

SECTION 15100-GENERAL MECHANICAL REQUIREMENTS

PART 1: GENERAL

1-01 DESCRIPTION

- A. Related Documents:
 - 1. The other Contract Documents complement the requirements of this Section.
 - 2. Division 1 - General Requirements applies to the Work of this Section.
 - 3. Where requirements of this Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.
- B. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
- C. Included: Work includes, but is not limited to the following:
 - 1. Heating, Ventilating, Air Conditioning and System Balancing
 - 2. Plumbing
 - 3. Carpentry and metal Work required for Work of this Section and not specifically shown under another Section. Openings in concrete or masonry construction shall be either core drilled or saw cut unless indicated otherwise on Drawings.
 - 4. Coordination Drawings
 - 5. Demolition:
 - a. The Demolition Plans were prepared for the convenience of the Contractor. The Engineer does not represent that all items, which may require demolition, have been shown. It shall be the responsibility of the Contractor to carefully examine the site and the Contract Documents and to perform all demolition and reconstruction, which may be required for the proper execution, and completion of work.
- D. Related Work:
 - 1. Cutting and Patching (Division 1)
 - 2. Low voltage electrical control (Division 16)

1-02 DEFINITIONS

- A. Furnish: Purchase and deliver to job site in new condition.

- B. Install: Receive and store at job site until required; place secure and connect; furnish required appurtenances.
- C. Provide: Furnish and install as defined above.
- D. Section: Refers to a Section of these Specifications.
- E. Standards: The issue in effect as of the date of the contract documents.

1-03 PROJECT RECORD DRAWINGS

- A. Comply with pertinent provisions of Architectural Sections (Division 1).

1-04 SERVICE INTERRUPTIONS

- A. When Work of this Section requires temporary shutdown of existing systems for connections, the shutdown shall be made only during pre-arranged time agreeable to the Owner.

1-05 CORRELATION, INTERPRETATION AND INTENT OF CONTRACT DOCUMENTS

- A. The Mechanical Drawings are, in general, made to scale and the Contractor may obtain approximate distances and dimensions by scaling the Plans. It is distinctly understood, however, that it is done entirely at the Contractor's responsibility. Refer to Architect's Plans and Specifications for construction details, which will affect the Work and equipment. Examine the Architectural, Civil, Structural, Mechanical, Electrical, Landscape, Irrigation, Data, Fire Protection and Plumbing Plans and Specifications to ensure that this work does not conflict with the above trades. Plumbing, Mechanical and Electrical Plans are diagrammatic and, therefore, do not necessarily represent the exact installation. However, pipe sizing for utility services and ductwork are calculated per their respective codes and Standard Engineering Practice and shall be installed as sized from point of origin to terminal point. It shall remain the Contractor's responsibility to submit Shop Drawings if he/she has any questions about the final arrangement. Nothing on these Plans or Specifications shall be construed to permit work not conforming to all applicable codes and regulations.

PART 2: PRODUCTS

2-01 ACCESS PANELS

- A. If not called for under other Sections, furnish Milcor, Elmdor, or Jay R. Smith access panels where shown on the Drawings or required for maintenance access to completed Work of this Section. Submit size, type, and location of proposed access panels not specifically shown, for review by Architect.
- B. Access panels shall be constructed of 16 gauge prime coated steel or stainless steel with screwdriver operated cam latch, concealed hinges, and fire rating equal to adjacent construction.
- C. Provide flush type doors with:
 - 1. Stainless steel finish for tiled surfaces.
 - 2. Prime coated finish for other surfaces.

2-02 FLASHING

- A. Provide watertight flashing at all openings through exterior walls and roof. Refer to Architectural Drawings.

2-03 BELT DRIVES

- A. All belts shall be "Vee" type, or approved equal. Sheaves shall be adjustable and shall be sized to drive fan at scheduled RPM when set at midpoint of adjustment range. All belt drive assemblies shall be rated at 150% of drive motor horsepower. OSHA approved belt guards shall be provided over all drive assemblies. The Contractor shall change any belts and drives as required to produce the specified CFM.

2-04 VIBRATION ISOLATION AND NOISE CONTROL

- A. All fans, heating and ventilating units, air conditioning units, blowers and similar equipment shall be securely mounted to and/or supported from the structure.
- B. Isolate all bare water piping from structural members or hangers with "Trisolators" or submitted and approved equal insulating sleeves. Install hangers on outside of insulated jacket on all insulated lines.

2-05 WEATHERPROOFING

- A. All equipment exposed to weather shall be protected by means of a suitable finish (i.e. paint). All fan cabinets, roof-mounted equipment, and ductwork shall be fabricated in such a manner to prevent leakage through seams and joints. Water rated, exterior hoods shall be provided over motors, belts, and other devices to insure against damage by water. At all locations where pipes and/or ducts penetrate exterior walls, or roofs, suitable rain tight flashing shall be provided.

2-06 PIPE WRAPPING

- A. All pipe, metal components, and joints buried in ground shall be primed and protected with 10-mil tape double wrapped or approved equal per IAPMO IS 13-2006. Before tape application, all bare pipe and fittings to be wrapped must be coated with pipe wrap primer. Stretch first layer of tape to conform to the surface while spirally half-lapping, apply a second layer, half-lapped and spiraled as the first layer with spirals perpendicular to first wrapping. In lieu of tape wrap, heat shrinkable 10-mil minimum thick polyethylene sleeve may be used.
- B. When applying tape, use only enough pull to cause the tape to properly conform to the irregular surfaces of the item. The proper amount of pull is reached when the tape surface is smooth without any wrinkles. Continue tape 4" above grade. End overlaps should point down. Tape shall be applied per manufacturer's installation instructions.

2-07 ELECTRIC MOTORS AND ELECTRICAL DEVICES

- A. All Electric motor current characteristics are as shown in equipment schedules on drawings and as specified hereinafter in this Specification. The Contractor shall refer to the Electrical Plans and shall confirm all motor voltage, amperage and phase characteristics before processing submittals or ordering equipment. If any equipment is installed different from the supplied electrical power, it is the

contractor's responsibility to correct equipment to the required electrical characteristics.

- B. All electrical devices of a type normally listed by Underwriters Laboratories, Inc. shall bear U.L. label of approval.
- C. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for motor control specified. Mount starter adjacent to equipment. See electrical drawing. Maintain minimum of 3' clearance to front of device.
- D. Motor Starters: Shall be NEMA I or III as appropriate, general purpose, weather-resistant, with watertight enclosure where required.

PART 3: **EXECUTION**

3-01 **DEMOLITION**

- A. Remove all heating, ventilation, and air conditioning equipment, fans, ductwork, supply, return and exhaust grilles, supports, controls including thermostats, control wire, conduits, control panels and any related equipment as indicated or noted on plans. Dispose of as directed by Owner.
- B. Remove all plumbing fixtures and fittings, water piping, gas piping, equipment, and supports as indicated on plans. Dispose of as directed by Owner.
- C. Any piping or ductwork to be reused to complete the project shall be capped immediately after removal of the demolished piping or ductwork.
- D. All existing piping and ductwork "to remain" shall be firmly secured with temporary supports approved by the Architect until final supports or installation is complete.
- E. Any waste piping including vents and drains, to be reused to complete the project shall be capped immediately after removal of the demolished piping. Cap or cover any open drains "to remain" prior to demolition work.
- F. All existing water and waste pipe "to remain" shall be flushed out prior to connection to any new work. All ductwork shall be blown out prior to the installation of new diffusers and grilles.
- G. All mechanical or plumbing equipment or fixtures to be reused shall be stored and protected in a clean area. The items shall be thoroughly cleaned before reinstallation.
- H. Any existing piping in a demolished area, and not shown on the plans, shall be rerouted and reconnected to piping outside of the demolished area.

3-02 **GENERAL EQUIPMENT INSTALLATION REQUIREMENTS**

- A. Install equipment to provide neat appearance, required manufacturer's access, and required space to allow replacement or maintenance. Provide bases, supports, anchor bolts, and other items required to install equipment. Installation shall be level and braced per CBC.
- B. Equipment shall operate quietly and without objectionable vibration. Excessive vibration, other than from specified equipment operating at optimum conditions,

shall be the Contractor's responsibility and shall be eliminated as directed by Architect.

3-03 COORDINATION OF WORK

- A. Coordinate Work of this Section with Work of other Sections to avoid conflicts. If required, provide shop drawings and submit to Architect for approval.
- B. Insure that Work of other Sections is suitable to accommodate Work of this Section.

3-04 ADEQUACY OF FURRING

- A. Conceal piping and ductwork in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify Architect prior to ordering materials and fabrication of components.

3-05 PROTECTION AND CLEANING

- A. Protect equipment from dirt, moisture, and mechanical damage during construction. Restore or replace damaged equipment to original condition.
- B. Keep interior of piping and ductwork free of foreign material during construction. Flush piping systems with test medium specified under Piping Tests before installing equipment and appurtenances or making final connections.

3-06 CLOSING-IN OF UNINSPECTED WORK

- A. Do not conceal or cover Work before tests and observations are completed. Uncover Work prematurely closed in and repair resulting damage to all Work, if requested by Architect, Engineer, or Project Inspector.

3-07 DAMAGE

- A. Repair or replace items damaged by leaks or overflow from Work provided under this Section and for any damage to any part of the project site, for a period of 1 year after notice of completion date. This is in addition to and not a limitation of other rights the Owner may have against the contractor under the Contract Documents.

3-08 MECHANICAL SYSTEM TESTING

- A. Furnish all test pumps, gauges, and equipment. Test all safety controls and devices.
- B. For air tests, install a calibrated test pressure gauge in the piping system to observe any loss in pressure. Calibrate the test pressure gauge with a dead weight tester within 15 days before use and certify by initial and date on a sticker applied to the dial face. Maintain the required test pressure for the time indicated. Brush joints with a soapy water solution to check for leaks if the required pressure cannot be maintained.
- C. After any test, repair all leaks found as directed and re-test as necessary until the system is proven tight.

- D. Before applying test pressure to any piping systems the Contractor shall be responsible for isolating all equipment e.g. control valves, regulators, relief devices, tanks and any other line accessories, which would otherwise be damaged by the test pressure.
1. Soil, Waste, Vent, Roof, and Condensate Drainage:
 - a. Entire System: Tightly close all openings except the highest one. Fill to overflowing with water.
 - b. Sections of System: Tightly close all openings except the highest opening of the section under test. Fill section with water to test each section with a minimum 10-foot head of water except for the uppermost 10 feet of the system.
 - c. Allow to stand for (4) hours or longer, as required to complete the inspection.
 2. Domestic Water: Fill with water and test at 150 psig. Retain for (4) hours.
 3. Refrigerant: Pressurize the system with nitrogen to 150 psig and hold for 24 hours with no drop in pressure; test joints and equipment for evidence of leaks after satisfactory pressure test.
 4. Hydronic Piping: Piping shall be pressure tested with water with a hydrostatic pressure of not less than 100 psi or 1.5 times the design pressure, whichever is greater. Pressure test shall be conducted at design temperature for 4 hours. Piping components shall be suitable for use under design pressures specified. Pressures in this specification are pressures in pounds per square inch (psi) above atmospheric pressure, and temperatures are in degrees Fahrenheit (F). Pressure test shall be conducted by the contractor in the presence of an authorized inspector. The piping being tested shall remain exposed to the inspector and shall not leak during the test.
- E. After all Systems have been tested as outlined, all flow rates shall be balanced, and all control devices adjusted. See Section 15600.
- F. The equipment and installations shall be operated by the Contractor and he shall demonstrate that all Systems are performing according to the requirements of the Plans and Specifications and to the satisfaction of the Architect, Engineer and Owner.

3-09 CUTTING AND PATCHING

- A. The Contractor shall do all cutting and patching which may be required for the installation of the Work under this Division of the Specifications. Patching shall be of the same quality, materials and finish as, and shall match accurately, all surrounding construction. No cutting of the Structure shall be permitted without the approval of the Architect.
- B. Wherever concrete or paved surfaces are cut to provide for the installation under this Section, the Contractor shall restore the surfaces to their original condition. Subgrade materials, concrete, and paving materials, along with the placement of same, shall be in accordance with the respective Sections of this Specification as they apply to the installation of such material.

