

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Basic Mechanical Requirements specifically applicable to Division 15 Sections, in addition to Division 1 - General Requirements.

1.02 DESCRIPTION

- A. Furnish materials and perform labor required to execute this work as indicated on the drawings, as specified and as required to complete the work of this section, except as otherwise herein specifically excluded.

1.03 WORK INCLUDED

- A. The complete Heating, Ventilating and Air Conditioning (HVAC) and Plumbing systems including but not limited to these major items.
 - 1. Coordinate work of this Section with related trades.
 - 2. Verify applicable dimensions at the jobsite.
 - 3. Roof top gas/electric package air conditioning units.
 - 4. Air filters.
 - 5. Duct systems; supply, return and exhaust complete with combination fire-smoke dampers, and manual dampers.
 - 6. Diffusers and registers.
 - 7. Mechanical and plumbing equipment bases and roof curbs.
 - 8. Exhaust fans.
 - 9. Data room ductless split-system air conditioners.
 - 10. Furnishing and installation of miscellaneous hangers, supports, sleeves, inserts, anchors and other auxiliary equipment for systems under this Division.
 - 11. Duct lining and insulation.
 - 12. Domestic hot water, condensate, condensate drain, refrigeration piping, fittings, valves and specialties, and insulation.

13. Soil waste and vent system inside and outside the building including connections to fixtures, equipment, sewer connections, clean-outs, indirect drains.
14. Water piping systems inside and outside the building, including connections to fixtures, equipment, water meters and vaults.
15. Interruptible and non-interruptible fuel gas systems inside and outside the building, including connections, gas meters, earthquake valves, and pressure regulating stations.
16. Plumbing fixtures, carriers, fittings, trim, hose bibs, wall hydrants, and accessories.
17. Natural gas piping system including connections to equipment and site.
18. Water heating systems, including water heating equipment, circulating pumps, connections.
19. Temperature control.
20. Shop drawings.
21. Equipment identification.
22. Equipment and systems adjustments and balancing.
23. Air, water and gas systems testing, adjusting and balancing.
24. Written operating and maintenance instructions.
25. Record drawings.
26. Guarantee

1.04 WORK SPECIFIED ELSEWHERE

- A. Concrete, Architectural Sheet Metal, Door and Exterior Wall Louvers, Painting and Electrical.

1.05 SITE INSPECTION

- A. Contractor shall familiarize himself with the conditions at the site. No allowance will be made subsequently for any error through negligence in observing the site conditions. Contractor shall observe and make cost allowance for any mechanical and/or electrical items that must be relocated to accommodate the installation or servicing of any item covered under this contract.

1.06 ORDINANCES, REGULATIONS AND CODES

- A. References to Technical Societies, Trade Organizations, Governmental Agencies is made in Division 15 in accordance with the following abbreviations.

AFI - Air Filter Institute
AMCA - Air Moving & Conditioning Association
ARI - Air Conditioning & Refrigeration Institute
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society of Testing Materials
AWSC - American Welding Society Code
ANSI - American National Standards Institute
CBC - California Building Code
CCR - California Code of Regulations
CEC - California Electrical Code
CFC - California Fire Codes
CMC - California Mechanical Code
CPC - California Plumbing Code
DSA - Division of the State Architect
FIA - Factory Insurance Association
NAFM - National Association of Fan Manufacturers
NEMA - National Electrical Manufacturer's Association
NFPA - National Fire Protection Association
ORS - Office of Regulatory Services
OSHDP - Office of Statewide Health, Planning and Development
SCAQMD - South Coast Air Quality Management District
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
UFC - Uniform Fire Code
UL - Underwriter's Laboratories
UPC - Uniform Plumbing Code

- B. Requirements of Regulatory Agencies: Materials and installation shall comply with applicable local, state, and national codes and ordinances. Rulings and interpretations of the enforcing agencies shall be considered as part of the local codes. No extras will be permitted for furnishing items required by the local codes but not specified or shown on the drawings.

