**SECTION 15100**

**GENERAL MECHANICAL REQUIREMENTS**

**PART - 1 GENERAL**

1.1 **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 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.

2. In case of conflict between or among specified requirements and pertinent regulations, the more stringent requirements will govern when so directed by the Contracting Officer.

C. Included: Work includes, but is not necessarily limited to the following:

1. Heating, Ventilating, Air Conditioning and Balancing

2. Plumbing

3. Fire Protection

4. 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 sawcut unless indicated otherwise on Drawings.

5. Excavation and Backfill

6. Demolition:

a. The Demolition Plans were prepared for the convenience of the Contractor. The Contracting Officer 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.

7. Related Work:

a. Painting

b. Cutting and Patching

c. Low voltage electrical control

1.2 **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 most recent issue approved and accepted.

1.3 **PROJECT RECORD DRAWINGS**

A. Comply with pertinent provisions of Architectural Sections.

1.4 **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.

1.5 **CORRELATION, INTERPRETATION AND INTENT OF CONTRACT DOCUMENTS**

A. The 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. The accuracy of the Drawings is not guaranteed. Refer to Architect's Plans, Specifications and Room Schedules for construction details, which will affect the Work and equipment. Examine the Architectural, Civil, Structural, Mechanical, Electrical, Fire Protection and Drawings and Specifications to ensure that this Work does not conflict with the above trades. Plumbing, Mechanical and Electrical Drawings are largely schematic, and, therefore, do not necessarily represent the exact installation. It shall remain the Contractor's responsibility to cover all conditions

on prepared Shop Drawings and by arrangement in the field. Nothing on these Drawings or Specifications shall be construed to permit Work not conforming to all applicable codes and regulations.

**PART - 2 PRODUCTS**

2.1 **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 the Contracting Officer.

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.

2.2 **FLASHING**

A. Provide watertight flashing at all openings through exterior walls and roof.

2.3 **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. Suitable belt guards shall be provided over all drive assemblies. The Contractor shall change any belts and drives as may be necessary to produce the specified CFM.

2.4 **VIBRATION ISOLATION AND NOISE CONTROL**

A. All fans, heating and ventilating units, air conditioning units, blowers and similar equipment shall be securely mounted to or supported from the structure.

B. Isolate all bare piping from structural members or hangers with "Trisolators" or approved equal insulating sleeves. Install hangers on outside of insulated jacket on all insulated lines.

2.5 **WEATHERPROOFING**

A. All equipment exposed to weather shall be protected by means of a suitable finish. All fan cabinets, roof-mounted equipment, and ductwork shall be fabricated in such a manner to prevent leakage through seams and joints. 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.

2.6 **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 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 proper electrical characteristics.

B. All electrical devices of a type normally listed by Underwriters Laboratories, Inc. shall bear U.L. label of approval, or be listed by the Laboratories.

**PART - 3 EXECUTION**

3.1 **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 Contracting Officer 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.

A. 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.

1.2 **GENERAL EQUIPMENT INSTALLATION REQUIREMENTS**

A. Install equipment to provide good appearance, easy access, and adequate space to allow replacement or maintenance. Provide bases, supports, anchor bolts, and other items required to achieve this. Installation shall be level and adequately braced.

B. Equipment shall operate quietly and without objectionable vibration. Such problems, other than from specified equipment operating at optimum conditions, shall be the Contractor's responsibility and shall be eliminated as directed by the Contracting Officer.

1.3 **COORDINATION OF WORK**

A. Coordinate Work of this Section with Work of other Sections to avoid conflicts. Provide drawings where required. Relocate Work done without regard to requirements of other Sections as directed by the Contracting Officer.

B. Insure that Work of other Sections is suitable to accommodate Work of this Section. Pay costs of corrective Work.

1.4 **ADEQUACY OF FURRING**

A. Conceal piping and ductwork in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify the Contracting Officer in time to avoid unnecessary Work.

1.5 **PROTECTION AND CLEANING**

A. Protect equipment from dirt, moisture, and mechanical damage during construction. Restore 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 appurtenances or making final connections.

1.6 **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 Contracting Officer.

1.7 **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 premises caused by moving material into the building, for a period of 1 year after acceptance of the Work by the Contracting Officer.

1.8 **TESTS**

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 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 one (1) hour before the inspection starts.

2. Domestic Water: Fill with water and test at 150 psig. Retain for four hours.

3. Gas Piping: Air test to pressure equal to one and one-half times the design pressure, but in no case less than 50 psig. Retain for four hours.

4. 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.

5. After all Systems have been tested as outlined, all flow rates shall be balanced, and all control devices adjusted. See Section 15600.

E. 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 Contracting Officer.

1.9 **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 Contracting Officer.

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.

1.10 **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 Contracting Officer 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.

1.11 **EXCAVATION AND BACKFILL: (Buried pipes beyond 5 feet from the to building walls.)**

A. The Contractor shall excavate for the installation of underground plumbing piping, and shall perform all Work to accomplish required excavation. Should it be required to cut asphaltic pavement, such pavement shall be sawed or cut, to a depth necessary to bring about a straight line break parallel to sides of the trench, so as not to disturb the adjoining pavement. All Work during its progress and after its completion shall conform truly to lines and grades given by the Contracting Officer.

B. The width of the trench shall not be less than twelve (12") inches, no more than twenty-four (24") inches greater than the outside diameter of the barrel of the pipe to be laid therein. Where sheeting is required, this width shall be increased by the thickness of the sheeting.

C. Should the trench be excavated to a greater depth than that given by the Contracting Officer, the Contractor shall bring such excavation to the required grade with such material as the Contracting Officer may designate, notwithstanding that it may be necessary to bring such material from other localities or to purchase suitable material; and the trench shall be tamped, as directed by the Contracting Officer. The required work shall be at the Contractor's expense.

D. The material excavated shall be deposited along the side of the trench in such a manner as to create the least inconvenience possible.

E. Special care shall be taken to have all fire hydrants and gate valves on water mains kept accessible at all times. The Contractor shall not obstruct the gutter or any street or driveway, but shall use all proper means to provide for the free passage of surface water along the gutters into storm water inlets. He shall provide channels where necessary, suitable to the Contracting Officer.

F. Wherever necessary, the side of the trench shall be sheeted and braced in strict accordance with the rules, orders and regulations of the Division of Industrial Safety of the State of California. If water or quicksand is encountered, it may be necessary to sheet the trench solid with the type of sheeting suitable to the Contracting Officer.

G. The Contractor shall cooperate with the Contracting Officer and maintain access to all areas required by the Contracting Officer. The Contractor shall be liable for all damages suffered by the Contracting

Officer resulting from the contractor's negligence or lack of cooperation.

H. Surplus earth from the trenches, after compacting, shall be removed and disposed of by the Contractor unless otherwise directed by the Contracting Officer.

I. Where groundwater or soft, yielding or otherwise unsuitable material is encountered in the bottom of the trench, which in the opinion of the Contracting Officer is an unsuitable foundation for the pipe, such material shall be excavated from the full width of the trench to a depth satisfactory to the Contracting Officer. Said depth shall be a minimum of six (6") inches. The resulting space shall be backfilled with imported bedding properly compacted to give adequate pipe support.

J. 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 and both sides of the pipe shall be filled at the same time.

K. 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 as to maintain a minimum relative dry density of 95% as determined by California Impact Test Method No. 216.

L. Any asphaltic pavement cut for the purpose of installing underground piping shall be replaced and shall conform in kind and quality to the type of pavement removed, but, in no case less than 12" of base rock be placed beneath the pavement. Where plant mix or asphaltic concrete surfacing exists, pavement shall not be less than 3" in thickness unless otherwise authorized by the Contracting Officer.

1.12 **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 Contracting Officer. Check Drawings and Work of others to prevent interference. Deviations of the Work determined by the Contracting Officer 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 a first-class manner 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.