3-10**EXCAVATION AND BACKFILL: (BURIED PIPES WITHIN THE BUILDING WALLS AND TO 5 FEET FROM THE BUILDING.)**

- A. Dig trenches straight and true to line and grade; bottom shall be left smoothed of rock points. Pipe shall be supported for the entire length on undisturbed, original earth. The minimum trench width shall be 16" and all pipe shall be 2 feet below the finished grade, minimum, wherever conditions permit. Sewer pipes to be below grade as necessary to meet the slope and invert on the Drawing. Whenever substantial variations of pipe bury is indicated by field conditions, the proposed changes in depth of bury shall be submitted, in writing, to the Architect for approval.
- B. All piping shall be laid on a bed of clean dry sand not less than 6" thick. The space between the pipe and the sides of the trench shall be backfilled with clean dry sand to a point 6" above the crown of the pipe. Both sides of the pipe shall be filled at the same time.
- C. The remainder of the trench shall be backfilled with native soil in lifts no greater than 12" and shall be mechanically compacted by tamping so to maintain a minimum relative dry density of 95%, determined by California Impact Test Method No. 216.
- D. All backfilling shall be brought flush with finished subgrade.
- E. Excess material shall be removed from the site. Trenches shall be backfilled immediately after approval.

3-11**INSTALLATION OF PIPING, DUCTWORK AND EQUIPMENT**

- A. The installation of piping, ductwork, and equipment shall be made in such a manner to clear beams and obstructions. Do not cut into or reduce the size of plates or any load carrying members without approval of the Architect. Check Drawings and Work of others to prevent interference. Deviations of the Work determined by the Architect shall be installed by the Contractor without additional cost.
- B. Install piping and ductwork promptly, cap or plug open ends of pipe. No piping shall be permanently covered by construction before inspection and approval. Piping and ductwork shall be installed in accordance with best practice and recommendations of the manufacturer.
- C. Conceal piping and ductwork unless indicated otherwise. Inspect each piece of pipe, tubing, fittings, and equipment for defects and obstructions. Remove defective material from site. Install piping generally level, free of traps and unnecessary bends to conform with building requirements and provide space for other work. Piping to be free of unusual noises. Avoid any possible galvanic action by isolating dissimilar metals with suitable Dielectric Insulating Fittings.
- D. Unless called for otherwise, hereinafter in this Specification or by specific detail on the Drawings, all water pipes in contact with structure and/or hangers shall be suitably isolated. In the case of uninsulated pipe, "Trisolators" or equal shall be used.
- E. Protect enameled or polished equipment from damage, tool marks, etc.

3-12**STERILIZATION OF PIPES**

- A. After preliminary purging of the Systems, the entire domestic potable water system pertaining to Work under this Contract shall be chlorinated in accordance with American Water Works Association, State of California Health and Safety Code procedure for disinfecting water mains. A thorough flushing operation shall be run upon completion of sterilization. Contractor shall then arrange with local health authority for test on mains and water systems and provide three (3) copies of test results to the Architect.

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EQUIPMENT IDENTIFICATION TAGS

- A. Major pieces of equipment shall include, but are not limited to: water heaters, air conditioners, unit heaters, supply and exhaust fans, and shall be tagged.

1. Tags shall be 2" x 2" x 1/8" thick Formica/plastic engraving stock beveled on both sides and with two 3/16" diameter holes near the top uppermost tag corners.
2. Tags shall be white with 3/8" high red engraved letters.
3. Tags shall be attached to the equipment with bolts, screws or chains as per valves.
4. Tags shall have the following information:
 - a. Equipment number and nomenclature corresponding to the information on the mechanical contract drawings.
 - b. Examples:

WH	EF	AC
1	2	3

3-14

IDENTIFICATION OF PIPING SYSTEMS

- A. Building Systems:
1. Piping systems installed anywhere within the scope of the Work shall be identified as to contents using a color banding and marking system as outlined and in compliance with Federal OSHA requirements.
 2. This Work includes furnishing and application of all snap-around and/or self-sticking pipe markers. Formica valve tags, chains, wires, and related materials proper for the completion of the Work.
 3. Pipe markers shall be permanently shaped vinylite plastic snap-around pipe markers as manufactured by Seton Nameplate Corporation, Wilmington Plastic Company, or approved equal.
 4. A maximum of four basic background colors shall be used and they shall conform to the American Standards Association Standard A13.1, "Scheme For Identification of Piping Systems" The names of materials (pipe contents) shall be superimposed on these ANSI background colors. Work legends shall conform to ANSI A13.1 to avoid confusion and mistakes. Basic background colors and content classification are:

Yellow	Dangerous Materials
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Red	Fire Protection
Bright Blue	Protective Materials
Green	Safe Materials

5. Pipe marking and installation shall be as follows:
- Apply "Plastic Pipe Marker" at each valve to show proper identification of pipe contents.
 - Use an "Arrow Marker" with each "Pipe Content Marker". The Arrow shall always point away from the "Pipe Marker" and in the direction of the flow.
 - If flow can be in both directions, use a double-header "Arrow Marker".
 - Apply "Pipe Marker" and "Arrow Marker" at every point of pipe entry and exit where the line goes through the wall, floor or roof.
 - Apply "Pipe Marker" and "Arrow Marker" on each riser and "T" joint.
 - Apply "Pipe Marker" and "Arrow Marker" every 50 feet on long continuous lines.
 - Identifying long continuous lines with "Pipe Marker" and "Arrow Marker" at every bay or aisle within the building. All branch runs from mains on the roof shall be identified with "Pipe Marker" and "Arrow Marker" at the point of takeoff.
 - Apply "Markers" on the two lower quarters of the pipe where view is unobstructed. In this position "Markers" are read at a glance from ground floor level and dust will not obscure the "Marker". Roof-mounted piping "Markers" shall be so located that they can be read from a standing position on the roof.
 - All identification markers located out of doors and exposed to the sun and the elements shall receive one coat of clear lacquer after application to the pipe, to seal edges and to act as a protective coating.
 - Each "Arrow Marker" must have the same ANSI background color as its companion "Pipe Marker". Arrow must point away from "Pipe Marker" and indicate direction of flow.
 - "Pipe Markers" shall be guaranteed to stay on pipe systems for a period of not less than five years.
6. Following is a list of, but not necessarily limited to, the more commonly used piping systems that require identification "Pipe Markers" and "Arrow Markers".

Abbreviations on Drawings	Wording to Put on Pipe Marker	ANSI Color Background
CHWS	Chilled Water Supply	Green
CHWR	Chilled Water Return	Green
HWS	Hot Water Supply	Yellow

HWR	Hot Water Return	Yellow
CW	Domestic Cold Water	Green
DI	Deionized Water	Green
DHWS	Domestic Hot Water Supply	Yellow
DHWR	Domestic Hot Water Return	Yellow
S	Gravity Sewer or Drain	Green
V	Vent	Green
G	Natural Gas	Yellow
A	Compressed Air	Blue
FM	Fire Protection Water	Red
ST	Steam	Yellow
CD	Condensate Drain Return	Yellow
VAC	Vacuum	Green
RL	Refrigerant Liquid	Yellow
RS	Refrigerant Suction	Yellow
All lettering shall be black on the yellow background and white on all other background.		

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SEISMIC BRACING

- A. It shall be required that pipes, ducts and conduits be supported and braced per the latest addition of the SMACNA "Seismic Restraints Manual Guidelines for Mechanical Systems".
- B. When the SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems" does not specifically address the size of duct or pipe to be braced, the following shall apply:
 1. All ducts shall be braced and guyed to prevent lateral or horizontal swing to the satisfaction of the Architect, Engineer, and Inspector.
 2. All pipes shall be braced and guyed to prevent lateral or horizontal swing to the satisfaction of the Architect, Engineer, and Inspector. Absolutely, no "Plumber's Tape" shall be used anywhere on this project.

3-16

OPERATION AND INSTRUCTION

- A. The Contractor shall furnish competent Technicians to supervise start-up operations of equipment specified by the Architect or Engineer and to instruct Owner's operators. The Contractor shall furnish six complete sets of operating instructions and service manuals to the Architect.
- B. Instruction period shall be started after instruction books and service manuals have been submitted to and approved by the Architect and shall be at hours (regular and non-regular) arranged by the Architect.
- C. Service manuals shall include oiling, cleaning, and servicing data, compiled in clearly and easily understood form and in a durable binder. Data shall show all serial numbers of every piece of equipment and complete list of replacement parts.

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WARRANTY

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or Owner.

END OF SECTION 15100

SECTION 15300: FIRE SUPPRESSION SYSTEMS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION

A. Work Included in This Section:

1. The Work covered by this shall include furnishing all labor, material, equipment and services to design, install and place in operation:
 - a. Required modifications to existing system to complete Wet Pipe Sprinkler System in compliance with NFPA Standards and based on current fire hydrant flow test report.
 - b. Complete clean agent fire suppression gas system within the designated electrical/data equipment room in compliance with NFPA Standards.

B. Related Work Specified Elsewhere:

1. ACOUSTICAL CEILING TREATMENT Section.
2. PLUMBING Sections.
3. ELECTRICAL Sections.

1.03 GENERAL - MODIFICATIONS TO EXISTING FIRE SPRINKLER SYSTEM

A. SCOPE OF WORK

1. The Work covered by this shall include furnishing all engineering, labor, material, equipment and services to design, install and place in operation required modifications to existing system to complete Wet Pipe Sprinkler System in compliance with NFPA Standards and based on current fire hydrant flow test report.
2. Obtain and pay for all licenses, permits, hydrant flow test

and report, and fees required for this Work when applicable.

3. Obtain required approvals for the fire suppression system in accordance with the requirements of the Authorities having jurisdiction.

B. CODES AND REGULATIONS

1. Comply with regulations and requirements of the local Fire Marshall, local building officials and other authorities having jurisdiction.
2. Comply with requirements contained in NFPA Standard 13, Installation of Sprinkler Systems, 2016 edition for equipment, specialties, accessories, installation, and testing.
3. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Architect.

C. QUALITY ASSURANCE

1. Installer's responsibilities include designing, fabricating, and installing Fire Suppression Systems and providing professional engineering services needed to assume engineering responsibility. Calculations shall be based on result of Fire-Hydrant flow test.
2. Welding:
 - a. Comply with Section IX of the ASME Boiler and Pressure Vessel Code.
 - b. Comply with the applicable requirements of AWS B2.1, specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.

D. PERFORMANCE REQUIREMENTS

1. Standard piping system component working pressure: listed for 175 PSIG.
2. Fire Suppression Sprinkler System design shall be approved by the authorities having jurisdiction.
3. Hazard classification per NFPA 13, Appendix A.
4. Fire Suppression piping shall be seismically braced per NFPA -

13, Seismic Zone 4. Calculations and selection and type of hangers and supports shall be included on the drawings.

E. SUBMITTALS AND RECORD DRAWINGS

1. Comply with pertinent provisions of Architectural Sections.
2. Product Data: Within 35 calendar days after the Contractor(s) has received the "Notice to Proceed", submit 6 copies of the following:
 - a. Materials and equipment list of items proposed to be provided under this Section.
 - b. Design drawings including Hydraulic Calculations, stamped as having been approved by the Authority having jurisdiction, showing the modifications to the sprinkler system and the installation of the synthetic/chemical gas system.

1.04 GENERAL - NEW CLEAN AGENT FIRE SUPPRESSION SYSTEM

A. SCOPE OF WORK

1. The Work covered by this shall include furnishing all engineering, labor, material, equipment and services to design, install and place in operation a "total flood" clean agent fire suppression system. The system shall be complete in all ways, and shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, agent, discharge nozzles, pipe and fittings, devices and controls, and all else necessary for a functional, UL Listed or FM approved clean agent fire suppression system.
2. Obtain and pay for all licenses, permits, and fees required for this Work when applicable.
3. Obtain required approvals for the fire suppression system in accordance with the requirements of the Authorities having jurisdiction.

B. CODES AND REGULATIONS

1. Comply with regulations and requirements of the local Fire Marshall, local building officials and other authorities having jurisdiction.