- C. Codes and Standards:

1. 2006 IBC and 2007 California Amendments (2007 California Building Code - Part 2, Title 24, CCR).
2. 2006 UMC and 2007 California Amendments (2007 California Mechanical Code - Part 4, Title 24 CCR).
3. 2006 UPC and 2007 California Amendments (2007 California Plumbing Code - Part 5, Title 24 CCR).

4. 2006 International Fire Code with 2007 California State Amendments (2007 California Fire Code - Part 9, Title 24 CCR).
 5. 2005 National Electrical Code (NEC) and 2007 California Amendments (2007 California Electrical Code - Part 3, Title 24, CCR).
 6. National Fire Protection Association's - National Fire Code.
 7. 2008 California Energy Code, California Code of Regulations (CCR) Title 24, Part 6.
- D. Nothing in these drawings and specifications is to be construed to permit work in violation thereof. Ordinances, regulations and codes are to be construed as minimum requirements.
- E. The responsibility of the Architect to conduct construction reviews of the Contractor's performance is not intended to include the adequacy of the Contractor's safety measures in, on, or near the construction site.
- F. Ventilating, refrigeration and electrical equipment and appliances are required to be approved by the Underwriters' Laboratories, Inc., or other nationally recognized testing agency and installed per the testing agency's specifications.

1.07 PERMITS, FEES AND INSPECTIONS

- A. Obtain and pay for all necessary permits, fees, assessments, complimentary drawings, required by any legally constituted public authorities having jurisdiction.

1.08 DRAWINGS AND SPECIFICATIONS

- A. The Architect's decision will be final on interpretation of the Drawings and Specifications.
- B. The Drawings and Specifications are complimentary. Any work called for on the Drawings and not mentioned in the Specifications, or vice versa, shall be performed as though fully set forth in both.
- C. Where codes, standards, drawings or specifications conflict, the most stringent shall prevail, unless prior approval for variance is obtained. Specific details on the drawings shall supercede the specification in the event of a conflict.
- D. Alternate support or seismic detail shall have prior approval by the Architect; and the Contractor shall obtain agency approval without any additional cost or time to the contract and without any time penalty on the work schedule.

1.09 SUBMITTALS

- A. Before starting work, the Contractor shall furnish for the approval of the Architect, shop drawings and itemized equipment lists, complete in all details that

he proposes to install. All items shall be submitted at the same time. Conform to Division 1.

- B. Submittals must be specific to this project with respect to model number, capacities, performance, etc., generic submittals will not be accepted.
- C. Submittals shall include, but not necessarily be limited to the following which are mandatory:
 - 1. Draw Equipment Layouts to 1/4" scale, including equipment, piping accessories, and showing clearances for operating and servicing.
 - 2. Schedule of pipe, fittings, valves, with manufacturer and catalog number.
 - 3. Specialties, valves, gauges and thermometers of all types.
 - 4. Foundations, supports, hangers, inserts.
 - 5. Earthquake supports and calculations.
 - 6. Expansion loops, expansion joints, guides, and anchors.
 - 7. Insulation.
 - 8. Ventilation and air conditioning equipment, specialties and the air control systems.
 - 9. Fans, fan characteristic curves, fan tests.
 - 10. Dampers, louvers, grilles, registers, diffusers.
 - 11. Shop fabrication drawings and installation drawings of ductwork and piping layouts. Submit for approval prior to fabrication. Drawings shall indicate dimensions from bottom of piping and ductwork to finish floor level.
 - 12. Wiring diagrams, control panel board, motor starters and controls for electrically operated equipment furnished by mechanical trades.
 - 13. Automatic control system diagrams.
 - 14. Exhaust fans.
 - 15. Access panels.
 - 16. Clean-outs
 - 17. Fixture carriers.
 - 18. Hangers, inserts, supports, anchors.