1.13 **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 Contracting Officer.

1.14 **OPERATION AND INSTRUCTION**

A. The Contractor shall furnish competent Technicians to supervise start-up operations of equipment specified by the Contracting Officer and to instruct Owner's operators. The Contractor shall furnish six complete sets of operating instructions and service manuals to the Contracting Officer.

B. Instruction period shall be started after instruction books and service manuals have been submitted to and approved by the Contracting Officer and shall be at hours (regular and non-regular) arranged by the Contracting Officer.

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.

D. Charts and operating permits shall be mounted and be large enough to be read easily and provided in a neat metal or wood frame under glass.

E. Provide six unmounted copies of all charts to the Contracting Officer.

1.15 **SEISMIC BRACING**

A. It shall be required that pipes, ducts and conduits be supported and braced per the SMACNA "Seismic Restraints Manual Guidelines for

Mechanical Systems", 1991 Edition, and 1993 Appendix "E" addendum or approved equal.

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 Contracting Officer and State Inspector.

2. All pipes shall be braced and guyed to prevent lateral or horizontal swing to the satisfaction of the Contracting Officer and State Inspector. Absolutely, no "Plumber's Tape" shall be used anywhere on this project.

C. The SMACNA Manual can be obtained through SMACNA (VA) at (703) 803-2989. It is strongly recommended that this manual be obtained prior to the start of any work.

END OF SECTION

**SECTION 15300**

**FIRE PROTECTION SYSTEM**

**PART - 1 GENERAL**

1.1 **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 apply to the Work of this Section.

3. Where requirements of this Section exceed those in other Contract Documents, Contractor(s) shall comply with the requirements of this Section.

B. Codes and Regulations:

1. In addition to complying with pertinent codes and regulations of Authorities having jurisdiction, comply with:

a. Recommendations of the Authority having jurisdiction.

b. Pertinent recommendations contained in NFPA Codes.

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 Contracting Officer.

C. Included: Work includes, but is not necessarily limited to the following.

1. The Work covered by this shall include furnishing all labor, material, equipment and services to construct, install and place in operation, the complete Fire Protection System to the extent as indicated and as shown on the Drawings and specified herein.

2. Provide a NFPA 13 design which is complete in all regards including, but not necessarily limited to:

a. Connection to utility main including required valves, fittings, and similar items.

b. Underground piping pertaining to the Work of this Section including required pipe, valves, thrust blocks, trenching, backfilling, and similar items.

c. Fire riser with required accessories.

d. A complete overhead sprinkler system.

e. Access panels for concealed valves.

3. Obtain and pay for all licenses, permits, and fees required for this Work when applicable.

4. Secure required approvals for the complete Fire Protection System in accordance with pertinent requirements of the Authority having jurisdiction.

D. Related work not included in the specification section:

1. All electrical Work, wiring, fire alarm Work, fire extinguishers, monitoring systems and smoke detectors are by others.

2. Painting of exposed pipe.

## 1.2 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.

1. All welding shall conform to NFPA Codes and shall be performed by certified welders.

B. Plans shall be designed by the “installing licensed contractor (C-16, C-34, C-36, or General Engineering Contractor [A]) or by Registered Professional Engineer (Civil, Mechanical, or Fire Protection), licensed by the State of California (Board of Professional Engineers).

## 1.3 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 6 copies of the following:

1. Materials list of items proposed to be provided under this Section.

2. Design drawings, stamped as having been approved by the Authority having jurisdiction, showing the complete overhead sprinkler system. The location of drain line terminations shall be approved by the Contracting Officer.

3. A plan drawing, stamped as having been approved by the Authority having jurisdiction, showing location of underground connections, control valves, fire hydrant and related items.

4. Details and sections as required to clarify the design.

5. Plans shall conform to appropriate NFPA requirements.

C. Record Drawings:

1. Include a copy of the Record Drawings in each copy of the operation and maintenance manual described below.

D. Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Contracting Officer two (2) copies of an operation and maintenance manual compiled in accordance with the provisions of Architectural Sections of these Specifications.

1.4 **PRODUCT HANDLING**

A. Comply with pertinent provisions of Architectural Sections.

1.5 **WARRANTY**

A. Contractor shall warrant the installation free from defects for a period of one year from filing Notice of Completion. Remedy any defects 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**

2.1 **PIPING, FITTINGS AND JOINTS**

A. All aboveground fire-protection system line piping shall be approved Schedule 10, 30 (threadable thinwall) or 40 black steel. Schedule 30 or 40 shall be made up with cast iron fittings and Schedule 10 with welded or grooved mechanical fittings. Other materials approved by codes may be used if first approved by the Contracting Officer.

B. All underground fire-protection system piping shall be ductile iron pipe in accordance with NFPA Pamphlet No. 24. Concrete thrust blocks shall be furnished and installed at all fittings, bends, and changes

of pipe direction in strict accordance with the manufacturer's recommendations and NFPA Pamphlet No. 24. C-900 or "Blue Brute" PVC pipe is acceptable to the extent that such material and method of installation meet the requirements of governmental agencies having jurisdiction. Ductile iron pipe shall be used when underground pipe runs under buildings, foundations, footings or through below grade walls.

C. Piping shall be “listed” for fire protection service and comply with AWWA Standards, where applicable.

2.2 **SPRINKLER HEADS**

A. Provide automatic closed type sprinkler heads with temperature rating complying with NFPA Codes.

B. Provide semi-recessed sprinkler heads with escutcheon, Model H manufactured by the Central Sprinkler Co. or equal, in all rooms/area of the Building unless directed otherwise.

C. Provide brass standard pendent sprinkler heads with escutcheon, Model A, manufactured by the Central Sprinkler Co. or equal, for mechanical rooms, hidden areas and where piping is exposed.

D. Sprinkler heads from Central, Viking, Grinnel, Star, Globe and Reliable companies are considered equal.

E. Provide sprinkler cover plate/escutcheon finish as per the Contracting Officer's directions. Use bright chrome finish when the Contracting Officer does not furnish directions.

F. Furnish spare heads, cabinet box, and wrench per NFPA 13.

2.3 **SECURITY, SIGNS, TAGS AND CHARTS**

A. Security: Provide chain, padlock or other tamper proof device as required by the Authority having jurisdiction for each manually operated shutoff valve required to be sealed in the open position.

B. Signs: Provide identification signs of standard design, fastened securely at designated locations in accordance with NFPA Pamphlet No. 13.

C. Tags: Provide 2" diameter brass tags, stamped with designation numbers, secured with #12 gage copper wire to spindle of the control valves.

D. Charts:

1. Provide two copies of the "As-Built" sprinkler system diagram, giving the designated number, function, and location of each valve.

2.4 **PIPE HANGERS**

A. Provide Underwriter's listed hangers, rods, inserts, and accessories by Grinnel, Tolco or equal.

2.5 **FIRE RISER**

A. The Fire Riser shall be provided where schematically shown on the Drawings and be complete with equipment and fittings as schematically shown on the Drawings.

B. All control valves shall be “listed” indicating type unless a non-indicating valve, such as an underground gate valve with approved roadway box complete with T-wrench, is acceptable to the Authority Having Jurisdiction.

2.6 **FIRE DEPARTMENT CONNECTION**

A. Appropriately lettered free standing Fire Department Connection shall be provided where schematically shown on the Drawings. The Fire Department connection shall be equipped with a check valve and approved metal caps.

B. Fire Department Connection hose connections shall be of an approved type, properly supported, and located without interference from nearby obstructions and on the street side of the building(s) where approved by the Authority having Jurisdiction.

C. Fire Department Connection shall be identified by a sign having raised letters at least 1-inch in size, cast on a plate or fitting. (“AUTO SPKR”, “STANDPIPE”, etc.)