2. Comply with requirements contained in NFPA Standard 2001, Clean Agent Fire Extinguishing Systems, 2016 edition for equipment, specialties, accessories, installation, and testing.
3. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Architect.

C. QUALITY ASSURANCE

1. Manufacturer
 - a. The manufacturer of the suppression system hardware and detection components shall be ISO 9000 registered.
 - b. All devices, components and equipment shall be the products of the same manufacturer.
 - c. All devices, components, and equipment shall be new, standard products of the manufacturer's latest design and suitable to perform the functions intended.
2. Installer
 - a. The installing contractor shall have a minimum of five (5) years experience in the design, installation, and testing of clean agent, or similar, fire suppression systems.
 - b. The installing contractor shall maintain, or have access to, a clean agent recharging station.

1.05 SUBMITTALS AND RECORD DRAWINGS

- A. Comply with pertinent provisions of Architectural Sections.
- B. Product Data: Within 35 calendar days after the Contractor(s) has received the "Notice to Proceed", submit the following:
 1. Materials and equipment list of items proposed to be provided under this Section.
 2. Design drawings, including calculations, stamped as having been approved by the Authority having jurisdiction, showing the modifications to the fire sprinkler system and the

installation of the new clean agent fire suppression system.

1.06 PRODUCT HANDLING

- A. Comply with pertinent provisions of Architectural Sections.

1.07 WARRANTY

- A. Contractor shall warrant the installation free from defects for a period of one year from filing Notice of Completion. Correct any deficiencies developing during this period free of charge.
- B. The installer shall be responsible for all damage to any part of the premises caused by leaks or breaks in the piping or equipment furnished and/or installed under this Section of the Work for a period of one year after acceptance of Work.
- C. The above warranties are in addition to and not a limitation of other rights the Owner may have against the contractor under Contract Documents.

PART 2 : PRODUCTS

2.01 MODIFICATIONS TO EXISTING FIRE SPRINKLER SYSTEM

A. PIPING, FITTINGS AND JOINTS

- 1. Above grade fire protection system pipe, tube, and fittings shall be approved and "listed" for use in fire protection systems.

Acceptable Materials: As listed in NFPA-13 piping specifications for pipe, tube materials and dimensions.

B. SPRINKLER HEADS

- 1. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig pressure rating if sprinklers are components of high-pressure piping system.
- 2. Available Manufacturers:
 - a. Central Sprinkler Corp.
 - b. Globe Fire Sprinkler Corporation.

- c. Grinnell Fire Protection.
 - d. Reliable Automatic Sprinkler Co., Inc..
 - e. Star Sprinkler Inc..
 - f. Viking Corp.
3. Automatic Sprinklers: With heat-responsive element complying with the following:
- a. UL 199, nonresidential applications.
 - b. US 1626, for residential applications.
 - c. UL 1767, for early-suppression, fast-response applications.
4. Sprinkler types and categories: Nominal 1/2 inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
 - b. Orifice: 17/32, with discharge coefficient K between 7.4 and 8.2.
5. Sprinkler types, features, and options as follows:
- a. Concealed ceiling sprinklers, including cover plate.
 - b. Extended-coverage sprinklers, with automatic open and shutoff feature.
 - c. Flow-coverage sprinklers.
 - d. Flush ceiling sprinklers, including escutcheon.
 - e. High-pressure sprinklers.
 - f. Institution sprinklers, made with a small, breakaway projection.
 - g. Open sprinklers.
 - h. Pendent sprinklers.

- i. Pendent, dry-type sprinklers.
 - j. Quick-response sprinklers.
 - k. Recessed sprinklers, including escutcheon.
 - l. Sidewall sprinklers.
 - m. Sidewall, dry-type sprinklers.
 - n. Upright sprinklers.
- 6. Sprinkler Finishes: Match Existing
- 7. Special Coatings: Wax, lead, and corrosion-resistant paint.
- 8. Sprinklers Escutcheons: Match Existing.
- C. PIPE HANGERS/EARTHQUAKE PROTECTION
 - 1. Provide Factory Mutual listed hangers, rods, inserts, and accessories by Grinnel, Tolco or equal. Design and install hangers and supports for seismic Zone 4.
- D. GENERAL
 - 1. Provide other materials, not specifically described, but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.
 - 2. All fire protection equipment or materials shall be U.L. listed for fire protection use.

2.02 NEW CLEAN AGENT FIRE SUPPRESSION SYSTEM

- A. GENERAL REQUIREMENTS
 - 1. The Clean Agent System materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. When one or more pieces of equipment must perform the same function(s), they shall be duplicates produced by one manufacturer.
 - 2. All devices and equipment shall be UL Listed and/or FM approved.

B. CLEAN AGENT STORAGE AND DISTRIBUTION

1. The system design can be modular or central storage.
2. The clean agent shall be stored in approved containers that conform to NFPA 2001.
3. Containers shall be actuated by re-settable electric actuator with mechanical override. Non-re-settable or explosive devices shall not be permitted.
4. Each container shall have a pressure gauge and low pressure switch wired to control panel to provide an audible and visual low pressure alarm.
5. Each container shall have pressure relief provisions.
6. Engineered discharge nozzles shall be provided within the manufacturer's guidelines to distribute the clean agent throughout the protected spaces.

C. CONTROL PANEL

1. The control system shall perform all functions necessary to operate the system detection, actuation, and auxiliary functions.
2. The control system and its components shall be UL Listed and FM approved for use as a local fire alarm system with releasing device service.
3. The control system shall include battery standby power to support 24 hours in standby and 5 minutes in alarm.

D. DETECTORS

1. The detectors shall be of the required types and shall be spaced and installed in accordance with the manufacturer's specifications and the guidelines of NFPA 72.

E. MANUAL RELEASE

1. The electric manual release switch shall provide a means of manually discharging the suppression system when used in conjunction with the control system.
2. The manual release switch shall be a dual action device

requiring two distinct operations to initiate a system actuation.

3. The manual release switch shall be located at the exit from the protected space.

F. ALARMS

1. Alarm audible and visual signal devices shall operate from the control panel.
2. A strobe device shall be placed outside, and centered above, the exit door from the protected space.

G. SIGNS

1. Entrance Sign: Provided by others under Section 10426.
2. Manual Discharge Sign: (1) required at manual discharge.
3. Flashing Light Sign: Provided by others under Section 10426.

H. SYSTEM AND CONTROL WIRING

1. All system wiring shall be furnished and installed by fire suppression contractor.

PART 3: EXECUTION

3.01 MODIFICATIONS TO EXISTING FIRE SPRINKLER SYSTEM

A. SURFACE CONDITIONS

1. Examine the areas and conditions under which Work of this Section will be performed. Conditions detrimental to timely and proper completion of the Work shall be brought to the attention of the Architect before the installation of any materials. Do not proceed until unsatisfactory conditions are corrected. Incorrectly installed materials requiring changes will be at Contractor's expense.
2. INSTALLATION - GENERAL
 - a. Coordinate as necessary with other trades to assure

proper and adequate provision in the Work of those trades for interface with the Work of this Section.

- b. Install the Work of this Section in strict accordance with the approved design drawings and the requirements of the Authority having jurisdiction.
- c. In area having ceilings, conceal all pipes unless directed otherwise by the Architect.
- d. In non-ceiling areas, pipe shall be exposed and routed in the truss space. Where it is not practical to run in the truss space, hold pipes to underside of trusses.
- e. All sprinkler heads shall be arranged in straight rows in both directions, as much as possible. Refer to architects' notes for sprinkler head arrangement.
- f. Do not locate sprinkler heads in any luminous ceiling. Methods for sprinklering such areas shall comply with NFPA.
- g. Sprinkler heads located where they may easily be damaged, shall be fitted with approved guards.
- h. Cut piping accurately to job measurements and install without springing or forcing. Ream cut pipe to full inside diameter. Insure all filings have been removed from inside of the pipe. Install piping generally square with building, free of traps or air pockets and true to line and grade. Do not install piping in any locations where, in the Architect's opinion, it will interfere with the use of the building; where space is inadequate, notify Architect in time to avoid unnecessary Work. Coordinate and install all piping system without interfering with other trades.
- i. Make up screwed joints with anti-seize thread lubricant applied to male threads only. Threads shall be American-Standard pipe threads.
- j. All low points of the sprinkler system shall have provisions for drainage per NFPA 13. Drain piping shall be run to accessible places approved by the Architect.
- k. Support and brace piping to protect from

earthquake damage from structure in accordance with NFPA 13. Do not support piping from ductwork, other pipes, or by resting on the structure.

- l. Provide access panels per for all concealed valves.
- m. The Fire Sprinkler Piping spacing of vertical supports, lateral bracing, and the details of the lateral bracing must comply with NFPA Standards.
- n. All tees, plugs, caps, bends, and hydrant branches on pipe-installed underground shall be restrained (pipe clamps and tie-rods, thrust blocks, locked mechanical or push-on joints, mechanical joints utilizing set screw retainer glands, or other approved methods) against movement.
- o. All piping shall be painted in compliance of pertinent Architectural Sections.

B. CLOSING IN UNINSPECTED WORK

- 1. Work in furred areas and below grade and slabs shall not be concealed until such Work has been inspected and approved by the inspecting Authorities. If such Work is concealed without inspection and approval, the installer shall be financially responsible for all Work required to open and restore the concealed areas in addition to any required modification to the system.

C. CLEANUP

- 1. During the process of the Work, premises shall be kept reasonably free of all debris, cutting and waste material resulting from the Work under this Section. All such debris and rubbish shall be removed from the site. Upon completion and final acceptance of the Work, all debris, rubbish and left-over materials, tools, and equipment shall be removed from the site.

D. TESTING AND INSPECTION

- 1. The Contractor shall arrange and pay for all necessary or required inspections by the governmental agencies having jurisdiction to ensure the Work outlined in the Drawings and Specifications complies with the codes. The Architect shall be notified when the Contractor has arranged for inspections

3.02 NEW CLEAN AGENT FIRE SUPPRESSION SYSTEM

A. SURFACE CONDITIONS

1. Examine the areas and conditions under which Work of this Section will be performed. Conditions detrimental to timely and proper completion of the Work shall be brought to the attention of the Architect before the installation of any materials. Do not proceed until unsatisfactory conditions are corrected. Incorrectly installed materials requiring changes will be at Contractor's expense.

B. INSTALLATION - GENERAL

1. Coordinate as necessary with other trades to assure proper and adequate provision in the Work of those trades for interface with the Work of this Section.
2. Install the Work of this Section in strict accordance with the approved design drawings and the requirements of the Authority having jurisdiction.
3. In area having ceilings, conceal all pipes unless directed otherwise by the Architect.
4. In non-ceiling areas, pipe shall be exposed and routed in the truss space. Where it is not practical to run in the truss space, hold pipes to underside of trusses.

C. STORAGE AND DISTRIBUTION COMPONENTS

1. Supply shall be located as near as possible to the hazard area to reduce the amount of pipe and fittings required.
2. Distribution piping, and fittings, shall be installed in accordance with the manufacturer's requirements and NFPA 2001.
3. All piping shall be adequately supported and anchored at all directional changes and nozzle locations.
4. Ceiling plates shall be used to conceal entry holes through ceiling tiles.

D. DETECTORS

1. Detectors shall be installed in accordance with the

manufacturer's specifications and the guidelines of NFPA 72.

E. SYSTEM AND CONTROL WIRING

1. All wiring shall be installed in electrical metallic tubing (EMT), or conduit, and must be installed and kept separate from all other building wiring.
2. All system components shall be securely supported independent of the wiring. Runs of conduit and wiring shall be straight, neatly arranged, properly supported, and installed parallel and perpendicular to walls and partitions. The sizes of the conductors shall be those specified by the manufacturer. Color-coded wire shall be used. All wires shall be tagged at all junction points and shall be free from shorts, earth connections (unless so noted on the system drawings), and crosses between conductors.
3. All wiring shall be installed by qualified individuals, in a neat and workmanlike manner, to conform to the National Electric Code, Article 725 and Article 760, except as otherwise permitted for limited energy circuits, as described in NFPA 72 (1993). Wiring installation shall meet all local and state codes.
4. The complete system electrical installation, and all auxiliary components, shall be connected to earth ground in accordance with the National Electrical Code.