19. Hose bibs.
20. Hot water circulators.
21. Pipe, fittings and specialties.
22. Pipe isolators.
23. Plumbing fixtures, fittings, trim, drains and receptors.
24. Pressure regulators.
25. Roof flashing.
26. Sleeves, escutcheons, caulking, waterproofing, fireproofing.
27. Strainers
28. Vaults
29. Water hammer arrestors.
30. Water heating equipment.
31. Expansion joints, guides and anchors.
32. Shop fabrications drawings and calculations.
33. Approved seismic drawings and calculations for applicable piping equipment, as required by authority having jurisdiction.
34. Special and miscellaneous products furnished under this section and not listed herein.

1.10 RECORD DRAWINGS AND MANUALS

- A. Record Set During the Work: At site, maintain at least one set of Drawings as a Field Record Set. Also maintain at least one copy of all Addenda, Modifications, approved submittals, correspondence, and transmittals at site. Keep Drawings and data in good order and readily available to Architect and Owner.
- B. Changes: Clearly and correctly mark Record Drawings to show changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless authorized by the Architect.
- C. Final Record Drawings: Conform to Division 1 requirements.
- D. Preparation of Final Record Drawings: Contractor shall transfer recorded changes in the work indicated on the Field Record Set to the record set. Changes shall be neatly and clearly drawn and noted by skilled draftsmen, and shown technically correct.

- E. Approval: Prior to Architect's inspection for Substantial Completion, submit the Final Record Drawings to the Architect for review, and make such revisions as may be necessary for Final Record Drawings to be a true, complete, and accurate record of the work.
- F. Manuals: Obtain data from the various manufacturers and submit instruction, operation, and maintenance manuals as required and to the extent required under other Sections.
- G. Contents: Each manual shall have an index listing the contents. Information in the manuals shall include not less than:
 - 1. General introductions and overall equipment description, purpose, functions and simplified theory of operation.
 - 2. Specifications
 - 3. Installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal and vertical alignment.
 - 4. Grouting requirements.
 - 5. List showing lubricants for each item of mechanical equipment and recommended lubrication intervals.
 - 6. Start-up and beginning operation procedures.
 - 7. Operational procedures.
 - 8. Shutdown procedures.
 - 9. Maintenance and calibration procedures
 - 10. Parts lists
 - 11. Name, address and telephone number of each manufacturer's local representative.
- H. Manual Submittals: Unless otherwise specified, each submittal shall include two copies of each manual, one of which will be returned to the Contractor, marked to show the required review. When approved, deliver four copies to Architect unless otherwise specified.
- I. "As-Built" drawings of ductwork and piping, including all elbows, transitions, damper and valve locations shall be provided ***prior*** to commencement of air and water balance.

1.11 QUALITY OF EQUIPMENT, MATERIALS AND WORKMANSHIP

- A. Unless otherwise specified, equipment and materials used in the installation shall be new and in perfect condition when installed. Articles provided for the same

general purpose or use shall be of the same make. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. Furnish the services of an experienced superintendent, who shall be constantly in charge of the work, together with all necessary journeymen, helpers and laborers required.

1.12 SEISMIC DESIGN

- A. Contractor shall be responsible for anchors and connections of mechanical work to the building structure including calculations for approval by Local Agency for items or work, where alternate support or anchorage detail is proposed to prevent damage as a result of an earthquake, including manufactured equipment, the connection and integrity of shop fabricated and field fabricated materials and equipment. The anchorage of all pipes, ducts, conduits, fixtures, equipment, etc. shall withstand the lateral forces and shall accommodate calculated building displacement as required by the California Building Code, and local city/county codes. Conform to the following:
1. In accordance with Title 24, 2007 CBC Section 16, details shall be provided for the seismic anchorage of all mechanical and electrical equipment, anchorage details shall be based upon appropriate design calculations.
 2. The seismic anchorage of mechanical and electrical equipment shall conform to C.C.R. Title 24, 2007 CBC Section 16. Anchorage details for roof/floor-mounted equipment shall be shown on plans.

