 (150 PSIG steam, 300 PSIG WOG) malleable iron, ground joint, ASME B1.20.1, ASME B16.39. McMaster-Carr.
  - 2. Where indicated: Class 250 malleable iron ground joint, copper or copper alloy seat. McMaster-Carr.
- B. Copper Piping (Sweat): Cast bronze, ASTM B584 Alloy C84400, copper to copper. Nibco No. 733.

### 2.4 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

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

### 2.5 PRESSURE GAUGES

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

- D. Differential pressure gauges shall be piston or diaphragm type with range suitable for application and static pressure capability suitable for system pressure. Orange Research.

## 2.6 THERMOMETERS

- A. Provide where shown on drawings, specified in Part 3, or as required.
- B. Liquid in glass type: Industrial quality blue-reading with nine-inch scale length (minimum). Straight angle or adjustable as necessary for visibility. Trerice, Marsh, Weksler, or approved equal.
- C. Dial Type: Industrial quality three-inch dial with a 270 degrees (minimum) scale. Straight, angle or remote as necessary for visibility. Trerice, Marsh, Weksler, or approved equal.
- D. Digital, self-powered type: Weiss DVU or equal.
- E. Normal operating temperature at scale midpoint and sufficient range to cover operating conditions.
- F. Provide separable wells of suitable material for piping and mounting hardware for ducts. Set probe in heat transfer paste recommended by thermometer manufacturer.

## 2.7 PRESSURE AND TEMPERATURE TEST PLUGS

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

## 2.8 FLEXIBLE PIPE CONNECTORS

- A. General:
  - 1. System Application: Hot water heating or 50 percent propylene glycol solution (heating) or 30 percent propylene glycol solution (cooling).
  - 2. System Maximum Operating Temperature: 210 degrees F.
  - 3. Pressure: Internal.
  - 4. Installation: Straight or Offset as shown.
  - 5. Movement: Constant or Intermittent.
  - 6. Maximum offset: Not to exceed 25 percent of the centerline bend radius.
  - 7. Determine appropriate minimum "live hose length" (flexible portion of assembly) based on the centerline bend radius for each application in accordance with manufacturer's sizing tables.

- B. Copper Pipe Flexible Connectors - Small Diameter (Sweat):
1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
  2. Pipe Ends: Copper tube sweat.
  3. Corrugated Hose: Bronze.
  4. Outer Braid: Single braided bronze.
  5. Minimum Working Pressure Rating: 120 PSIG at 250 degrees F.
  6. Maximum Temperature Rating: 250 degrees F.
- C. Copper Pipe Flexible Connectors - Small Diameter (Removable):
1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
  2. Pipe Ends: Female pipe coupling, Female union, Male Hex Nipple, Male Pipe with Hex Nut.
  3. Corrugated Hose: Bronze.
  4. Outer Braid: Single braided bronze.
  5. Minimum Working Pressure Rating: 120 PSIG at 250 degrees F.
  6. Maximum Temperature Rating: 250 degrees F.
- D. Steel Pipe Flexible Connectors - Small Diameter (welded):
1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
  2. Pipe Ends: Weld nipple.
  3. Corrugated Hose: Bronze.
  4. Outer Braid: Single braided bronze.
  5. Minimum Working Pressure Rating: 300 PSIG at 250 degrees F.
  6. Maximum Temperature Rating: 250 degrees F.
- E. Steel Pipe Flexible Connectors - Small Diameter (Removable):
1. Size: 3/4 inch through 2-1/2 inch nominal pipe size (NPS).
  2. Pipe Ends: Schedule 40 steel with male pipe thread (MPT).
  3. Corrugated Hose: Bronze.
  4. Outer Braid: Single braided bronze.
  5. Minimum Working Pressure Rating: 300 PSIG at 250 degrees F.
  6. Maximum Temperature Rating: 250 degrees F.
- F. Steel Pipe Flexible Connectors - Large Diameter:
1. Size: 3 inch through 10 inch nominal pipe size (NPS).
  2. Pipe Ends: 150 LB plate steel flat faced flange.
  3. Corrugated Hose: Type 304 stainless steel.
  4. Outer Braid: Single braided Type 304 stainless steel.
  5. Minimum Working Pressure Rating: 150 PSIG at 250 degrees F.
  6. Maximum Temperature Rating: 250 degrees F.
- G. Manufacturers: Metraflex, Keflex, or equal.