F. CLEANUP

1. During the process of the Work, premises shall be kept reasonably free of all debris, cutting and waste material resulting from the Work under this Section. All such debris and rubbish shall be removed from the site. Upon completion and final acceptance of the Work, all debris, rubbish and left-over materials, tools, and equipment shall be removed from the site.

G. TESTING AND INSPECTION

1. The Contractor shall arrange and pay for all necessary or required inspections by the governmental agencies having jurisdiction to ensure the Work outlined in the Drawings and Specifications complies with the codes. The Architect shall be notified when the Contractor has arranged for inspections.

End Of Section 15300

SECTION 15400-PLUMBING

PART 1: GENERAL

1-01 DESCRIPTION

- A. Related Documents:
 - 1. The other Contract Documents complement the requirements of this Section and apply to this Section
 - 2. Division 1 - General Requirements and Section 15100 and apply to the Work of this Section.
 - 3. Where requirements of this Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.
- B. Codes and Regulations:
 - 1. California Plumbing Code (CPC).
 - 2. California Mechanical Code (CMC).
 - 3. California Building Code (CBC).
 - 4. California Green Building Standard Code.
 - 5. National Fire Code (NFC).
 - 6. National Fire Protection Association (NFPA).
 - 7. Local Building Department.
 - 8. Local Fire Marshal.
 - 9. Office of the State Fire Marshall.
 - 10. Division of the State Architect.
 - 11. Office of the Statewide Health Planning and Development.
 - 12. California Energy Commission.
 - 13. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Architect.
- C. Scope of Work: (Plumbing Section Division 15)
 - 1. Material and labor including rough-in for and connection to fixtures, appliances and equipment are:
 - a. WASTE AND VENT
 - 1. Soil piping

2. Drain waste and vent piping (DWV)
 3. Indirect waste piping
 4. Traps.
- b. SEWERS (To five feet beyond building)
1. Including metallic or non-metallic piping used to convey sewage and other waste to, and including, connection with offsite utility or onsite treatment and disposal system.
- c. WATER
1. Potable water piping systems including above and below grade tanks, pressure reducing valves, relief valves, balancing valves, water hammer shock absorbers, air chambers.
 2. Isolation, Zone and Control Valves.
 3. Hot water systems including heaters and storage tanks.
 4. Disinfecting of water systems.
 5. Insulation of piping and equipment for heat, sound, and vibration.
- d. ALL PLUMBING FIXTURES AND SUPPORTS
1. Including, but not limited to:
 - (a) Sinks, lavatories, water closets, urinals, tubs, service sinks, etc., - all materials
 - (b) Supports (backing) for all plumbing fixtures and accessories
 - (c) Installation of sinks in or part of drain boards - all materials
- e. PIPE IDENTIFICATION – Refer to Section 15100
- f. CONNECTIONS
1. Utilities-Sanitary sewer and water
 2. Temporary water, waste and air lines
 3. The joining of pipe by any mode or method including, but not limited to, acetylene and arc welding, brazing, lead burning, plastics welding, soldering, wiped joints, caulked joints expanded or rolled joints, etc., used in connection with any of the work listed herein.
- g. LAYOUT AND CUTTING

1. Holes, chases, channels, the setting and erection of bolts, inserts, stands, brackets, stanchions, supports, sleeves, escutcheon plates, thimbles, hangers, conduits, and boxes.
- h. TEMPORARY PIPING in connection with:
 1. Building and construction work
 2. Excavating and underground construction
 3. Demolition work
- i. PIPE HANGERS, SUPPORTS, ANCHORS, GUIDES, EXPANSION JOINTS
 1. Including:
 - (a) Supports for equipment to which pipe is connected, such as tank supports
 - (b) Isolators-dielectric and vibration
 - (c) Anchors and thrust blocks of concrete, metal, etc.
 - (d) Seismic bracing
 - (1) Anvil/Badger, Mason Industries, B-Line/TOLCO or approved equal.
 - (2) Seismic hanger system design shall comply with CBC 2013 requirements and ASCE 7-05 and 7-10.
- j. SIGNS AND NOTICES
- k. ROOF FLASHINGS FOR PIPING PENETRATIONS
- l. TESTS
 1. Piping, for tightness
 2. Equipment for performance
 3. Operating instructions
 4. Final operation

1-02 ACCESSIBLE PLUMBING FIXTURES

- A. Accessible plumbing fixtures shall comply with all of the requirements of CBC Section 11B-213, 11B-305, & 11B-308.

1-03 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
- C. Welder's Qualifications: Comply with ASME B31.8. The pipe welder shall have a copy of a certified ASME B31.8 qualification test report. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1-04 SUBMITTALS

- A. Comply with pertinent provisions of Architectural Sections.
- B. Product Data: Within 35 calendar days after the Contractor has received the Notice to Proceed, submit 6 copies of the following to the Architect for approval prior to acquisition:
 - 1. Materials list of items proposed to be provided under this Section.
 - 2. Manufacturer's specifications, catalog cuts, and other data needed to prove compliance with the specified requirements. All pieces of equipment shall be clearly identified on corresponding manufacturer's literature being submitted.
 - 3. Shop Drawings or other data as required to indicate method of installing and attaching equipment, except where such details are fully shown on the Drawings.
 - 4. All submittals for the entire project shall be submitted at the same time. Submittals shall be provided in a tabulated three ring binder or in PDF format. Incomplete or noncompliant submittals may be rejected.

1-05 DESIGN CHANGES CAUSED BY PRODUCT SUBSTITUTIONS

- A. Contractor shall pay costs of design and installation for changes resulting from substitution of alternate products.
- B. Acceptance of alternate products by Architect does not change this requirement.

1-06 PRODUCT HANDLING

- A. Comply with pertinent provisions of Architectural Sections.

PART 2: PRODUCTS

2-01 WASTE, VENT, SEWER AND STORM DRAINAGE

- A. Above Grade

1. All waste, vent, sewer and storm lines shall be of cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888 or ASTM A-74 for all pipe and fittings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.
 - a. Acceptable Manufacturers:
 1. AB&I Foundry
 2. Charlotte Pipe and Foundry
 3. Tyler Pipe Company
 - b. Joints
 1. Standard joints: for hubless pipe and fittings shall conform to the manufacturer's installation instructions and local code requirements. Hubless coupling gaskets shall conform to ASTM Standard C-564 and be listed with NSF International.
 - c. Mandatory Referenced Standards
 1. Cast Iron Soil Pipe Institute Standard Specifications - Latest Issue
 - (a) CISPI 301: Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - (b) CISPI 310: Couplings for use in connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. ASTM Standard Specifications - Latest Issue
 - (a) A-888: Standard Specifications for Hubless Cast Iron Soil Pipe and Fittings.
 - (b) C-564: Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- B. Below Grade:
 1. Schedule 40 Solid wall PVC plastic DWV pipe with solvent-cemented drainage pattern fittings complying with ASTM D 1785 - Latest Issue.
 - a. SCH. 40 Cellular Core PVC plastic DWV pipe with solvent-cemented drainage pattern fittings complying with ASTM D 4396 may be used at Contractor's option for vent piping. -Latest Issue.
- C. Above Grade:

1. Type DWV Copper tube with cast bronze and wrought copper solder drainage fittings, complying with ASTM B-306 - Latest Issue.
- D. Condensate (sized per CMC) and indirect waste drains
1. Type M Copper Water Tube ASTM B88 with wrought Copper solder fittings, ANSI-B16.22

2-02 DOMESTIC WATER PIPING

- A. Above Grade (Distribution System inside building)
1. Piping
 - a. For soldered, brazed, and mechanical joints, 4" and smaller Copper Water Tube Type L Annealed Temper (Hard Drawn) ASTM B75 or ASTM B88.
 2. Fittings
 - a. Wrought Copper Pressure Solder Fittings, ASME B16.22 or ASME B16-25, 95-5 Tin-Antimony Filler Metal.
 - b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - c. Copper Unions: MSS SP-123, cast-copper alloy, hexagonal-stock body, with ball-and-socket, met-to-metal seating surfaces, and solder-joint or threaded ends.
 - d. All underground water piping within the building boundaries shall be ASTM B88-93a Type "L" annealed (soft) copper tube made up without fittings below the floor level.

2-03 VALVES

- A. Acceptable Manufacturers: Milwaukee, Hammond, Jomar, NIBCO, Watts, others as noted.

Type	Size Range	Part Number
Ball	2" and smaller (2 piece)	Milwaukee UPBA400 Hammond UP8301A NIBCO 585-80-LF
Ball	2-1/2" and larger (3 piece)	Milwaukee UPBA300 Hammond UP8604 NIBCO 595Y-LF
Note: Stem extensions of non-thermal-conductive material and protective sleeve that meets UL 2043 approved for inside air plenum and allows operation of value without breaking the vapor seal shall be used on all insulated pipe. NIBCO NIB-Seal handle or acceptable equal.		
Gate	2" and smaller	Milwaukee UP115 Hammond UP645 NIBCO T-113-LF
Gate	2½" and larger	NIBCO F-619-RW
Gate-Underground	3" and larger	Mueller A-2362 NIBCO F-619-RW
Check-Swing	2" and smaller	Milwaukee UP509

Type	Size Range	Part Number
		Hammond UP943 NIBCO 413Y-LF
Check-Spring	2" and smaller	Milwaukee UP548T NIBCO 480Y-LF
Check-Swing	2½" and larger	Apollo 61YLF NIBCO F-910-B-LF
Check-Spring	2½" and larger	NIBCO F-938-33
Gas Cock (ball)	2" and smaller	Milwaukee BA475B Hammond 8901 NIBCO FP600
Gas Cock (plug)	1/2" to 4"	Homestead 611/612 Walworth 1796/1797 (with wrench)

2-04 HANGERS AND SUPPORTS

- A. In general, all pipe hangers and supports shall conform to the following except where special pipe hangers and supports are detailed on the Drawings. In all cases hanger and support details on the Drawings shall take precedent over the following:

Piping 6" Size and Smaller:		
Items	TOLCO	Anvil
Pipe Hanger	1; 2; 200	260
Side Beam Clamp for Wood Joist	58	207
Beam Coupling for Steel Beams	65	92
Rod Coupling for Connection to "Hilti"	70	135
Inserts in Concrete Decks	107; 109A; 109AF	N/A
Trapeze Hangers	Tolstrut A12	AS200
Pipe Clamp	TOLCO cush clamp	AS002OD-AS098D

- B. Similar items by Anvil International, Erico-Caddy, or TOLCO/B-Line will be acceptable.
- C. Hanger Rods shall conform to the following table:

Tube/Pipe Size	Rod Diameter
½" to 4"	3/8"

- D. Trapeze hangers may be used where parallel runs of pipe occur. All rods on trapeze hangers shall be 1/2" minimum size.
- E. Hanger Support Spacing shall be as follows unless shown otherwise on the Drawings:
1. Horizontal:
 - a. Cast Iron: Every other joint unless over 4 feet, then at every joint.

- b. Copper: Every 6 feet for 1-1/2 inch and smaller, and 10 feet for 2 inch and larger.
 - 2. Vertical:
 - a. Cast Iron: Base and every floor not to exceed 15 feet.
 - b. Copper: Every floor not to exceed 10 feet.
- F. Refer to the plumbing code for materials not listed above.
- G. At all points where insulated pipe contacts a hanger or support, the point of contact shall be protected by metal insulation pipe shield #B3153 as manufactured by B-Line. Equivalent pipe protectors will be considered provided the substitute item meets the same standard of quality and performance as the specified item.
- H. Seismic restraint devices
 - 1. Available Manufactureres:
 - 2. Anvil/Badger
 - 3. Mason Industries
 - 4. B-Line Tolco Division of Eaton
 - 5. Seismic hanger system design shall meet the requirements of IBC, CBC and ASCE 7-05 and 7-10.