1.13 SUBSTITUTIONS AND CHANGES

- A. The design has been based on data from certain manufacturers, suitable for each application. Recommendations for alternative manufacturers are made for each product, except when "no substitutions permitted" is indicated.
- B. It is the intent of the Owner to have this project constructed with materials, products and system originally designed and specified into the project.
- C. Alternatives that may require the modification, realignment and/or adjustment of other associated components, including impact on other trades, shall be accomplished at no additional cost or time to the contract and shall have the approval of the Architect.
- D. Substitutions shall be submitted addressing all features listed in the specifications. Features that deviate from the plans and specifications shall be clearly identified including justification for deviations. TMAD Taylor & Gaines will review initial submittal on substitutes only. Subsequent submittals made to correct deficiencies in original submittals will be reviewed at Contractor's expense based on TMAD Taylor & Gaines' hourly rate for engineering services.
- E. Should the Contractor elect to propose substitutions for the Owner's interest, the substitutions shall be in compliance with Division 1.

1.14 APPROVALS

- A. The Architect will have the right to accept or reject equipment, materials, workmanship, tests and determine when the Contractor has complied with the requirements herein specified.

1.15 SELECTION AND ORDERING OF EQUIPMENT AND MATERIALS

- A. Immediately after award of the Contract and after the approval of submittals by the Architect, the Contractor shall arrange for the purchase and delivery of equipment and materials required, in ample quantities and at the proper time. He shall deliver to the Architect a complete list of equipment and materials ordered, giving descriptions, plate numbers, brochures, name of the wholesalers, date of the orders and approximate delivery dates.

1.16 LOCATIONS AND ACCESSIBILITY

- A. Drawings show pipe and ductwork diagrammatically. Conform to Drawings as closely as possible in layout work. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences as approved by Architect. Install piping and ductwork to best suit field conditions after coordinating with other trades. Run exposed piping and ductwork parallel to, or at right angle to, building walls. Keep horizontal lines as close to bottom of structures as possible. Conform to ceiling heights established on Drawings.
- B. Install equipment in such a manner as to be readily accessible for maintenance and repairs. Install piping, ducts and conduit in such a manner as to preserve headroom, avoid obstructions and keep openings and passageways clear.
- C. Installation at valves, thermometers, gauges, cleanouts, dampers, controls, steam and water specialties, duct access doors or any other indicating equipment or specialties requiring reading, adjustment, inspection, maintenance shall be conveniently and accessibly located with reference to the finished building.
- D. Where wall and ceiling access doors are required but not shown, such doors shall be furnished under other sections and as directed by the Architect. Coordinate this requirement with appropriate trade.
- E. If changes in the indicated locations or arrangements are required, they shall be made without additional charges.
- F. In an existing area, where required, remove, reinstall, reconnect or replace, etc., any existing work to accommodate new work without any additional cost to the Owner. Material shall match existing, unless otherwise specified or approved in writing by the Architect.
- G. Provide sheaves and belts if required, to Test, Adjust and Balance Agency, to allow air moving equipment to meet flow requirements specified at no additional cost to the Owner.

1.17 COORDINATION OF TRADES

- A. Contractor shall coordinate all trades in the interest of obtaining the most practical overall arrangement of equipment, piping, conduit, and ducts and to maintain maximum headroom and accessibility.
- B. No extras will be allowed for changes made necessary by interference between trades.
- C. Submit Composite Drawings in accordance with Special Conditions. Include dimensioned plans, elevations, sections and details and give complete information particularly as to the kinds and types of materials and equipment, size and location of sleeves, inserts, attachments, chases, openings, conduits, ducts, boxes, lighting, structural interferences. Coordinate these Composite Drawings and field layouts in the field for proper relationship to work of applicable trades based on field conditions. Contractor shall have competent personnel readily available for coordinating, checking, and supervision of field layouts. The procedures for submittals and resubmittals, and final distribution shall be as specified in Division 1. Do not start installation of work involved under Composite Drawings until the Architect reviews applicable submittal. Discrepancies between the Drawings and Composite Drawings shall be specifically noted and identified on the Composite Drawings. Drawings for the various trades involved shall be submitted as required and reviewed prior to preparation of Composite Drawings.
 - 1. Equipment Foundations and Bases: Furnish certified details and drawings for approval before fabrication. Furnish parts necessary for each foundation sub base and support.
 - 2. Pipe Sleeves and Inserts: Furnish and install pipe sleeves and pipe support inserts before concrete is poured.
 - 3. Roof, Wall and Floor Openings: Furnish Shop Drawings showing exact locations and sizes of openings through roofs, walls and floors.
 - 4. Concrete: Conform to Concrete Section of the Specifications.