2.7 **POST INDICATOR VALVE**

A. A Post Indicator Valve shall be provided where schematically shown on the Drawings. The valve shall be monitored for tampering as required by the Authority having jurisdiction.

2.8 **WATER MAIN CONNECTIONS**

A. Water Main Connections shall be provided where schematically shown on the Drawings in accordance with the standards of the local water servicing agency.

2.9 **WALL AND FLOOR PENETRATION SLEEVES**

A. Fire walls and floors:

1. Wall and floor penetrations shall be protected with a U.L. approved fire rated assembly. The assembly shall be per the Drawings Details, or manufacturer’s installation instructions.

2. Fire stopping materials by Hilti, Metacaulk, or Dow-Corning are considered equal. The material shall be the same as called out for the U.L. approved assembly.

B. Poured concrete walls and floors.

1. Pipes penetrating poured concrete walls and floors shall be protected by providing sleeves per NFPA code but not less than 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.

b. Protection shall end flush with the wall or floor surface.

C. All walls:

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.

2.10 **GENERAL**

A. 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 Contracting Officer.

B. All fire protection equipment or materials shall be U.L. listed for fire protection use.

**PART - 3 EXECUTION**

3.1 **SURFACE 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 Contracting Officer 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.

3.2 **INSTALLATION**

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. Perform trenching and backfilling required for the Work of this Section in strict accordance with Section 15100.

1. Depth of cover of piping shall be 30-inches (minimum) and 36-inches (minimum) under driveways and 48-inches (minimum) under railroad tracks.

2. Backfill shall be well tamped in layers. No ashes, cinders, refuse, organic or other corrosive materials shall be used as backfill material.

D. In area having ceilings, conceal all pipes unless directed otherwise by the Contracting Officer.

E. 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.

F. All sprinkler heads shall be arranged in straight rows in both directions, as much as possible.

G. Do not locate sprinkler heads in any luminous ceiling. Devise methods for sprinklering such areas as approved by the Authority having jurisdiction.

H. Sprinkler heads located where they may easily be damaged, shall be fitted with approved guards.

I. 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 Contracting Officer's opinion, it will interfere with the use of the building; where space is inadequate, notify Contracting Officer in time to avoid unnecessary Work. Coordinate and install all piping system without interfering with other trades.

J. Make up screwed joints with anti-seize thread lubricant applied to male threads only. Threads shall be American-Standard pipe threads.

K. 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 Contracting Officer.

L. Support and brace piping from structure in accordance with NFPA 13. Do not support piping from ductwork, other pipes, or by resting on the structure.

M. Provide access panels per Section 15100 for all concealed valves.

N. The Fire Sprinkler Piping spacing of vertical supports, lateral bracing, and the details of the lateral bracing must comply with OSHPD pre-approved anchorage No. R-0010, The SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems".

O. 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.

P. All piping shall be painted in compliance of pertinent Architectural Sections.

## 3.3 CLOSING IN UNINSPECTED WORK

A. 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.

## 3.4 CLEANUP

A. 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.

## 3.5 TESTING AND INSPECTION

A. Upon completion of the installation, provide necessary personnel and equipment and test and re-test the complete system making adjustments as required, and secure all necessary approvals.

1. Test the system at 200 psi for two (2) hours per NFPA 13.

2. The underground system shall be flushed per NFPA 13, and tested before connection with the overhead section. Backfill the trench between joints before pressure testing to prevent pipe movement.

3. Post Indicating Valves (PIV) shall be tested to insure that the “targets” (OPEN, CLOSED) are clearly identified when valve is opened and closed.

B. 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 Contracting Officer shall be notified when the Contractor has arranged for inspections.

C. When the system has been completely approved, secure a Test Certificate from Authority having jurisdiction, and forward two (2) copies of the Certificate to the Contracting Officer.

END OF SECTION

**SECTION 15400**

**PLUMBING**

**PART - 1 GENERAL**

1.1 **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 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. 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 Contracting Officer.

C. Scope of Work:

1. Included: Work includes, but is not necessarily limited to, the following:

a. The Work covered by this Specification shall include furnishing all labor, material, equipment and services to construct, install and place in operation, the complete plumbing system to the extent as indicated and as shown on the accompanying plans and specified herein. All the work covered under this Section shall hereinafter be referred to as the Plumbing System.

b. Pipe Insulation

c. Plumbing Fixtures, Supports and Trim

d. Piping, Valves and Appurtenances

e. All excavating and backfilling necessary for the Plumbing installation, cutting and patching of concrete and paved surfaces where required for the installation of buried pipes.

f. Sanitary soil, waste and vent systems including condensate drains.

g. Domestic Water System

h. Gas System

i. Coring of Concrete and Sealing Around Pipe Penetrations.

j. Pipe Support Racks and Hangers

k. Rough-in and final connections to all fixtures and equipment including connections to equipment furnished under other Sections.

l. All blocking, framing and supports required for the purpose of accommodating the Plumbing Systems. Wherever the roof is penetrated for the purpose of installing pipes, penetration shall be flashed and counter-flashed.

m. All inspection fees and permits required for the performance of this Work when applicable.

D. Related work not included in this specification section:

1. Line voltage wiring and conduit to plumbing devices requiring electrical connections.

2. Electrical devices, such as starters, switches, over current protective devices, unless specifically called for hereinafter in this Section of the Specifications or on the Drawings.

3. Painting, except when supplied as factory finish, or when specifically called for in this Section or on the Drawings.

## 1.2 **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.

1.3 **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 Contracting Officer 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 in a folder or binder or all may be rejected until all are included.

1.4 **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 the Contracting Officer does not change this requirement.

1.5 **PRODUCT HANDLING**

A. Comply with pertinent provisions of Architectural Sections.

**PART - 2 PRODUCTS**

2.1 **SANITARY SOIL, WASTE, VENT, AND CONDENSATE PIPING**

A. Except for fixture connections and where otherwise indicated, standard weight CISPI 301 cast iron "No-Hub" or ASTM A-74 hub and spigot pipe and fittings shall be used throughout unless otherwise noted on the Drawings.

1. ASTM D 2661 or F628 Schedule 40 ABS pipe and fittings may be used to the extent that such materials and methods of installation meet the requirements of governmental agencies having jurisdiction. Pipe and fittings shall meet IAMPO UPC Installation Standards. ABS pipe shall only be used within the building footprint for the:

a. Vent system.

b. Sewer piping below the ground floor/slab.

2. ASTM D-3034, PSM SDR-35 PVC pipe and fittings may be used at Contractor's option to the extent that such materials and methods of installation meet the requirements of governmental agencies having jurisdiction. Pipe and fittings shall meet IAMPO UPC Installation Standards. PVC pipe shall only be used for underground piping exterior of the building.

B. Condensate Drains:

1. Drains from air conditioning type equipment shall be ASTM B88 Type M copper, hard drawn tube with ANSI B16.22 wrought copper solder joint type fittings.

## 2.2 **DOMESTIC WATER PIPING**

A. All domestic water piping above ground and within building shall be ASTM B88 Type "L" hard drawn copper tube, made up with ANSI B16.22 wrot or forged copper fittings and 95-5 tin antimony, or other lead-free solder.

B. 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.

C. Domestic water pipe and fittings shall meet IAMPO UPC Installation Standards.

## 2.3 **GAS PIPING**

A. Gas piping shall be standard weight Schedule 40 steel pipe conforming to the following specifications.

1. Above Ground Pipe Exposed to Weather: Black pipe made up with extra heavy malleable iron screwed fittings. Pipe to be painted per Section 15100.