2-05 **WALL AND FLOOR PENETRATIONS**

- A. Fire walls and floors:
 - 1. Wall and floor penetrations shall be protected with a U.L. approved fire rated system. The system shall be per the Drawing Details, or other manufacturer's installation instructions.
 - 2. Fire stopping materials by Hilti, Metacaulk, or 3M are considered equal. The material shall be the same as called out for in the U.L. approved system.
- B. Poured concrete walls and floors:
 - 1. Pipes penetrating poured concrete walls and floors shall be protected by providing the following:
 - a. A Schedule 40 PVC sleeve one (1) size larger than the pipe or one quarter (1/4) inch of foam material wrapped around and secured to the pipe or packed and caulked with mineral wool.
 - b. Protection shall end flush with the wall or floor surface.
- C. All walls and floors:

1. Piping passing through walls and floors exposed to view shall be provided with chrome plated split-ring escutcheon plates in finished areas. Brass or galvanized escutcheon plates may be used elsewhere.

2-06 **CLEANOUTS**

- A. Provide cleanouts per Drawings and details on Drawings. Cleanouts as manufactured by J. R. Smith, Mifab, Wade, or Zurn are approved equals.
- B. Cleanout tops to be installed with tamper-proof screws.

2-07 **PLUMBING FIXTURES**

- A. Fixture locations, quantities, types, sizes and connections shall be as shown on both the Plumbing and Architectural Drawings. If a conflict in fixture location is noted between the Plumbing and Architectural Drawings, the Architectural Drawings shall take precedence.
- B. Fixtures shall be thoroughly protected against damage to the chrome plate or enamel, by chipping, scratching or other damage during the entire period of construction. Roof drains, floor sinks and drains, toilet and sink drains, plumbing vents, and all other similar fixtures shall be covered to prevent trash from entering the pipes until final installation of grates, domes, fixtures or other protective devices.
- C. Provide fixtures as specified in the Plumbing Schedule. American Standard, Crane, Elkay, Kohler, or Zurn are acceptable substitutes provided they are equal if approved by Engineer.
- D. Fixture carrier numbers listed are as specified on the Plumbing Schedule; however, carriers as manufactured by J.R. Smith, Mifab, Wade, or Zurn are acceptable provided they are equal.

2-08 **CONNECTORS**

- A. Provide Brass Craft "Speedway" or equal heavy pattern iron pipe size brass stops, rigid or flexible supplies and chrome plated brass "P" traps. Stops in "Public" areas are to have screwdriver slots and those in "Private" areas are to have all cross handles.
- B. Provide Brass Craft or equal flexible stainless steel braided water supplies to appliances. They may also be used to fixtures as an option to rigid supplies. Aquaflo is an acceptable substitute.
- C. Provide Brass Craft flexible or equal, stainless steel gas appliance connectors. Dormont is an acceptable substitute. Diameter of connector to be as recommended by manufacturer based on connector length and rated capacity of equipment.

2-09 **ACCESS BOXES**

- A. See section 15100 for access panels.

2-10 **WATER HEATERS**

- A. Provide water heaters as specified in Plumbing Schedule or approved equal of size, capacity, recovery, and KW/BTUH input. American, A.O. Smith and State are considered equal. Heater shall be A.G.A. or U.L. listed.
 - 1. Provide approved flexible copper supplies for the water heater water connections.
 - 2. Instantaneous tankless water heaters shall be with water flow activated switch to energize the electrical/gas power source, a safety high water temperature limit, and all standard factory trim.

2-11 PROTECTIVE INSULATION (ADA FIXTURES)

- A. Provide approved manufactured, molded antimicrobial vinyl protective pipe and fitting covering for exposed waste and drain assembly and for hot and cold water supplies and stops. Protective system shall consist of pre-formed pipe or tubing sleeve and pre-formed fitting patterns for trap and stops. Assembly shall have integral snap fasteners.
- B. Provide protective covering for off-set drain assembly and disposer at kitchen sinks.
- C. Foam pipe wrap, duct tape, baggy-type covers, tie-strap fasteners are not acceptable.
- D. Acceptable manufacturers:
 - 1. Truebro "Lav-Guard"
 - 2. Plumberex "Pro-Xtreme"
 - 3. Zurn #Z89XX-XX

2-12 INSULATION

- A. All pipe insulation shall conform to Section 123 of the California Energy Efficiency Standards except to the extent that this Specification supersedes the minimum standards as established by the Code, in which case this Specification shall take precedent. Outside insulation shall be protected with a hard plastic or metal shell covering.
- B. Insulation material shall meet requirements of flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by Procedure ASTM-E-84, NFPA 255 or U.L.723.
- C. Domestic cold water piping shall be insulated with a minimum 1" insulation in unheated areas of the building and where exposed outside of the building.
- D. Domestic hot water piping shall be insulated with Owens-Corning Fiberglass heavy density pipe insulation 25 ASJ/SSL-II (All Service Jacket/Double/ Self-Sealing Lap). Insulation shall be UL rated non-combustible pipe insulation with a k factor of 0.24-0.28 @ 100 degrees F. mean temperature, an embossed vapor barrier laminated and pressure sealing lap adhesive. All lap and butt strips shall have integral pressure-sensitive strips and shall be applied in strict accordance with manufacturer's instructions.

1. Closed cell polyethylene foam by IMCOA or equal may be used at Contractor's option provided it meets the above requirements.
- E. Insulation thickness' shown below are based on insulation having a conductivity range of 0.24 to 0.28 per BTU/inch per hour per square foot per °F temperature of 100 degrees F.

Temperature Range: Above 105°F	
Pipe Size	Minimum Insulation Thickness
Run outs* up to 2"	0.5"
1" and less	1.0"
1.25" – 2"	1.0"
*Run outs are defined as being less than 2-inches in diameter, less than 12 feet long, and connected to fixtures or individual terminal units.	

- F. Insulation materials not meeting the specified conductivity range shall be submitted for approval and determination of the insulation thickness required.

PART 3: **EXECUTION**

3-01 **GENERAL CONDITIONS**

- A. Examine the areas and conditions under which Work of this Section will be performed. Conditions detrimental to timely and proper completion of the Work shall be brought to the attention of the Architect before the installation of materials. Do not proceed until unsatisfactory conditions are corrected. Incorrectly installed materials requiring changes will be at Contractor's expense.
- B. All plumbing fixtures, appliances, and appurtenances furnished with manufacturer's installation instructions shall be installed per those instructions.

3-02 **PLUMBING SYSTEM LAYOUT**

- A. Lay out the plumbing system in careful coordination with the Drawings. Determine proper elevations for all components of the system and use only the minimum number of bends to produce a satisfactorily functioning system.
- B. Follow the general layout shown on the Drawings in all cases except where other Work may interfere.
- C. Lay out pipes to fall within partitions, walls, or roof cavities, and to not require furring other than as shown on the Drawings.

3-03 **PIPING INSTALLATION**

- A. Pipe sizes as shown on drawings are Nominal Pipe Size (NPS) or Iron Pipe Size (IPS). Drawings and fixture schedule indicate pipe sizing per the CPC and Standard Engineering Practice. Pipe sizes shall be maintained to fixtures, appliances and equipment. Approved reducing fittings shall be installed at all points of connections.
- B. Install piping generally square with building, free of traps or air pockets, and true to line and grade. Keep all piping tight to the building structure, unless pipe slope is required. Do not install piping in any locations where, in the Architect's opinion,

it will interfere with the use of the building or create a safety hazard. Where space is inadequate, notify the Architect in time to avoid unnecessary Work. Install all exposed piping as high as possible without interfering with other trades.

- C. Make changes in direction with manufactured fittings; use long radius elbows. Street elbows, bushings, close nipples and bending of pipe or tubing will not be allowed.
- D. Provide "P" traps at sanitary sewer drainage devices without integral traps.
- E. Use friction wrenches when installing brass, polished, or soft metal piping, and when installing piping exposed in finished areas. Replace piping showing wrench marks.
- F. Attach escutcheon plates to pipes with set screws or spring clamps with concealed hinges. Continue insulation through escutcheon plates.
- G. General:
 - 1. Proceed as rapidly as the building construction will permit.
 - 2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
 - 3. Cut pipe accurately, and work into place without springing or forcing, properly clearing windows, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.
 - 4. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
 - 5. Provide sufficient swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings.
 - 6. Support piping independently at pumps, coils, tanks, and similar locations, so that weight of pipe will not be supported by the equipment. Support the equipment independently from the pipe.
 - 7. Pipe the drains from mechanical equipment, drip pans, relief valves, air vents and similar locations, to an open sight drain, floor drain, or other acceptable discharge point, and terminate with an air break or air gap per C.P.C.
 - 8. Securely bolt all equipment, isolators, hangers, and similar items in place.

3-04

PIPE SUPPORT INSTALLATION

- A. Support pipes from structure with assemblies specified. Provide auxiliary members, anchors, guides, and sway braces necessary to maintain pipe alignment and prevent excessive movement or strain on piping system or components; allow for expansion and contraction of piping. Provide at least one hanger for each branch. Do not use powder driven fasteners, wire, perforated tape, nails, wood blocking, or other makeshift devices to support pipe.

- B. Attach supports to structure with bolts, screws or concrete anchors, per support manufacturer's requirements.

3-05 JOINTS AND CONNECTIONS

- A. Cut pipe shall be reamed to full inside diameter of pipe. Cut threads straight and true. Insure all filings have been removed from inside of the pipe. Apply liquid Teflon to male pipe threads and not inside fittings. Use graphite on cleanout plug threads.
- B. Joints in cast iron "No-Hub" soil/waste pipe and fittings shall be made up with neoprene gaskets and stainless steel bands conforming to CISPI 310, torque to the manufacturer's specification with an approved torque wrench. Joints in hub and spigot shall be made up with compression gaskets conforming to ASTM C-564.
- C. Joints in copper tube shall be made with 95-5 tin-antimony or lead-free solder, applied in strict accordance with the manufacturer's directions.
- D. Dissimilar metals shall be isolated with dielectric couplings, "EPCO" or approved equal. Provide access panels at all hidden couplings.
- E. All plastic pipe shall be joined in accordance with the manufacturer's recommendations for their pipe and IAPMO Installation Standard per the latest edition of the C.P.C.
- F. Pipe Protection: Provide protection against abrasion where copper tubing is in contact with other building members by wrapping with an approved tape, pipe insulation or otherwise suitable method of isolation.
- G. Penetration Protection: Provide allowance for thermal expansion and contraction of copper tubing passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation, or by installing through an appropriately sized sleeve. Penetrations of fire resistance rated assemblies shall maintain the rating of the assembly

3-06 SANITARY SEWER, VENT AND INDIRECT WASTE SYSTEM INSTALLATION

- A. Install horizontal drainage piping at a minimum 2%, condensate 1%, slope unless otherwise noted. Where this is impractical notify the Architect before installing the pipes.
- B. Install vent piping to drain back into the sewer system.
- C. Provide cleanouts where shown on Drawings and where required by governmental agencies having jurisdiction.

3-07 VALVE INSTALLATION

- A. Provide valves in the water systems. Locate and arrange so as to give a complete regulation of apparatus, equipment, and fixtures.
- B. Provide valves in at least the following locations:
 - 1. In branches and/or headers of water piping serving a group of fixtures.

2. On both sides of apparatus and equipment.
 3. For shutoff of risers and branch mains.
 4. For flushing and sterilizing the system.
 5. Where shown on the Drawings.
- C. Locate valves for easy accessibility and maintenance. Provide access panels for all hidden valves.
 - D. Unions shall be installed downstream of all screwed valves.

3-08 PLUMBING FIXTURE INSTALLATION

- A. Connect plumbing services to fixtures as shown on Drawings and as specified.
- B. Provide & install compression stops and flexible supplies per fixture manufacturer's recommendation or as high as possible on wall directly below fixtures.
- C. Install fixtures at right angles to, and tightly against, building surfaces, and in proper alignment. Fill gaps between fixtures and building surfaces with white grout. Mounting heights and locations shall be as shown on the Drawings, or, if not shown, as directed by the Architect.