1.18 GUARANTEES

- A. Contractor shall guarantee workmanship, equipment and materials installed under his contract for a period of not less than one (1) year from the date of Substantial Completion. Should any defects occur during this period, the Contractor shall promptly repair or replace the defective item and any other damage caused to the building free of charge to the Owner, including cost of labor and materials.
- B. Guarantee included in this section to cover:
 - 1. Faulty or inadequate design of equipment or material installed.
 - 2. Improper assembly or erection.

3. Defective workmanship or material.
 4. Incorrect or inadequate operation or other failure.
- C. He shall guarantee the complete and perfect operation of the entire system and that equipment will be supported in such a way as to be free of objectionable vibration and noise.
- D. Furnish the parts and labor to replace any items found to be defective in the refrigeration equipment within the guarantee period.
- E. In addition to other guarantees, furnish free maintenance for the refrigeration equipment, including replacement of refrigerant and oil, for a period of one (1) year. This shall include regular monthly maintenance and "On Call" service if required.
- F. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty to the Owner, who shall be named as beneficiary.

1.19 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Provide adequate storage facilities for equipment and materials on the site and shall make provisions to protect such materials and equipment from damage.

1.20 CLOSING-IN OF UNINSPECTED WORK

- A. Contractor shall not allow or cause any of the work, specifically ductwork and piping, to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Should any of work be covered up or enclosed before such inspection and test, he shall at his own expense, uncover the work and after it has been inspected, tested, and approved, make repairs with such materials as may be necessary to restore work to its original and proper condition.

1.21 BUILDING FOOTING CLEARANCES

- A. Under no circumstances shall pipes, ducts, or conduits penetrate footings. They shall cross below footings or through sleeves above footings. Those running parallel to footings shall have the minimum clearance from the cone of influence indicated on the Drawings or as required by Code.

1.22 DAMAGE BY LEAKS

- A. Contractor shall be responsible for all damage to any part of the premises caused by rain leaks through or around ducts or pipes, leaks or breaks in piping, equipment or fixtures furnished or installed by him for a period of one (1) year from the date of Substantial Completion.

1.23 EQUIPMENT LABELS

- A. Equipment provided under this Section shall be provided with the manufacturer's metal identification labels attached to each individual piece of equipment showing complete performance characteristics, size, model and serial number.

1.24 EXCAVATION, TRENCHING AND BACKFILLING

- A. Excavating, trenching and backfilling for utilities within the building area shall be done in conformity with Division 2 - Sitework. Piping shall be installed promptly after excavation in order to keep the trenches open as short a time as possible.
- B. Excavating, trenching and backfilling for utilities outside the building area shall be done in conformity with Division 2 - Site work.
- C. Any existing underground piping and conduit that is encountered shall be properly shored and protected from damage. Active piping shall be left intact and undamaged.

1.25 PRELIMINARY OPERATION

- A. Should the Owner request that any portion of the plant, apparatus, or equipment be operated for the Owner's beneficial use prior to the final completion and acceptance of the work, the Contractor shall conform to Beneficial Occupancy Provisions of the General Conditions. Such operation shall be under the supervision and direction of the Contractor. Such preliminary operation shall not be construed as an acceptance of any of the work.