2. Concealed or Exposed within Buildings: Black pipe made up with black malleable iron fittings.

3. Gas steel pipe and fittings shall meet ASTM A53, and ANSI B16 Standards.

B. All screwed unions in gas pipe shall be 150 pound rated ground joint type.

## 2.4 **VALVES**

A. All valve numbers listed are Nibco unless noted otherwise. Valves by Milwaukee, Hammond, Watts and Grinnell are considered equal.

| Type | Size Range | Part Number |
|---|---|---|
| Ball | 2" and smaller | 585-70 |
| Ball | 2-1/2" and larger | 595-Y |
| Gas Cock | 2" and smaller | 585-70 |
| Gas Cock | 2-1/2" and larger | Walworth 1796-1797 (With Wrench) |

B. All valves in copper piping shall be soldered in or have screwed threads. Threaded valves shall be installed with sweat to screwed adapters.

## 2.5 **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 | 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" Inserts in Concrete Decks | H-119 |
| Trapeze Hangers | A1200-A1202 |
| Pipe Clamp | A716 or 701 W/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" |
| 5" to 8" | 1/2" |
| 10" to 12" | 5/8" |

D. At the Contractor's option and subject to the approval of the Contracting Officer, 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.

c. 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.

d. Schedule 40 PVC or ABS DWV: Every 4 feet for all sizes. Provide for expansions every 30 feet.

2. Vertical:

a. Cast Iron: Base and every floor not to exceed 15 feet.

b. Copper: Every floor not to exceed 10 feet.

c. Steel, Gas: Same as horizontal spacing except 1-1/4" and larger at every floor.

d. Schedule 40 PVC or ABS DWV: Base and every floor with mid-floor guides. Provide for expansion every 30 feet.

F. Refer to the plumbing UPC 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 a metal insulation pipe shield #B3153 as manufactured by B-Line. Equivalent pipe protectors as manufactured by Unistrut, or Securstrut will be considered provided the substitute item meets the same standard of quality and performance as the specified item.

H. A stud brace shall be installed at all places where a wood stud has been cut or notched more than 1/3 of its' dimension or as directed by the Contracting Officer. A KC Metal Products stud brace #SB, or equal shall be used.

## 1.6 **WALL AND FLOOR PENETRATIONS**

A. Fire walls and floors:

1. Wall and floor penetrations shall be protected with a U.L. approved fire rated assembly. The assembly shall be per the Drawing Details, or other manufacturer’s installation instructions.

2. Fire stopping materials by Hilti, Metacaulk, or Dow-Corning are considered equal. The material shall be the same as called out for in the U.L. approved assembly.

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.

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.

## 1.7 FLASHING

A. All flashing shall be 4 lb. sheet lead and all vents penetrating the roof shall be flashed and counter-flashed. Stoneman Co. roof flashing assembly with 10" skirt or equal may be used.

## 1.8 CLEANOUTS

A. Provide cleanouts per Drawings and details on Drawings. Cleanouts as manufactured by J. R. Smith, Josam or Zurn are approved equals.

B. Cleanout tops to be installed with tamper-proof screws.

## 1.9 FLOOR DRAINS, FLOOR SINKS AND ROOF DRAINS

A. Provide drains as specified on the Plumbing Schedule. However, drains as manufactured by J.R. Smith, Josam and Zurn will be acceptable provided they are equal.

## 1.10 WATER HAMMER ARRESTORS

A. Provide Wilkins Piston Model #1200, Sioux Chief #65X-X or equal, as sized on the Drawings. Install per manufacturer’s instructions.

## 1.11 AUTOMATIC TRAP PRIMERS

A. Provide Precision Plumbing Products, J.R. Smith or Sloan as specified on the Drawings. Install per manufacturer's instructions.

## 1.12 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, Eljer, Kohler, or Just are acceptable substitutes as equal if approved by Conttracting Officer.

D. Fixture carrier numbers listed are as specified on the Plumbing Schedule; however, carriers as manufactured by J.R. Smith, Zurn or Josam are acceptable provided they are equal.

1.13 **CONNECTORS**

A. Provide Brass Craft "Speedway" or equal heavy pattern brass stops, rigid supplies and chrome plated brass "P" traps. Stops in "Public" areas to have screwdriver slots and those in "Private" areas 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.

1.14 **ACCESS BOXES**

A. See section 15100 for access panels.

1.15 **PRESSURE REGULATORS AND BACKFLOW PREVENTORS**

A. Provide backflow preventor as specified on the drawings and/or as required by the governmental authority having jurisdiction.

B. Backflow preventors by Febco, Hersey, Watts or Wilkins are considered equal when their pressure fall-off/loss is equal to or less than the specified regulators/preventor's loss for the given flow rate.

C. Provide all potable water outlets with hose attachments with non-removable hose bibb backflow preventors per the C.P.C..

1.16 **HANDICAPPED INSULATION**

A. Hot water supply and trap handicap insulation shall be molded closed cell vinyl, Bocar "Trap Wrap", Truebro "Handy Lav-Guard", or equal. When the trap and hot water supply are insulated, the cold water supply shall be insulated.

1.17 **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. 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.

C. 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.

D. 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 |
|---|---|
| Runouts up to 2"* | .5" |
| 1" and less | 1.0" |
| 1.25" - 2" | 1.0" |
| 2.5" - 4" | 1.5" |
| 5" and larger | 1.5" |

*Runouts are defined as being less than 2-inches in diameter, less than 12 feet long, and connected to fixtures or individual terminal units.

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

**PART - 3 EXECUTION**

3.1 **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 Contracting Officer 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.

3.2 **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.

3.3 **PIPING INSTALLATION**

A. Sizes shown in the Drawings and Specifications are nominal unless noted otherwise. Any unsized pipe section shall be the same size as the largest pipe connected to it. Run pipe full size through valves and appurtenances and make size reductions for undersize connections within three (3) pipe diameters of connection. Piping shall be the minimum branch size to within 2 feet of the fixture.

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 Contracting Officer's opinion, it will interfere with the use of the building or create a safety hazard. Where space is inadequate, notify the Contracting Officer 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. All natural gas piping under structures or concrete slabs will be installed in a protective vent sleeve. Sleeves under a building will be vented to outside the building per detail on Plans. Sleeves under concrete slabs will extend a minimum of 1 foot beyond the slab. All sleeves will be sloped 1/8" per foot up toward the vented end. The vent end of sleeves under slabs will terminate under a landscaped or asphalted area.

F. Gas piping shall be tapped off the top or side of pipe and ends of mains shall be provided with dirt legs.

G. Use friction wrenches when installing brass, polished, or soft metal piping, and when installing piping exposed in finished areas. Replace piping showing wrench marks.

H. Attach escutcheon plates to pipes with set screws or spring clamps with concealed hinges. Continue insulation through escutcheon plates.

I. 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.

## 3.4 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.

## 3.5 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, torqued 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.

## 3.6 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 Contracting Officer 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.

1. All cleanouts to grade shall be firmly secured by means of a concrete block 20" square by 5" thick, and shall be flush with finished grade, unless otherwise noted on the plans.

D. Provide automatic trap primers as specified at floor sinks and drains as indicated on Drawings or where required by governmental agencies having jurisdiction. Provide access panels for all hidden mechanical trap primers.

## 3.7 VALVE INSTALLATION

A. Provide valves in the water, and gas 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.

E. All gas pressure regulating valves shall be vented to the atmosphere.

## 3.8 WATER HAMMER ARRESTOR INSTALLATION

A. Provide water hammer arrestor on hot and cold water lines.

1. Install at all quick closing valves, solenoids, and supply headers at plumbing fixture groups.

2. Locate and size as shown on Drawings, and where not shown, locate in accordance with Plumbing and Drainage Institute Standard WH-201.

3. Install water hammer arrestor behind access panels.

## 3.9 BACKFLOW PREVENTION INSTALLATION

A. Protect plumbing fixtures, faucets with hose connections, and other equipment having plumbing connection, against possible back-siphonage.