3-09 INSULATION INSTALLATION

- A. Ensure surfaces are clean and dry surfaces to application of insulation or adhesives.
- B. Insulate piping, fittings, valves, and strainers. Leave unions exposed. Where insulation terminates, bevel ends of insulation and continue jacket over insulation and secure to pipe. Do not interrupt insulation at hangers, supports, clamps, or penetrations through structure. Fittings shall be finished with "Zeston" or approved equal fitting closures. If fitting closures not available, use 8 oz. canvas dipped in "Seal-Fas".
- C. Attach longitudinal jacket laps and butt strips with factory applied pressure sensitive adhesive. On concealed piping only, outward clinching coated staples at two inch spacing may be used. Cover elbows with one piece polyvinyl chloride covers. Secure with tack fasteners. Tape ends of covers with matching tape on exposed piping. Seal off all cut ends with canvas and Benjamin Foster 30-36.
- D. Install closed cell polyethylene foam per manufacturer's instructions.

3-10 TESTING AND ADJUSTING

- A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and inspections required by governmental agencies having jurisdiction. See Section 15100 for test requirements.
- B. Where tests show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.
- C. Adjust the system to optimum standards of operation.

3-11**CLEANING (FOR POTABLE WATER SYSTEMS)**

- A. Disinfection: The hot and cold water distribution system shall be disinfected prior to being placed in service. The system shall be disinfected within 3 weeks of occupancy in accordance with AWWA C651 or the following requirements:
1. The piping system shall be flushed with potable water until discolored water does not appear at any of the outlets.
 2. The system shall be filled with a water chlorine solution containing at least 50 parts per million of chlorine. The system shall be valved off and allowed to stand for 24 hours. Or, the system shall be filled with a water chlorine solution containing at least 200 parts per million of chlorine. The system shall be valved off and allowed to stand for 3 hours.
 3. Following the standing time, the system shall be flushed with water until the chlorine is purged from the system.
 4. Provide bacteriological sampling and analysis results to the Engineer for review.

3-12**WARRANTY**

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or owner.

END OF SECTION 15400

SECTION 15600-HEATING, VENTILATION, AND AIR CONDITIONING

PART 1 - GENERAL

1-01 DESCRIPTION:

- A. Related Documents:
 - 1. The other Contract Documents complement the requirements of this Section and apply to this Section.
 - 2. Division 1 - General Requirements and Section 15100 and Section 15995 HVAC and Plumbing Commissioning apply to the Work of this Section.
 - 3. Where requirements of the Section exceed those in other Contract Documents, Contractor shall comply with the requirements of this Section.
- B. Codes and Regulations:
 - 1. In addition to complying with the specified requirements, comply with pertinent regulations of governmental agencies having jurisdiction.
 - 2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Architect.
- C. Included: Work includes, but is not necessarily limited to, the following.
 - 1. The Work covered by this Specification shall include furnishing labor, material, equipment and services to construct, install and place in operation, the complete Heating, Ventilating and Air Conditioning Systems to the extent as indicated, and as shown on the Drawings and specified herein. The Work covered under this Section shall hereinafter be referred to as the Mechanical System.
 - 2. A system of temperature controls shall be furnished and installed complete as hereinafter described. Low voltage wiring and conduit, complete with electrical accessories and materials as required for the installation of the temperature control system shall be furnished and installed under this Section of the Contract, but shall conform to the Specification requirements as set forth under Division 16.
 - 3. Variable air Volume Boxes
 - 4. Hot and Chilled Water piping
 - 5. Fan Coil Units
 - 6. Condensing Units
 - 7. Heat Pump Units
 - 8. Supply, return, and exhaust duct systems complete with grilles, registers and diffusers.
 - 9. Duct, Pipe and Equipment Insulation

10. Space Temperature Controls
11. Refrigerant Piping
12. Fire Dampers
13. Smoke Dampers
14. Vibration Isolators

D. Work Not Included In This Section:

1. Blocking, framing and wood supports required for the purpose of accommodating the Mechanical System unless specifically called for under this Division. The contractor is responsible for the correct location of such items and shall bear the expenses covering their omission or improper location.
2. Electrical connections to motors, electric starters, disconnect and over-current protective devices, unless specifically called for by this Section, or unless the equipment is furnished as an integral part of the Mechanical System Equipment, as hereinafter specified or noted on the Drawings.
3. Line voltage electrical wiring and conduit, except where specifically called for on the Drawings or hereinafter in this Section.
4. Painting, except when supplied as factory finish, or specifically called for in this Section or on Drawings.

1-02 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the Work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1-03 SUBMITTALS

- A. Comply with pertinent provisions of Architectural Section.
- B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit the following to the Architect for approval prior to acquisition:
 1. Materials list of items proposed to be provided under this Section including, but not limited to heating, ventilating and air conditioning equipment and mountings, air distribution equipment, ductwork and fittings, flexible ductwork, flue vent pipe, duct specialties, flexible

connections, insulation, lining and adhesive, duct joint sealer, temperature controls, piping and accessories.

2. Manufacturer's specifications, catalog cuts, and other data needed to prove compliance with the specified requirements. All pieces of equipment shall be clearly identified on corresponding manufacturer's literature being submitted.
3. Submittals for entire Project shall be submitted at the same time or may be rejected until all are included in one submittal package.
4. Submittals shall be provided in a single pdf file.

1-04 DESIGN CHANGES CAUSED BY PRODUCT SUBSTITUTIONS

- A. Contractor shall pay costs of design and installation for changes resulting from substitution of alternate products.
- B. Acceptance of alternate products by Architect does not change this requirement.

1-05 PRODUCT HANDLING

- A. Comply with pertinent provisions of Architectural Sections.

PART 2 - PRODUCTS

2-01 HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

- A. Heating, Ventilating, and Air Conditioning Equipment: Equipment shall be as specified on the Drawings. All other equipment shall be pre-approved by the Mechanical Engineer.
- B. It shall be the responsibility of the Contractor to see that any substituted equipment performs similarly to that which is specified and fits in the same area as specified. Cost of any additional Work caused by the substitution of equipment shall be borne by the Contractor.

2-02 AIR DISTRIBUTION EQUIPMENT

- A. Grilles, registers and ceiling diffusers and other accessory equipment shown on the Drawings and "Grille, Register and Diffuser Schedule" shall be manufactured by Titus unless shown otherwise.
- B. Any substitutions of the above equipment which may be proposed by the Contractor shall be re-sized to suit his equipment by the proposed manufacturer and submitted in tabular form listing components proposed for each location in the System, identifying each as to location, design, air quantity passing through the devices, pressure drop, noise criteria data, velocities of air leaving the device and "K" flow factors for each item. Manufacturer's data sheets showing dimensions and recommended method of installation for each component must also be included.

2-03 CONTROL DAMPERS

- A. In all other locations provide Greenheck model VCD-23, class 1 @ 4"wg as scheduled on plans. Damper frame shall be stainless steel, formed into a 5" X 1" structural hat channel. Blades shall be 16 gauge stainless steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Blade seals shall be Silicone. Jamb to be flexible stainless steel compression type. The linkage shall be concealed in the frame out of the air stream, stainless steel material. The Axle shall be stainless steel. Bearings to be stainless steel. Finish shall be Hi-Pro polyester power coated.

2-04 RECTANGULAR SHEET METAL DUCTWORK

- A. Rectangular supply, return, outside air and exhaust ducts, single leaf dampers and plenums shall be fabricated from prime grade galvanized steel sheets of lock form quality and shall be constructed in accordance with appropriate tables of the latest ASHRAE "Guide and Data Book" and SMACNA "HVAC Duct Construction Standards" handbook and Chapter 6 of the 2013 CMC.
- B. Transverse Duct Joints shall be made with The Ductmate System. When using The Ductmate System, construction of the duct such as gage, reinforcing, etc. shall be as indicated in the latest addition of the applicable SMACNA standards. With proper data, an equal may be submitted, providing the corners have a downset and corner clips to insure airtight integrity. Testing must be done by a nationally recognized testing laboratory. The standard Ductmate 35 System joint is the equivalent of a SMACNA "J" connection. The Ductmate 25 System joint is the equivalent of a SMACNA "F" connection. The installation of the Ductmate System shall be in accordance with the latest manufacturer's printed Assembly and Installation Instructions.
- C. Each duct or plenum shall be diagonally cross-broken for rigidity.
- D. Duct bends, fittings, transitions, etc. shall be fabricated in accordance with Fabrication Standards as shown on the Drawings or in accordance with latest SMACNA "HVAC Duct Construction Standards" where not shown on Drawings.
- E. Support ducts to joists or similar structural members. Except where indicated otherwise, ducts with a side of 24" or more shall be supported on Ductmate trapeze duct hangers consisting of 2" high x 1-1/2" wide x 18" gauge channel and 3/8" diameter hanger rods hung from support brackets bolted to structural members. See also Special Fabrications as shown on the Drawings. Duct supports shall be eight (8) feet maximum on center.
- F. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gages heavier than the duct (if single leaf type) in which installed, and equipped with locking quadrants and closed end bearings.
- G. Sizes shown on Drawings are net inside dimensions. Enlarge duct to accommodate lining.

2-05 ROUND DUCTWORK AND FITTINGS

- A. 2-10" w.g. round duct through 61" in diameter shall be United Sheet Metal spiral lockseam unseal duct, or approved equal, manufactured from galvanized steel meeting the ASTM A-527-71 in the following gages:

Diameter	Metal Thickness
3-13"	26 ga.
14-23"	24 ga.

- B. Round duct shall be new and exclusively obtained for this project. Each piece shall be in 20' lengths. Ducts shall be cut to length required with joints only at fitting locations, except on duct runs longer than 20 feet.
- C. Spiral duct and fitting connections, 15" diameter and larger shall be Ductmate Spiralmate round duct connectors. The connector system shall consist of two mating round duct connector flanges roll-formed from hot dipped galvanized steel with an integral sealant and closure ring roll-formed from hot dipped galvanized steel.
- D. Fittings shall be United Sheet Metal galvanized fittings in the following gauges:

Diameter	Metal Thickness
3-13"	24 ga.
14-23"	22 ga.

- E. Spiral duct fittings must be manufactured as separated fittings and shall not be saddle taps, stubs or tap-in fittings tapped into spiral duct, nor may they be dove-tailed tap-ins into pipe or fittings.
- F. Reducers shall occur after a branch tap occurs on the main portion of the fitting. Divided-flow fittings shall be used unless shown otherwise on the Drawings.
- G. Joints on ducts and fittings shall be covered and sealed with 4" wide, 6 oz. canvas saturated with Arabol lagging adhesive, or Hardcast DT tape in conjunction with Hardcast FTA-20, non flammable, non-toxic adhesive, or GlenKote duct sealer or other approved mastic type sealer. Duct tape will not be allowed. Where exposed to weather, paint lagging strips with two coats of silver enamel paint.
- H. All ductwork shall be constructed in accordance with appropriate tables of the latest ASHRAE "Guide and Data Book" and SMACNA "HVAC Duct Construction Standards" handbook and Chapter 6 of the 2019 CMC. Duct gauges to be in accordance with 2.6.A and 2.6.D of this section.
- I. At branch ducts, provide manually operated dampers of the type and arrangement shown on the Drawings, two gages heavier than the duct (if single leaf type) in which installed and equipped with locking quadrants and closed end bearings.

2-06 FLEXIBLE DUCT

- A. Flexible air duct shall be Hart & Cooley Model F218. Duct shall consist of an inner core having two layers of polyester film encapsulating a steel wire helix surrounded by a blanket of fiberglass insulation and sheathed in a metalized polyester vapor barrier reinforced with fiberglass scrim. All air ducts shall be UL listed under the UL-181 standard as a Class 1 Air Duct also conforming to NFPA standards 90A and 90B. This air duct shall have a certified thermal resistance rating of R-8 in accordance with ASTM C518 at 75°F and carry the ADC "Thermal Performance" seal.

- B. Use only the minimum length required to make the connection. In no case shall any section of flexible duct exceed 5 feet in length.
- C. Use two layers of UL listed 181 duct tape to connect flexible duct to the metal duct if flexible duct does not have S.M. collars.
- D. The number of bends shall not exceed a combined total of 90 degrees. 90 degree bends will not be allowed at diffuser connections.