1.26 ELECTRICAL WORK

- A. Coordinate with Division 16 in making the line and low voltage electrical connections and be responsible for the operation of the equipment furnished under this section.
- B. Voltage for electrical work will be included in Division 16. However, any control wiring which is required that is not shown on the control diagram shall be as described under this Section. In the event that the Contractor chooses to provide equipment that requires extra expense in the power or control wiring, he shall pay additional electrical costs.
- C. Safety switches, starters, circuit breakers, unless provided as a portion of package equipment, and the electrical connections of mechanical equipment to the electrical power service shall be provided under Division 16.
- D. Interconnecting wiring, safety switches, relays, controllers and motor starters which are integral components of packaged equipment shall be provided as an integral part of that equipment.
- E. All interconnecting power wiring and conduits shall be provided by Division 16.

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- F. Control wiring shall be provided by Division 15, unless otherwise indicated on the drawings.
- G. Conduit for control wiring shall be provided by Division 16.

END OF SECTION

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe, duct and equipment hangers, supports and associated anchors.
- B. Equipment bases and supports.
- C. Sleeves and seals.
- D. Flashing and sealing equipment.

1.02 QUALITY ASSURANCE

- A. Supports for Sprinkler Piping: In conformance with NFPA 13.
- B. Supports for Standpipes: In conformance with NFPA14.
- C. Manufacturer's Qualifications: Firm regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Indicate hanger and support framing and attachment methods.

PART 2 - PRODUCTS

2.01 PIPE AND DUCT HANGERS AND SUPPORTS

- A. Pipe Support: All piping shall be supported in such a manner that it is securely attached to the structure of the building. Attachment shall be capable of supporting the tributary weight of the pipe and contents in any direction.
 - 1. Pipes, ducts, and conduits shall be supported and braced per OSHPD anchorage pre-approval No. OPA-0349, the Mason Industries "Seismic Restraints Guidelines for Suspended Piping, Ductwork and Electrical Systems" or No. OPA-0114, the "B-Line Seismic Restraint System" or OPA-0300, the "Tolco Seismic Restraint Systems Guidelines."
 - 2. The maximum support spacing for vertical and horizontal pipes shall be as required by the California Plumbing Code, Chapter 3, but not less than that indicated in the table below for horizontal piping.

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Maximum Spacing for Horizontal Pipes						
Water/Waste /Refrigerant						
Pipe Size	Hanger Rod Size	Copper	Steel	Cast Iron	Nat. Gas	Med. Gases
≤1/2"	3/8"	6'	6'	-	6'	6'
3/4"	3/8"	6'	8'	-	8'	8'
1"	3/8"	6'	8'	-	8'	8'
1-1/4"	3/8"	6'	8'	-	10'	10'
1-1/2"	3/8"	6'	10'	10'	10'	10'
2"	3/8"	10'	10'	10'	10'	10'
2-1/2"	1/2"	10'	10'	10'	10'	10'
3"	1/2"	10'	10'	10'	10'	10'
4"	5/8"	10'	10'	10'	10'	10'
6"	5/8"	10'	10'	10'	10'	10'
8"	5/8"	10'	10'	10'	10'	10'

- B. Duct Supports: The maximum support spacing for ducts shall be as required by the California Mechanical Code Chapter 6 and SMACNA.
- C. Arrange hangers to prevent transmission of vibration from piping/ducting to building structure and allow for expansion and contraction to hangers and supports. Clearance for application of specified insulation without cutting pipeline covering or fitting covering in installation of pipe hangers and fittings shall be provided. Uninsulated copper or brass pipe or tubing shall be isolated from ferrous hangers or supports as indicated herein. Where concealed piping may be supported from structural floor, provide angle members to span joint or distribute load of additional members. All hangers and pipe/duct supports that are exposed to weather shall be made of galvanized steel.
- D. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon Steel, adjustable swivel, split ring.
- E. Hangers for Pipe Sizes 2 to 4 Inches and Cold Pipe Sizes 6 Inches and Over: Carbon steel, adjustable, clevis.
- F. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods; cast iron roll and stand for hot pipe sizes 6 inches and over.
- H. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- I. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
- J. Vertical Support: Steel riser clamp.