B. Arrange for testing of backflow devices as required by the governmental agencies having jurisdiction.

## 3.10 PLUMBING FIXTURE INSTALLATION

A. Connect plumbing services to fixtures as shown on Drawings and as specified.

B. 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 Contracting Officer.

## 3.11 INSULATION INSTALLATION

A. Clean and dry surfaces prior 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 manufacturers instructions.

## 3.12 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.

END OF SECTION

**SECTION 15600**

**HEATING, VENTILATION, AND AIR CONDITIONING**

**PART - 1 GENERAL**

1.1 **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 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 Contracting Officer.

C. Included: Work includes, but is not necessarily limited to, the following.

1. The Work covered by this Specification shall include furnishing all 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. All 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. All wiring, and electrical cable, complete with all 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. Roof Top Gas Heat/Mechanical Cooling A/C Units

4. Roof Top Gas Fired Furnaces

5. Cooling Coils

6. Condensing Units

7. Centrifugal Exhaust Fans and Roof Exhausters

8. Supply, return and exhaust duct systems complete with all grilles, registers and diffusers.

9. Filter and Filter Boxes

10. Duct, Pipe and Equipment Insulation

11. Space Temperature Controls

12. Refrigerant Piping

13. Fire Dampers

14. Vibration Isolators

D. Work Not Included In This Section:

1. All blocking, framing and 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 all such items and shall bear the expenses covering their omission or improper location.

2. Electrical connections to all 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.

## 1.2 **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.

1.3 **SUBMITTALS**

A. Comply with pertinent provisions of Architectural Section.

B. Product data: Within 35 calendar days after the Contractor has received the Notice to Proceed, submit 6 copies of the following to the Contracting Officer for approval prior to acquisition:

1. Materials list of all 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. 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 entire Project shall be submitted at the same time or all may be rejected until all are included in one submittal package.

5. All submittals shall be bound together in a three hole folder or a three ring binder.

1.4 **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 the Contracting Officer does not change this requirement.

1.5 **PRODUCT HANDLING**

A. Comply with pertinent provisions of Architectural Sections.

**PART - 2 PRODUCTS**

2.1 **HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT**

A. Heating, Ventilating, and Air Conditioning Equipment: All equipment shall be as specified on the Drawings or approved equal.

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.

2.2 **ROOF TOP PACKAGE UNIT**

A. General:

1. Factory-assembled, single-piece heating and cooling unit. Contained within the unit enclousure shall be all factory wiring, piping, controls, refrigerant charge (R-22) and special features.

B. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish on all externally exposed surfaces, and have primer-coated interior panels.

2. Evaporator-fan cabinet interior shall be insulated with a minimum 1/2" thick flexible fiberglass insulation coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heating compartment.

3. Cabinet panels shall be easily removable for servicing.

4. Unit shall have a factory-installed, sloped condensate drain pan made of a non-corrosive material, providing a minimum 3/4" connection with both vertical and horizontal drains and shall comply with ASHRAE 62.

5. Unit shall have factory-installed filter access panel to provide filter access with tool-less removal.

C. Fans:

1. Indoor blower (evaporator fan) shall be of the belt-driven, double inlet, forward-curved centrifugal type. Belt drive shall include an adjustable pitch motor pulley.

2. Indoor blower (evaporator fan) shall be made from steel with a corrosion-resistant finish and shall be dynamically balanced.

3. Bearings shall be of the sealed, permanently lubricated, ball-bearing type for longer life and lower maintenance.

4. Condenser fan shall be of the direct-driven propeller type and shall be discharged air vertically upward.

5. Condenser fan shall have aluminum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

6. Condenser-fan motor shall be totally enclosed.

7. Induced draft blower shall be of the direct-driven, single inlet, forward curved, centrifugal type, shall be made from steel with corrosion-resistant finish, and shall be dynamically balanced.

D. Compressor(s):

1. Fully hermetic scroll type, internally protected.

2. Factory rubber-shock mounted and internally spring mounted for vibration isolation.

E. Coils:

1. Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to enhanced copper tubes with all joints brazed.

2. Provide condenser coil with dipped and baked heresile coating.

F. Heating Section:

1. Induced draft combustion type with energy saving direct spark ignition system, redundant main gas valve, and 2-stage heat.

2. The heat exchanger shall be of the tubular section type constructed of a minimum of 20 gage steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance, and shall have a 10-year warranty.

3. Burners shall be of the in-shot type constructed of aluminum coated steel.

4. All gas piping shall enter the unit cabinet at a single location.

G. Refrigerant Components:

Refrigerant circuit components shall include:

1. Refrigerant strainer.

2. Service gage connections on suction, discharge, and liquid lines.

3. Filter drier.

4. Ability to route gage hoses through unit top cover.

H. Filter Section:

1. Standard filter section shall consist of factory-installed low velocity, throwaway 2" thick fiberglass filters of commercially available sizes.

2. Filter face velocity shall not exceed 300 fpm at nominal airflows.

3. Filter section shall use only one size filter.

4. Filters shall be accessible through an access panel with "no-tool" removal.

I. Controls and Safties:

1. Unit Controls:

a. Unit shall be complete with self-contained low-voltage control circuit protected by a fuse on the 24-v transformer side.

2. Safeties:

a. Unit shall incorporate a solid-state compressor protects which provides anti-cycle reset capability at the space thermostat, should any of the following standard safety devices trip and shut off compressor.

1) Compressor overtemperature, overcurrent.

2) Loss-of-change/low-pressure switch.

3) Freeze-protection thermostat, evaporator coil.

4) High-pressure switch.

The lockout protection shall be easily disconnected at the control board if necessary.

b. Heating section shall be provided with the following minimum protections:

1) High-temperature limit switches.

2) Induced draft motor speed sensor.

3) Flame rollout switch.

4) Flame proving controls.

J. Operating Characteristics:

1. Unit shall be capable of starting and running at 125 F ambient outdoor temperature, meeting maximum load criteria of ARI Standard 210/240 or 360 at ± 10% voltage.

2. Compressor with standard controls shall be capable of operation down to 25 F ambient outdoor temperature.

K. Elecric Requirements:

1. All unit power wiring shall enter unit cabinet at a single factory-predrilled location.

L. Motors:

1. Compressor motors shall be cooled by refrigerant passing through motor windings and shall have line break thermal and current overload protection.

2. Indoor blower (evaporator-fan) motor shall have permanent lubricated bearings and inherent automatic-reset thermal overload protection.

3. Totally-enclosed condenser-fan motor shall have permanently lubricated bearings and inherent automatic-reset thermal overload protection.

4. Include draft motor shall have permanently lubricated, sealed bearings and inherent automatic reset thermal overload protection.

M. Roof Curbs:

1. Formed galvanized steel with wood nailer strip and capable of supporting entire unit weight.

2. Allows for installing and securing ductwork to curb prior to mounting unit on the curb.

N. Intergrated Economizers:

1. Integrated integral-modulating type capable of simultaneous economizer and compressor operation.

2. Includes all hardware and controls to provide cooling with outdoor air.

3. Equipped with low-leakage dampers no to exceed 3% leakage, at 1" wg pressure differential (variable sliding economizer).

4. Capable of introducing up to 100% outdoor air in both minimum and fully-open positions.

5. Equipped with a gravity relief sliding plate damper (variable sliding economizer). Damper shall close upon shutoff.

6. Parallel-blade economizer shall be equipped with a barometric relief damper with up to 45% of relief air.

7. Designed to close damper during loss-of-power situations with emergency power supply (variable sliding economizer) or spring return built into motor (parallel blade economizer).

8. Dry bulb outdoor-air thermostat (variable sliding economizer) or enthalpy (parallel-blade economizer) protection shall be provided as standard.

## 2.3 **CONDENSING UNIT**

A. Factory-assembled and wired air coooled condensing unit. The frame shall be constructed of 14 gauge welded galvanized steel. Panels and access doors shall be 14 gauge galvanized steel. Unit surface shall be phosphatized and finished with Trane Slate Gray air-dry paint. This paint finish shall exceed ASTM-B117 500 hour continuous salt spray test. The unit coils shall be protected with steel louvered panels.