2-07 FLUE VENT PIPE AND FITTINGS

2-08 DUCT SPECIALTIES

- A. Damper Regulators and Bearings: Duro-Dyne "Specline" SR-Series or approved equal, lever type with matching end bearing. Regulator set shall include rubber gasket between regulator and duct, spring washer between core and housing, wedge pin, dial indicator and handle. Matching end bearing shall be closed end with rubber gasket:

Model	Size
148	10" and Under
388	20" and Under
128	21" and Above

- B. Access Panels: Access panels shall be located at all points where adjustable mechanisms are installed internal to or on the surfaces of the ductwork. Where adjustable mechanisms are concealed by walls or ceilings, "Elmdor" or approved equal access doors shall be installed. Size shall be suitable for convenient servicing. Tile Walls: Doors and Frame: Stainless Steel. Other areas: recess type to receive ceiling or wall finish in order to provide "Blind Finish".
- C. Fire Dampers: Fire dampers shall be installed where shown on the Drawings and/or required, and shall be of a type approved by the U.L. Laboratories, Inc. and the State of California Fire Marshal. Dampers shall be installed per manufacturer's instructions. Provide access door in duct at each fire damper such that damper is easily accessible.
- D. Volume Dampers:
 - 1. In rectangular ducts greater than 1.5 sq. ft., provide Pottorff Model CD42, or equal, factory fabricated opposed blade damper, 16 gauge blades, and brass bearings. Blade width shall not exceed six inches.
 - 2. In rectangular ducts 1.5 sq. ft. and less, provide single leaf dampers as described in Section 15600, 2.3 (a. and g.).
 - 3. In round ducts 15" in diameter and less, provide shop fabricated galvanized sheet metal plate dampers. Plate shall be 18 gauge or shall be two even gauges heavier than duct; minimum thickness 22 gauge. Provide stiffening beads at 1/3 points in dampers lighter than 18 gauge.
 - 4. In round ducts 16" and greater, provide Pottorff opposed blade damper Model CD22R or approved equal.

5. In round ducts 4" – 24" in diameter, above "hard" ceilings, provide DuroZone Cable Operated Damper. Cable length to be between 3 and 15 FT long. Contractor to determine proper length to be use.
- E. Provide 20 gauge galvanized sheet metal escutcheon plates at duct penetrations of finished building surfaces. Install tight against surface and securely attached to duct. Continue insulation through openings.
- F. Duct Mounted Access Doors:
1. In rectangular duct provide, DuroDyne Model IAD, Ductmate "Sandwich", or equal, insulated, duct mounted access doors with Cam-Lock operated latches where shown on drawings or required for access to duct mounted equipment. Doorframe shall be 24-gauge with double wall door and 1/2" glass fiber insulation. Size doors to provide easy access to equipment.
 2. In round ducts, provide Ductmate - METU round duct access doors, fully insulated, with attached gasket and springs between inner and outer door. Access doors shall be as large as practical as duct size will allow.

2-09 FLEXIBLE CONNECTIONS

- A. Provide fireproof, insulated, non-porous, flexible connections between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connections by zinc coated steel clinch-type drawbands. Flexible connections shall be DuroDyne "Insulfab" or "Insulflex" or approved equal.
- B. Provide a duct support next to each flex connector to prevent any strain on connection.

2-10 HOT WATER PIPING

- A. Above Grade Hot Water Pipe: Piping shall be type L (ASTM 88) copper tubing with cast bronze or wrought copper fittings. Solder shall be streamline 95-5 (no lead with flux as recommended by manufacturer).

2-11 HOT WATER VALVES

- A. Two-way Automatic Temp. Valve (ATV) piping assembly:
1. Manufacture shall be Flow Design, Inc.
 2. Supply waterside: Model YC, to include integral combination ball valve, Y-strainer and union with two P/T=s, air vent and hose end drain valve with cap chain.
 3. Return waterside:
 - a. Downstream of ATV: Model AP, to include integral manual calibrated balance valve with P/T ports, union and shut-off valve.
 - b. Upstream of ATV: Model UP, to include integral union and manual air vent and P/T plug.
- B. Three-way Automatic Temp. Valve (ATV) piping assembly:

1. Manufacturer shall be Flow Design, Inc.
 2. Supply Water Side: Model YC, to include integral combination ball valve, Y-strainer and union with two P/T=s, air vent, by-pass adapter and hose end drain valve with cap and chain.
 3. Return water side:
 - a. Downstream of ATV: Model AP, to include integral manual calibrated balance valve with P/T ports, union and shut-off valve.
 - b. Upstream of ATV: Model UP, to include integral union and manual air vent and P/T plug.
 - c. By-pass side of ATV: Model HC, to include ball valve with memory stop and union.
- C. Valves and fittings not at coil connections:
1. Shut off valves (S.O.V.) shall be Nibco ball valves, or as indicated.
 2. Unions shall be Mueller Streamline, Type No. C-107 or equal.
 3. Dielectric fittings shall be EPCO or Mahoney used for connecting of ferrous and non-ferrous metals.
 4. Install unions as required to allow removal of any or all equipment.

2-12

CHILLED AND HOT WATER PIPE, FITTINGS AND VALVE INSULATION

- A. Manville micro-lok fiberglass pipe insulation, AP-T type, K factor of .23 at 75°F Zeston 2000 PVC insulated pipe fitting and installed per manufacturer's recommendations.
- B. Pipe exposed to weather shall be covered with metal or aluminum jacket installed per manufacturer's recommendations.
- C. Insulation thickness:

Fluid	Pipe Size	Insulation Size
Hot Water – Run-Outs	½-2"	½"
Hot Water – Main Lines	½ -8"	1 ½"

2-13

PIPE HANGERS AND SUPPORTS

- A. In general, pipe hangers and supports shall conform to the following except where special pipe hangers and supports are detailed on the Drawings. In cases hanger and support details on the Drawings shall take precedent over the following:

Pipe 6" Size and Smaller	
Items	Superstrut Number
Pipe Hanger	710
Side Beam Clamp for Wood Joist	540
Beam Coupling for Steel Beams	U563-U562

Rod Coupling for Connection to "Hilti"	H-119
Inserts in Concrete Decks	
Trapeze Hangers	A1200-A1202
Pipe Clamp	A716 or 701W/S-716

- B. Similar items by Unistrut, Securstrut, Michigan, or B-Line will be acceptable.
- C. Hanger Rods shall conform to the following table:

Tube/Pipe Size	Rod Diameter
1/2 to 4"	3/8"

- D. Hanger Support Spacing shall be as follows unless shown otherwise on the Drawings:
1. Horizontal:
 - a. Copper: Every 6 feet for 1-1/2 inch and smaller, and 10 feet for 2 inch and larger.
 - b. Steel, Gas: Every 6 feet for □ inch, 8 feet for 3/4 inch and 1 inch, and 10 feet for 1-1/4 inch and larger.
 2. Vertical:
 - a. Copper: Every floor not to exceed 10 feet.
 - b. Steel, Gas: Same as horizontal spacing except 1-1/4" and larger at every floor.

2-14 **DAMPER ACTUATOR**

- A. Actuators shall be Belimo. Substitutions will not be acceptable. Actuator shall be direct coupled over the shaft, spring return type, unless specified otherwise

2-15 **ELECTRICAL EQUIPMENT**

- A. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for motor control specified. Mount starter adjacent to equipment. See electrical drawing. Maintain minimum of 3' clearance to front of device.
- B. Motor Starters: Shall be NEMA I or III as appropriate, general purpose, weather-resistant, with watertight enclosure where required.

2-16 **INSULATION**

- A. General: Insulation and lining material shall meet requirements of flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by Procedure ASTM-E-84, NFPA 255 or U.L. 723 and shall conform to NFPA 90A and 90B.
- B. Heating and cooling duct and related heating and cooling equipment insulation shall conform to 2015 Building Energy Efficiency Standards, Administrative Regulations, Title 24, Part I, Section 124, except to the extent that this Specification

supersedes the minimum standards as established by the Code, in which case this Specification shall take precedent.

- C. Unless noted otherwise, insulation shall be Fiberglass, or approved equal material. Application Work shall be performed in accordance with the best accepted practice of the trade and the manufacturer's recommendations. The performance of insulation Work shall be by experienced insulation applicators. Insulation shall be installed after the specified tests have been applied to the piping and duct systems, and the systems have been inspected and approved. Fiberglass trade names and/or numbers have been used to establish a standard of quality.
- D. External Duct Insulation – Outdoors, in a space between the roof and an insulated ceiling, in a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces, in an unconditioned crawlspace; or other unconditional spaces: Shall be applied to concealed heating and cooling, supply and return duct except duct that is internally lined. Insulation on duct shall be Manville Microlite FSK duct insulation, 3" thick, minimum installed R value of 8.0 or greater, FSK aluminum foil reinforced with fiberglass, scrim laminated to U.L. rated Kraft, or approved equal. Adhere to duct surfaces with Foster's 85-62 or approved equal, adhesive applied in strips of 6" wide on approximately 12" centers. Circumferential seams shall be butted together and sealed over joints with 3" wide pressure sensitive foil vapor barrier tape. Longitudinal edges shall be lapped 2" and secured with outward clinching staple 6" on center then sealed with pressure sensitive foil vapor barrier tape. Duct wrap shall be installed to allow maximum fullness at corners (avoid excessive compression) minimum thickness at corners shall be 1". Where ducts are over 24" in width, the duct wrap shall be additionally secured to the bottom of the rectangular ducts with mechanical fasteners spaced on 18" centers (Max.) to prevent sagging insulation.
- E. External Duct Insulation – All other locations not listed above: Shall be applied to concealed heating and cooling, supply and return duct except duct that is internally lined. Insulation on duct shall be Manville Microlite FSK duct insulation, 2" thick, type 100, minimum installed R value of 6.0 or greater, FSK aluminum foil reinforced with fiberglass, scrim laminated to U.L. rated Kraft, or approved equal. Adhere to duct surfaces with Foster's 85-62 or approved equal, adhesive applied in strips of 6" wide on approximately 12" centers. Circumferential seams shall be butted together and sealed over joints with 3" wide pressure sensitive foil vapor barrier tape. Longitudinal edges shall be lapped 2" and secured with outward clinching staple 6" on center then sealed with pressure sensitive foil vapor barrier tape. Duct wrap shall be installed to allow maximum fullness at corners (avoid excessive compression) minimum thickness at corners shall be 1". Where ducts are over 24" in width, the duct wrap shall be additionally secured to the bottom of the rectangular ducts with mechanical fasteners spaced on 18" centers (Max.) to prevent sagging insulation
- F. Internal Duct Insulation - Outdoors, in a space between the roof and an insulated ceiling, in a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces, in an unconditioned crawlspace; or other unconditional spaces: Shall be applied to all heating and cooling supply and return duct and plenums on roof or where shown on Drawings. Manufacturer shall be Manville Microlite, or approved equal. Duct Liner shall be Linacoustic R, 2" thick, 1.5 pcf, with a "K" value of 2.2 in. for a total "R" installed value of 8 or

greater. Insulation shall withstand velocities of up to 5000 FPM and temperatures up to 250 degrees F.

- G. Internal Duct Insulation – All other spaces not listed above: Shall be applied to all heating and cooling supply and return duct and plenums where shown on Drawings. Manufacturer shall be Manville Microlite, or approved equal. Duct Liner shall be Linacoustic R, 1 ½" thick, 1.5 pcf, with a "K" value of 2.2 in. for a total "R" installed value of 6 or greater. Insulation shall withstand velocities of up to 5000 FPM and temperatures up to 250 degrees F
- H. Portions of duct receiving Duct Liner shall be completed with transverse joints neatly butted with no gaps or interruptions. The duct liner shall be adhered to the sheet metal with 100% coverage of adhesive and exposed leading edges and transverse joints coated with adhesive. Adhesive shall be a water-based product. In addition, this shall be secured with mechanical fasteners which shall compress the liner sufficiently in place. The liner shall be cut to assure overlapped and compressed longitudinal corner joints. Application procedures shall comply with the recommendations of the Sheet Metal and Air Conditioning Contractor's National Association's Duct Liner Application Standard, Second Edition.
- I. External Duct Insulation Exposed to Weather: Shall be applied to heating and cooling supply and return ducts and plenums exposed to weather if not noted to be internally insulated. Insulation shall be Knauf Type ASJ, or approved equal, rigid board fiberglass, 3.0 # per cubic foot minimum density, 2" min. thickness, 8.0 min. R value. The board shall be neatly cut and fitted to the surface with joints tightly butted together and against standing seams. The insulation shall be secured to the duct with adhesive and mechanical fasteners starting 3" from butt joints and 18" on center each direction. Vapor-barrier tape shall be then applied over joints, seams, breaks and any penetrations of the insulation vapor barrier jacket. A weather-barrier mastic compound reinforced with fabric or mesh shall be applied as a finish coat. Finish by painting with two (2) coats of aluminum paint.
- J. Ducts: Ducts shall be constructed, installed, sealed and insulated in accordance with the 2019 CMC. The above paragraph(s) shall supersede if more stringent.