- K. Floor Support for Pipe Sizes to 4 Inches and All Cold Pipe Sizes: Cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier or steel support.
- L. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- M. Copper Pipe Support: Carbon steel ring, adjustable, copper plated. Provide "Unistrut Cush-a-Clamp" or equal, for uninsulated piping supported by strut bracing.
- N. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
- O. Shield for Insulated Piping 2-1/2 Inches and Larger (Except Cold Water Piping): Pipe covering protective saddles.
- P. Shields for Insulated Cold Water Piping 2-1/2 Inches and Larger: Hard block non-conducting saddles in 90 degree segments, 12 inch minimum length, block thickness same as insulation thickness.
- Q. Shields for Vertical Copper Pipe Risers: Sheet lead.

2.02 MANUFACTURERS - SEISMIC BRACING

- A. Systems: Products of B-Line, Inc., Oakland, CA, are the standard of quality required and specified herein. Similar products of other manufacturers meeting the same standards of performance and approved by authority having jurisdiction may be submitted for approval.

2.03 INSERTS

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

2.04 FLASHING

- A. Metal Flashing: 24 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 1/16-inch thick sheet compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.05 EQUIPMENT CURBS

- A. Fabricate curbs as detailed on the drawings.

2.06 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors: Form with 18 gage galvanized steel.
- B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings and Potentially Wet Floors: Form with steel pipe or 18 gage galvanized steel.
- C. Sleeves for Pipes through Fire Rated and Fire Resistive Floors and Walls, and Fireproofing: Prefabricated fire rated sleeves including seals, UL listed as specified in Division 7, Firestopping.
- D. Sleeves for Round Ductwork: Form with galvanized steel.
- E. Sleeves for Rectangular Ductwork: Form with galvanized steel.
- F. Fire Stopping Insulation: Glass fiber type, non-combustible, as specified in Division 7, Insulation.
- G. Sealant:
 - 1. Non-fire rated applications: polyurethane, two-component type.
 - 2. Fire-rated applications: single component, fire rated.

2.07 FABRICATION

- A. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- B. Design hangers without disengagement of supported pipe.
- C. Provide sheet lead packing between hanger or support and piping for copper piping,

2.08 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.01 INSERTS

- A. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

- C. Where concrete slabs form finished ceiling, provide inserts flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide thru-bolt with recessed square steel plate and nut flush with top of slab.

3.02 PIPE HANGERS AND SUPPORTS

- A. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow.
- C. Use hangers with 1-1/2 inch minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.

3.03 EQUIPMENT BASES AND SUPPORTS

- A. Provide equipment bases of type indicated on drawings.
- B. Provide templates, anchor bolts and accessories for mounting and anchoring equipment.
- C. Construct support of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.04 FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors and roofs.
- B. Flash vent and soil pipes projecting 6 inches minimum above finished roof surface with lead worked one-inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and calk, metal counterflash and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, mop sink drains watertight to adjacent materials with Noble Seal 40 mil thick.

- E. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Coordinate exact height requirement with Architect prior to ordering. Flexible sheet flash and counterflash with sheet metal; seal watertight.

3.05 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Extend sleeves through floors one inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping or ductwork penetrates floor, ceiling or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and fire rated calk seal in accordance with Division 7. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

SECTION 15190

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Identification of mechanical products installed under Division 15.