B. Refrigeration Circuits and Controls

Units to be single or dual circuit. All necessary controls to run the unit fans shall be provided. The control panel shall contain fan motor contractors, terminal point connection for compressor interlock and 115 volt control power transformer. Standard units shall operate from 40 to 115 F. All units shall be shipped with factory installed liquid line service valves.

C. Condenser Coils and Fans

Condenser coils shall have configurated copper fins mechanically bonded to seamless copper tubing with integral subcooler. The coils shall be underwater burst/leak tested at 450 psi. Direct drive condenser fan motors shall have permanently lubricated ball bearings and thermal overload protection.

D. Low Ambient Operation

Provide low ambient control to allow operation down to 0 F with external damper assembly for head pressure control.

## 2.4 COOLING COIL

A. Provide removable coils per ARI 410 with access to both sides. Enclose cooling coils in a individual casing with headers and return bends exposed outside casing. Cooling coils shall have a drain pan with piping connections to remove condensate. Seal coils to casing to prevent leakage of air around coils.

## 2.5 ROOF-TOP FURNACES

A. Provide packaged, roof mounted heating and makeup air units as manufactured by Reznor, Sterling or Modine. Units shall be designed for 80% thermal efficiency with gravity-vented gas furnaces, arranged for roof mounting on a slab. The units are to be arranged for field duct connection with horizontal (downturn plenum) supply connection at discharge and horizontal (and/or bottom) inlet connection.

B. The units are to include a centrifugal blower, open drip-proof energy efficient blower motor, and an adjustable belt drive, filter rack with 2" disposable pleated filters, factory installed. Include all required controls, dampers and inlets to provide an air control cycle with full cabinet insulation.

C. All units shall be equipped for use with natural gas, (120) supply voltage, 24-volt control transformer, gravity vent cap, motor contactor, motor starter, intermittent spark pilot, and a gas control system.

D. The gas furnace shall contain a heat exchanger of 321 stainless steel, die-formed burners of E-3 (409) stainless steel and an E-3 (409) stainless steel drip pan.

E. The duct furnace incorporated into the packaged heating and makeup air units shall be design-certified by the American Gas Association and bear the A.G.A. label or approved by the Canadian Gas Association and bear the C.G.A. label.

## 2.6 AIR DISTRIBUTION EQUIPMENT

A. All grilles, registers and ceiling diffusers and other accessory equipment shown on the Drawings and "Grille, Register and Diffuser Schedule" shall be manufactured by Metal*Aire or approved equal.

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 all 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.

2.7 **LOUVERS**

A. 4" deep louvers, Metal*Aire, Model OAL4, or approved equal. Deflection blades shall be spaced on 4" centers having 1/2" high vertical baffle and an additional lateral center rain hood. The edges of louver blades shall be folded or beaded to exclude driving rain. Louvers blades shall be oriented to minimize the entrainment of rainwater. Louver blades, heads, sills, jambs, braces and mullions shall be made of aluminum.

B. Provide 1/2" aluminum bird screen on outside air intake louvers and 1/4" aluminum insect screen on combustion air louvers.

2.8 **RECTANGULAR SHEET METAL DUCTWORK**

A. All 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

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 Ductmate’s own Addendum as provided by the manufacturer. The testing in the Addendum was done in conjunction with the Pittsburgh Testing Laboratory and conforms to the SMACNA criteria laid down in Section VII First Edition 1985 SMACNA Standards. The Ductmate System components shall be of standard identifiable catalogue manufacture as supplied by Ductmate Industries, Pittsburgh, PA 800-245-3188. 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 manufacturer’s printed Assembly and Installation Instructions dated September 1986.

C. Each duct or plenum shall be diagonally cross-broken for rigidity.

D. All 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 all 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.

H. Ducts penetrating a fire resistive element of a fire rated corridor wall, and passing over corridor with no openings into the corridor shall be constructed of a minimum of 26 gauge steel.

2.9 **ROUND DUCTWORK AND FITTINGS**

A. All 2-10" w.g. round duct through 84" 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 - 14" | 26 ga. |
| 15 - 26" | 24 ga. |
| 27 - 36" | 22 ga. |

When, due to structural interference or when spiral duct is not practical, longitudinal seam, KD pipe may be used. KD pipe shall be manufactured from galvanized steel meeting the ASTM A-527 standard in the following gauges:

| Diameter | Metal Thickness |
|---|---|
| 3 - 8" | 26 ga. |
| 9 - 14" | 24 ga. |

The maximum size KD pipe allowed under any circumstances is 14" diameter. Longitudinal as well as transverse joints shall be sealed in accordance with the requirements of this section.

B. All 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. All 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 - 14" | 22 ga. |
| 15 - 26" | 22 ga. |
| 27 - 50" | 20 ga. |

E. All 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. Round duct branch tap-ins into rectangular duct plenums or main ducts shall be a spin-in type.

F. All 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. All 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. At all 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.

I. Ducts penetrating a fire resistive element of a fire rated corridor wall and passing over corridor with no openings into corridor shall be constructed of a minimum 26 gauge steel.

2.10 **FLEXIBLE DUCT**

A. Flexible air ducts shall be Thermaflex M-KF, or approved equal, and shall be so labeled or approved. Flexible Duct shall be factory made and composed of: a CPE liner duct permanently bonded to a coated spring steel wire helix and supporting a thick fiberglass insulating

blanket. Low permeability outer vapor barrier of fiber glass reinforced film laminate shall complete the composite. Product shall bear UL Class I Air Duct label as tested under UL 181 and required NFPA 90A as an air duct or connector, and shall meet a R of 5.7. Flexible Duct shall be installed in accordance with the installation instructions of the manufacturer as shown in the latest publication.

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 nylon or stainless steel clinch type drawbands to connect flexible duct to rigid duct.

D. The number of bends shall not exceed a combined total of 90 degrees. 90 degree bends will not be allowed at diffuser connections.

2.11 **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. All 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.

E. Provide 20 gauge galvanized sheet metal escutcheon plates at all 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. Door frame 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.

## 2.12 **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.

## 2.13 **CONDENSATE DRAINS AND DRAIN PANS**

A. All air conditioning cooling coils shall have a condensate drain pipe, type "M" copper, to drain the condensate as shown on drawings.

2.14 **DUCT SMOKE DETECTORS:**

A. All HVAC systems rated at 2000 CFM or greater shall be equipped with a duct smoke detector to automatically shut off the HVAC system if smoke is detected and alarm fire system.

B. The detectors shall be installed in the main supply duct downstream of any filters.

2.15 **DAMPER ACTUATOR**

A. All actuators shall be Belimo or approved equal. Substitutions will not be acceptable. Actuator shall be direct coupled over the shaft, spring return type, unless specified otherwise

2.16 **KITCHEN HOOD, EXHAUST AND MAKE-UP SYSTEMS**

A. Type I Hood: All Type I grease and smoke hoods shall be constructed of 18 gauge stainless steel.

B. Exhaust Fan: Fans shall be listed and approved by UL for restaurant cooking appliances.

C. Exhaust Duct:

1. Exposed duct shall be 18 gauge 304 welded stainless steel.

2. Concealed duct shall be 16 gauge welded steel or 18 gauge stainless as described above.

D. Fire Suppression Systems:

1. All Type I systems shall be equipped with a Ansel R102 or equal fire suppression system.

2. System shall be approved by Vandenburg Base Fire Marshall prior to installation.

E. Code Requirements:

1. All systems shall be installed per UMC/CMC 1994 Ed., Chapter 5, Part II, Section 507.

2.17 **INSULATION**

A. General: All 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. All heating and cooling duct and related heating and cooling equipment insulation shall conform to Sections 4.2.1(J) of Title 24 of the California Administrative Code 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, all 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 all 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: shall be applied to all concealed heating and cooling, supply and return duct except duct that is internally lined for acoustical purposes. Insulation on duct shall be Manville Microlite FSK duct insulation, R-Series, 1-1/2" thick, minimum out of package R value of 4.8, 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 all 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. Internal Duct Insulation: 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, or approved equal. Duct Liner shall be Linacoustic R, 1-1/2" thick with a "R" value of 6.6. Insulation shall withstand velocities of up to 5000 FPM and temperatures up to 250 degrees F.