2-17 **TEMPERATURE CONTROLS**

- A. Temperature controls shall be furnished as indicated in schematic Drawing on Plans including room thermostats, relays and other necessary combustion, operating and safety controls.
- B. Wiring and Conduit
 - 1. Control wiring and conduit shall be the responsibility of this section and be installed as follows:
 - a. In equipment rooms/attics – Conductors shall be run in conduit. Final connection to equipment shall be flexible conduit.
 - b. Concealed in building construction (wall/inaccessible ceilings) - Conductors shall be run in conduit.

- c. Roof mounted/exterior equipment yards – Conductors shall be in conduit. All flexible conduit shall be seal-tite with weatherproof connections. Equipment on grade and detached from the building a distance greater than 36" shall have underground control conduit routed to equipment.
 - d. Above accessible ceiling spaces – Control cable will be allowed to be installed without conduit in accessible areas above ceilings as follows:
 - 1. Cable is an approved type for the application.
 - 2. Cable is bundled/organized in management devices routed square with building lines (no diagonals) and kept clear of electrical devices (i.e., ballasts, transformers, etc.) that could cause interference.
 - 3. Conduit sleeves are provided between accessible ceiling spaces (i.e., across soffits, gypboard ceilings, etc.) as required to maintain future access to cable.
 - e. Cable routed in accessible ceiling spaces shall comply with EIA/TIA standards for communications cabling. Communication bus wire shall be W183C-2058Y Connect Air, yellow shielded cable.
- C. Electric wiring, conduit and other electric devices required to complete the installation of the temperature control systems shall comply with requirements as set forth in the Electrical Section of this Specification.
- D. After completion of the installation, the Contractor shall adjust thermostats, motors and other equipment provided under this Contract. He shall place them in complete operating condition subject to approval of the Architect.
- E. The Control System herein specified shall be free from defects in workmanship and material under normal use and service. If, within twelve (12) months from date of acceptance by the Architect, any of the equipment herein described is proved to be defective in workmanship or material, it will be adjusted, repaired or replaced free of charge by the Contractor.
- F. The final connections and supervision of control wiring and interlock wiring shall be the responsibility of this Contractor.
- G. The Contractor shall submit to the Architect for approval, the required number of shop drawings of the entire control system before starting Work.
- H. Upon completion of the Work, the Contractor will provide diagrammatic layouts of the Automatic Control Systems specified herein. Layouts shall show control equipment and the function of each item shall be indicated.
- I. The temperature control system shall be installed by persons in the direct employment of the temperature controls manufacturer(s) exclusive contracting representative. The Mechanical Contractor shall not install the temperature controls unless pre-approved by the Mechanical Engineer.

- A. Refrigerant piping shall be flushed clean with nitrogen and the ends capped prior to installation. Refrigerant piping shall be Type L copper with wrought copper fittings. Use 45% minimum silver brazing alloy with melting point higher than 1100 F. for making the joints.
- B. Insulate refrigerant suction line with 3/4" thick Owens-Corning Fiberglass or Armstrong Armaflex foamed plastic flexible tubing insulation applied with No. 500 adhesive. Use multiple layers and miter insulation to cover joints and all other items as required to prevent condensation.
- C. VRF and Heat pump systems: Insulate all refrigerant lines with 3/4" thick Owens-Corning Fiberglass or Armstrong Armaflex foamed plastic flexible tubing insulation applied with No. 500 adhesive. Use multiple layers and miter insulation to cover joints and all other items as required to prevent condensation.
- D. When piping & insulation are installed outside of building, insulation shall be aluminum jacketed. Jacketing shall be minimum 0.016" thick, 3105 or 3003 alloy aluminum with moisture barrier & stucco embossed finish. Provide aluminum elbow covers at all pipe bends equivalent in construction to jacketing.

2-19 REFRIGERANT PIPING ACCESSORIES

- A. Stop valves shall be Henry Type 622, 500 psi pressure rating brass, soldered, packless diaphragm, globe shut-off pattern.
- B. Solenoid valves shall be Sporlan Type MA14, 450 psi rating, brass body.
- C. Filter dryer shall be Sporlan "Catch-All" with soldered connections.

PART 3 - EXECUTION

3-01 SURFACE CONDITIONS

- A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3-02 COORDINATION

- A. Coordinate as required with other trades to assure proper and adequate provision in the Work of those trades for interface with the Work of this Section.

3-03 PREPARATION

- A. Holes in concrete:
 - 1. Provide sleeves, accurately dimensioned and shaped to permit passage of items of this Section.
 - 2. Deliver such sleeves, with accurate setting drawings and setting information, to the trades providing the surfaces through which such items must penetrate, and in a timely manner to assure inclusion in the Work.
- B. Flashing:

1. Where items of this Section penetrate the roof, outer walls, or waterproofing of any kind, provide under this Section base flashing and counterflashing required at such penetration.
2. Provide on each pipe passing through the roof a 4 pound seamless lead flashing and counterflashing assembly.

3-04 GENERAL INSTALLATION REQUIREMENTS

- A. Conceal piping, ductwork, and equipment in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify Architect in time to avoid unnecessary Work. Do not cut or notch structural members without specific approval of the Architect.
- B. Follow manufacturer's instructions on items not specifically covered in drawings and specifications. Report discrepancies to Architect for clarification before starting Work.

3-05 EQUIPMENT INTERFACE

- A. Provide required shut off valves, unions, and final connections of piping to the Work of this Section.
- B. For electrically operated equipment, verify the electrical characteristics actually available for the Work of this Section and provide equipment meeting those characteristics.

3-06 PAINTING

- A. Paint inside of air outlets and connecting plenums with one coat of black paint, or provide all such items factory prepainted.
- B. For roof-mounted equipment, provide factory pre-finish on exposed surfaces.
- C. Touch-up scratches and abrasions to be invisible to the unaided eye from a distance of 5 feet.

3-07 INSTALLATION OF DUCTWORK

- A. Ductwork shall be delivered to the Project site with surfaces clean and free of loose dirt and rust. Special care shall be exercised by the Contractor to store the duct in a clean area to prevent the accumulation of dirt prior to installation. Fabricated or partially fabricated duct sections shall not be stored in open fields or on dirt areas surrounding the construction site. Paved areas may be used, if available, provided adequate protection is provided to prevent the accumulation of dirt on duct surfaces. If possible, the Contractor should arrange to deliver duct to the project site and store on the floor of the area in which it is to be installed.
- B. Before installation of ductwork, the Contractor shall inspect each section of duct and wipe internal surfaces clean. At the end of each Work period, or when ends of duct are left installed for future extension, the open ends shall be tightly closed off with a plastic sheet and taped securely to the open end of the duct.

- C. Construct and install sheet metal in accordance with latest SMACNA recommendations. Provide variations in duct size and additional duct fittings as required and approved by the Architect at no extra cost to the owner.
- D. The throat radius of bends shall be 1-1/2 times the width of the duct. Provide turning vanes in any mitered turn greater than 45 degrees.
- E. Transition slopes shall be no less than one to five where space permits.
- F. Abrupt offsets in the duct system greater than 30 degrees will not be allowed.

3-08 TEMPERATURE CONTROL INSTALLATION

- A. Install wiring and tubing parallel to walls and floors and securely clipped to structure or mechanical system components. Group parallel runs for neat appearance.
- B. Install room thermostats and other control devices at 48 inches above finished floor unless a lower mounting height is required for access by handicapped.
- C. Install outside air sensor in a location where it is not directly effected by radiation from the sun or any heat generating device or by a conditioned air stream or any other location that would produce a false reading.
- D. Upon completion of the installation calibrate all equipment and adjust controls for proper operation.

3-09 REFRIGERANT SYSTEM CHARGING PROCEDURE

- A. Pressurize the system with refrigerant and hold for 24 hours with no drop in pressure; test joints and equipment for evidence of leaks after satisfactory pressure test.
- B. Provide 1/2" angle type charging and purging valves adjacent to high and low side of the condensing unit to accomplish the procedure described hereinafter. Connect the vacuum pump to both the high and low side of the system. Do Work when ambient air temperature is above 60 degrees F during the evacuation process.
- C. Operate the vacuum pump until the system is evacuated to 2.5 mm Hg absolute. Break the system vacuum with nitrogen or refrigerant.
- D. After the system has been evacuated to 2.5 mm Hg absolute, close the vacuum pump suction valve and stop the pump.
- E. Charge system to required capacity with specified refrigerant.

3-10 CONTROL DEVICE IDENTIFICATION LABELS

- A. Thermostats and Exhaust fan switches shall have labels mounted on or just above the control device labled with the equipment being controlled. As an example, for a exhaust fan controlled by a switch the lable would read "EXHAUST FAN # 1" or if a thermostat the label would read "AC-1".

1. Labels shall be 2" x 1" x 1/8" thick Formica/plastic engraving stock beveled on both sides and with two 3/16" diameter holes near the top uppermost tag corners.
2. Labels shall be white with 3/8" high red engraved letters.
3. Labels shall be attached to the equipment with adhesive.

3-11 WARRANTY

- A. The contractor shall warranty all of the systems for proper operation installed by the contractor for not less than one calendar year from date of project completion. This completion date shall be set by the Architect or owner.

3-12 MECHANICAL SYSTEM START-UP RESPONSIBILITY

- A. Start up Mechanical Systems, and perform any such Work as may be required to adjust the systems to meet the requirements of the Contract Documents. Air distribution balancing shall be performed in accordance with Article "MECHANICAL SYSTEMS BALANCING".
- B. Install new clean specified filters in equipment containing filters immediately prior to owner occupancy. Contractor to bear all costs for this work.

3-13 MECHANICAL SYSTEMS BALANCING

- A. Testing and air balancing shall be performed by an independent balancing company certified by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Testing and balancing shall be performed by a company other than the mechanical system installers/contractor. The name of the firm that the Contractor proposes to engage to perform this Work of balancing the system shall be submitted to the Engineer for approval prior to commencing the Work.
- B. Conduct tests in presence of Architect/Engineer.
- C. After Systems have been tested as outlined, air and water flow rates shall be balanced, and control devices adjusted. Balance and testing shall not begin until systems have been completed and are in full working order. Upon completion of the balancing operation and prior to final acceptance of the systems, the balancing firm shall submit a report, with six (6) copies, certifying to the proper performance of the system for approval by the Mechanical Engineer.
 1. The following information shall be included in the Air Side Report:
 - a. Air quantities in CFM at supply, return, exhaust terminals, and outside air intakes, both at design value and actual measured value. Test and adjust each terminal to within +10% of design requirements.
 - b. Air velocities in FPM at supply, return, and exhaust terminals at design value and actual measured value.
 - c. Positive static pressure, negative and total pressures and total air quantities for each fan system.

- d. Equipment nameplate data.
- 2. The following information shall be included in the Water Side Report:
 - a. Water Coils:
 - 1. Design Data:
 - 2. Load in BTUH or MBH
 - 3. G.P.M.
 - 4. Entering and Leaving Water Temperatures
 - 5. Entering and Leaving Air Conditions (D.B. and W.B.)
 - 6. C.F.M.
 - 7. Water Pressure Drop
 - b. Recorded Data:
 - 1. Type of Equipment and Identification (location or number designation)
 - 2. Entering and Leaving Air Conditions (D.B. and W.B.)
 - 3. Entering and Leaving Water Temperatures
 - 4. G.P.M.
 - 5. Air and Water Temperature Rise on Drop
 - 6. Air and Water Pressure Drops

END OF SECTION 15600