F. All 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 all 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. All 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.

G. External Duct Insulation Exposed to Weather: Shall be applied to all 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, 1-1/2" min. Thickness, 6.5 min. AR@ value. The board shall be neatly cut and fitted to the surface with all 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 all 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.

H. Ducts: Ducts shall be constructed, installed, sealed and insulated in accordance with Chapters 4-10 of the 1994 California State Mechanical Code, which wholly adopts Chapter 10 of the 1994 Uniform Mechanical Code, (UMC). Insulation requirements are shown in Table 10-D of the UMC. The above paragraph(s) shall supersede if more stringent.

2.18 **TEMPERATURE CONTROLS**

A. All temperature controls shall be furnished as indicated in schematic Drawing on Plans including all room thermostats, relays and all other necessary combustion, operating and safety controls.

B. All electric wiring, conduit and other electric devices required to complete the installation of the temperature control systems shall comply with all requirements as set forth in the Electrical Section of this Specification.

C. After completion of the installation, the Contractor shall adjust all thermostats, motors and other equipment provided under this Contract. He shall place them in complete operating condition subject to approval of the Contracting Officer.

D. 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 Contracting Officer, 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.

E. The final connections and supervision of all control wiring and interlock wiring shall be the responsibility of this Contractor.

F. The Contractor shall submit to the Contracting Officer for approval, the required number of shop drawings of the entire control system before starting Work.

G. Upon completion of the Work, the Contractor will provide diagrammatic layouts of the Automatic Control Systems specified herein. Layouts shall show all control equipment and the function of each item shall be indicated.

H. 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 preapproved by the Contracting Officer.

2.19 **REFRIGERANT PIPING**

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. Slip insulation over open end of pipe as Work progresses. Do not slit insulation. Use multiple layers and miter insulation to cover joints and all other items as required to prevent condensation. Finish with 2 coats of Armstrong Armaflex finish, white in color.

2.20 **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**

3.1 **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.

3.2 **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.

## 3.3 PREPARATION

A. Holes in concrete:

1. Provide sleeves, accurately dimensioned and shaped to permit passage of items of this Section.

2. Deliver all 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 all 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.

## 3.4 GENERAL INSTALLATION REQUIREMENTS

A. Conceal piping, ductwork, and equipment in spaces provided unless specifically shown otherwise. If spaces are inadequate, notify Contracting Officer in time to avoid unnecessary Work. Do not cut or notch structural members without specific approval of the Contracting Officer.

B. Follow manufacturer's instructions on items not specifically covered in drawings and specifications. Report discrepancies to the Contracting Officer for clarification before starting Work.

## 3.5 EQUIPMENT INTERFACE

A. Provide all 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.

## 3.6 PAINTING

A. Paint inside of all 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 prefinish on all exposed surfaces.

C. Touch-up scratches and abrasions to be invisible to the unaided eye from a distance of 5 feet.

## 3.7 **INSTALLATION OF DUCTWORK**

A. All ductwork shall be delivered to the Project site with all 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 all 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 all sheet metal in accordance with latest SMACNA recommendations. Provide variations in duct size and additional duct fittings as required and approved by the Contracting Officer at no extra cost to the owner.

D. The throat radius of all 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.

## 3.8 **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. Upon completion of the installation calibrate all equipment and adjust controls for proper operation.

3.9 **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 **SHOP DRAWINGS**

A. The Contractor shall prepare shop drawings covering all duct systems, equipment and Mechanical Room piping systems. The drawings shall be prepared in 3/8" scale and shall be submitted to the Contracting Officer for approval prior to any fabrication. In preparing the shop drawings, the Contractor shall coordinate the location of all duct, piping and equipment with the Work of other trades.

3.11 **MECHANICAL SYSTEM START-UP RESPONSIBILITY**

A. Start up all Mechanical Systems, and perform any such Work as may be required to adjust the systems to meet the requirements of the Contract Documents. All air distribution balancing shall be performed in accordance with Article "MECHANICAL SYSTEMS BALANCING".

B. Install new clean specified filters in all equipment containing filters immediately prior to owner occupancy. Contractor to bear all costs for this work.

3.12 **MECHANICAL SYSTEMS BALANCING**

A. All 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 Contracting Officer for approval prior to commencing the Work.

B. Conduct tests in presence of Contracting Officer, if requested.

C. After all Systems have been tested as outlined, all air and water flow rates shall be balanced, and all 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. Fan speeds.

b. Motor current readings and voltage readings.

c. 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.

d. Air velocities in FPM at supply, return and exhaust terminals at design value and actual measured value.

e. Positive static pressure, negative and total pressures and total air quantities for each fan system.

f. Equipment nameplate data.

END OF SECTION

**SECTION 15700**

**DDC CONTROLS**

**PART - 1 GENERAL**

1.1 **DESCRIPTION:**

A. The intent of this document is to describe a DDC Control system that is complete in every respect without further cost to the Owner. Anything not shown on the drawings or indicated in the specifications, and required for complete operating systems, shall be included as part of this Work. This will also include all connections to new services.

B. All parts of the plans and specifications fully apply when applicable to work of this Division. No attempt has been made to divide the work between the various trades or subcontractors.

1.2 **CONTROL CONTRACTOR QUALIFICATIONS:**

A. The Contractor doing this work must approved by the Contracting Officer.

1.3 **CODES, STANDARDS, ORDINANCES AND REGULATIONS:**

A. All work and materials shall be in full accordance with the latest rules and regulations of applicable codes as amended and adopted by any governmental agency which has jurisdiction over this work. Nothing in these Plans or Specifications is to be construed to permit work not conforming to these codes. Should the Plans or Specifications call for material, methods, or construction of a higher quality or standard than required by the above rules, the higher quality shall govern.

B. When not contradicting the above, the manufacturers' recommendations along with applicable parts of the following documents shall be the basis for quality and technique of installation.

1. Title 24, California Administrative Code, all parts.

2. Applicable publications of the National Fire Protection Association (NFPA), including the National Electrical Code (NEC).

3. Applicable publications of the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE).

1.4 **CARE AND CONTINUATION OF SERVICES:**

A. The Contractor will be held responsible for the care and preservation of the building. Any part of it damaged or disturbed because of his work, shall be repaired, replaced or cleaned as required.

1.5 **SAFETY PRECAUTIONS:**

A. In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours.

B. The duty of the Engineer or Project Inspector to conduct construction review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

1.6 **SITE CONDITIONS AND LOCATIONS:**

A. The Contractor shall visit the site of the proposed work and familiarize himself with all the site conditions. No subsequent allowances will be made because of negligence in complying with the above, or alleged inability to understand the requirements.

B. The general location and arrangement of system hardware is shown on the drawings and all installations shall be made in accordance. Information on the drawings relative to existing services is approximate only. Minor deviations required to conform to actual locations shall be made without additional cost to Owner. The Contractor shall, as work progresses, verify the dimensions of the spaces available for the installation of the work and he shall assume full responsibility for the proper locations of each portion thereof.

C. The working drawings are generally diagrammatic and the locations indicated may be approximate only. They do not show every offset, bend, or elbow required for installation in the space provided. The Contractor, therefore, shall install all equipment, conduit runs and the like as follows:

1. Adhere to the location indicated as near as possible.

2. Maintain ample head room and access in all passageways, clearance around all equipment and under conduit runs for unrestricted passage and for easy servicing of all apparatus, equipment, devices and the like.

1.7 **SUBMITTALS:**

A. General: All submittals will be reviewed by the Contracting Officer. Unacceptable submittals will be returned for corrections. Until acceptable submittals are received progress payments for related work will be withheld.

B. Control Submittal: Within 30 calendar days after award of the contract, and before any materials of this Section are delivered to the job site, submit:

1. Complete materials and equipment list with manufacturers' literature on all items proposed to be furnished and installed under this Section.

2. Product data submittals must be complete and in a single bound document for all items supplied in this Division. Each document shall be bound with an index and marked with the equipment identification as specified in the Plans and Specifications. The Mechanical Engineer reserves the right to refuse to review partial or improperly prepared submittals.

3. Provide complete control shop drawing including equipment, control devices, point to point connections with terminal numbers, and any details necessary for a complete control drawing.

4. List of name plates to be engraved, showing each name plate wording and location.

C. Record Documents:

1. During progress of the work, maintain an accurate record of all changes made in the systems from those shown on the drawings, specifications and submittals.

2. Revise Shop Drawings and provide on reproducible media and in DXF format compatible with MS DOS operating systems.

D. Owner's Manual: Upon completion of the work, a complete bound book containing the following information shall be submitted to the Mechanical Engineer(a minimum of six (6) copies required:

1. Complete catalog and performance data on all control devices, including all documents included in submittals.

2. Complete manufacturers' operating and maintenance instructions on all control devices.

3. Complete wiring and control diagrams for all equipment and systems, including list of materials, description of operation and system flow diagrams.

4. Manufacturers' warranty certificates on all equipment.

5. Contractor's guarantee letter.

1.8 **OPERATION:**

A. The Owner may require operation of parts or all of the installation for beneficial occupancy prior to final acceptance.

B. Cost of utilities for such operation shall be paid by the Owner. Said operation shall not be construed as acceptance of the work.

1.9 **GUARANTEE:**

A. The Contractor shall guarantee in writing all work performed under this contract for a period of one year from the date of substantial completion.

B. When notified of a system failure relating to the work performed under this contract, the contractor will be responsible for all investigation, diagnoses, repair, revision or replacement necessary to correct the condition. The above fully applies to owner furnished equipment or components installed as part of this work. The contractor will be given a procedure to obtain parts for Owner furnished equipment without cost to the contractor.

**PART - 2 PRODUCTS**

2.1 **MATERIALS & EQUIPMENT:**

A. All materials and equipment installed shall be new, full weight and of the best quality. The same brand or manufacturer shall be used for each specific application of equipment.

B. All equipment and materials shall be the capacity and types shown on the drawings, and shall be the listed manufacturer and model number.

C. All hangers, brackets, clamps, etc., shall be manufactured for and be the type and strength suitable for each use.

**PART - 3 EXECUTION**

3.1 **PREPARATIONS:**

A. Prior to Installation: Inspect the installed work executed under other Sections which affect the installation of the controls. Report unacceptable conditions to Engineer. Do not begin work until unacceptable conditions have been corrected. Installation of the controls shall constitute acceptance of existing conditions.

B. Coordination: Coordinate work with work specified under other Sections to ensure proper and adequate interface of work. Equipment and systems drawings are generally diagrammatic unless dimensions are

indicated. Drawings and details shall be checked for interference's with structural and other conditions prior to performing work.

C. The Contractor shall be responsible for safety and good condition of his materials and equipment until final acceptance by the Owner. He shall erect and maintain suitable barriers, protective devices, lights and warning signs where required.

3.2 **INSTALLATION:**

A. General:

1. When applicable installation procedures are shown or specified in other sections, those procedures shall be followed.

2. Provide all foundations, supports and hangers, etc., as required to install the equipment as specified or shown on the drawings. All equipment shall be supported, braced and cross-braced in such a manner as to prevent sway and/or lateral movement up to 30% of the gravity force.

3. Sealing: Wherever any part of the control system has to pierce the roofing, openings through the roof shall be flashed absolutely watertight. Pipes through exterior basement walls shall be caulked watertight with oakum and hot tar.

4. Arrange and support piping and equipment so that vibration is at a minimum and is not transmitted to or through building structure.

3.3 **WIRING AND CONDUIT:**

A. Control wiring shall be in electrical conduit. If conduit is subject to physical damage use rigid conduit. If wiring is in a concealed air plenum use plenum rated electrical conduit.

3.4 **CONTROL PANELS AND DEVICE LOCATIONS:**

A. All controllers, relays, switches, etc., for equipment located within equipment rooms shall be mounted in enclosed control panels with hinged locking doors. Electric indicating devices shall be mounted on the face of the control panel door. All control devices equipment located in exposed areas subject to outside weather conditions shall be mounted inside weatherproof enclosures.

B. Location of each panel is to be convenient for adjustment and service. Submit locations of all panels to the engineer with shop drawings.

3.5 **IDENTIFICATION:**

A. The label wording shall match that used on the drawings and provide clearly readable printed labels for each control component inside a panel. When applicable, additional identification needed shall be documented on the Shop Drawings.

B. Engraved nameplates shall be provided on the face of each panel and beneath each actuator and control device not in a panel describing its use.

C. All electrical devices within the panel shall be wired to a terminal strip within the panel. An "electric terminal" numbering system shall be applied to all terminals with aforementioned numbers matching terminals shown on Shop Drawings.

3.6 **CLOSING-IN OF UNINSPECTED WORK:**

A. General: Do not allow or cause any of the Work of this Section to be covered up or enclosed until it has been inspected, tested, and approved by the Mechanical Engineer and by all other authorities having jurisdiction.

B. Uncovering: Should any of the Work of this Section be covered up or enclosed before it has been completely inspected, tested, or approved, do all things necessary to uncover all such work. After the Work has been completely inspected, tested, and approved, provide all materials and labor necessary and make all repairs necessary to restore the Work to its original and proper condition at no additional cost to the Owner.

3.7 **PROGRAMMING:**

A. The Direct Digital Control (DDC) operational program will be provided by the Control Systems Contractor. The Contractor shall provide any testing program he feels necessary to fully test the operation of the various components.

3.8 **COMMISSIONING THE SYSTEM:**

A. The commissioning period starts when the following conditions are met:

1. The DDC system and all involved HVAC equipment have been installed, connected to the DDC system and ready to operate.

2. A commissioning meeting has been conducted with representative of contractors involved building occupants, General Contractor, Mechanical Contractor, and the Control System Contractor.

3. Consensus is reached, by the representatives at the above referenced meeting, that it is appropriate for the commissioning process to start. The operational program is loaded into the DDC system by the Control Systems Contractor.

B. During the commissioning period, the Control System Contractor will maintain a commissioning file of the printed reports from the building and daily faxed copies of these reports to the Mechanical Contractor.

C. During the commissioning period the air conditioning units shall have new filters installed. The static pressure across the fan shall be accurately measured and documented. Using plywood or other suitable material the filter bank shall be restricted to reduce the flow to the minimum flow specified by the Mechanical Engineer. The static pressure across the fan shall be measured and documented again. The "new, clean filters" and the "restricted filter" static pressures shall be provided to the DDC system programmer so the pressures can be included in the DDC system program.

D. The commissioning process will be completed and the warranty period shall start when the following conditions are met.

1. All training to be provided as part of the project has been completed.

2. No "alarm" or "condition reports" are being generated by the DDC system for seven (7) calendar days (168 hours) due to incomplete or inaccurate installation, program, or programming.

3. All adjustments and "fine tuning" of the system have been completed.

4. The system has been accepted by the General Contractor and Building Owners and approved by the Mechanical Engineer.

END OF SECTION