1.02 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit list of wording, symbols, letter size and color-coding for mechanical identification.
- C. Submit valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.
- D. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Seton Name Plate Company.
- B. Brady Company

2.02 MATERIALS

- A. Color: Unless specified otherwise, conform with ASME A13.1.
- B. Plastic Nameplates: Laminated three-layer plastic with engraved black letters on light contrasting background color.
- C. Metal Tags: Brass with stamped letters; tag size minimum 2-inch diameter with smooth edges and brass chain.
- D. Stencils: With clean cut symbols and letters; identified as indicated below, including direction of flow:

<u>System</u>	<u>Letters</u>
Refrigerant Suction Line	R.S.L.
Refrigerant Liquid Line	R.L.L.
Pumped Condensate	P.C.
Gravity Condensate	G.C.
Domestic Cold Water	D.C.W.
Domestic Hot Water	D.H.W.

Domestic Hot Water Return

D.H.W.R.

- E. Stencil Paint: In accordance with Painting Section, semi-gloss enamel.
- F. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inch wide by 4 mil thick, manufactured for direct burial service.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners or adhesive.
- B. Metal Tags: Install with brass chain.
- C. Stencil Painting: Apply in accordance with Painting Section.
- D. Equipment: Identify air handling units, pumps, heat transfer equipment, tanks and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with metal tags.
- E. Controls: Identify control panels and major control components outside panels with plastic nameplates.
- F. Valves: Identify valves in main and branch piping with brass tags. Obtain existing numbering from Owner and continue existing sequence.
- G. Piping: Identify piping, concealed or exposed with stenciled painting. Tags may be used on small diameter piping. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and "T", at each side of penetration of structure or enclosure and at each obstruction.
- H. Ductwork: Identify ductwork with stenciled painting. Identify as to air handling unit number and area served. Locate identification at air handling unit at each side of penetration of structure or enclosure and at each obstruction.

3.03 VALVE CHART AND SCHEDULE

- A. Provide valve charts and schedules in aluminum frame with clear plastic shield. Install at location as approved.

END OF SECTION

SECTION 15260
PIPING INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Piping insulation.
- B. Jackets and accessories.

1.02 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread smoke developed rating of 25-50 in accordance with ASTM E84.
- C. Compliance: All insulating material shall meet the minimum requirements of California Energy Commission's Latest Energy Efficiency Standards.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.
- D. Providing work under this section shall be company licensed by the State as an insulation contractor.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Water Piping Insulation:
 - 1. Knauf Fiberglass.
 - 2. Owens-Corning Fiberglas.
 - 3. Johns Mansville.
- B. Refrigerant Piping Insulation:
 - 1. Armaflex 520

2. Halstead Insul-Tube
3. Rubatex

2.02 INSULATION

- A. Material: One-piece molded glass fiber with factory applied fire retardant jacket with 4" wide longitudinal lap. Service up to 850 degrees F. Schuller International, Inc. "Micro-Lok".
- B. Material: Flexible foamed pipe insulation.

2.03 JACKETS

- A. Interior Applications:
 1. Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints.
 2. PVC Jackets: One-piece, premolded type.
 3. Canvas Jackets: UL listed treated cotton fabric, 8-oz/sq yd.
- B. Exterior Applications:
 1. Aluminum Vapor Barrier Jackets: ASTM B209; 0.020 inch thick; smooth finish.

2.4 ACCESSORIES

- A. Insulation Bands: 3/4 inch wide; 0.015-inch thick galvanized steel.
- B. Metal Jacket Bands: 3/8 inch wide; 0.015-inch thick aluminum.
- C. Insulating Cement: ASTM C195; hydraulic setting mineral wool.
- D. Finishing Cement: ASTM C449.
- E. Adhesives: Compatible with insulation.
- F. Refrigerant Pipe Insulation Exterior Finish: WB Armaflex finish by Armstrong or Rubatex Protective Coating 67 x 944.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install materials after piping has been tested and approved.

3.02 INSTALLATION

A. Water Piping Insulation:

1. Install materials in accordance with manufacturer's instructions.
2. Continue insulation with vapor barrier through penetrations.
3. In exposed piping, locate insulation and cover seams in least visible locations.
4. On insulated piping with vapor barrier, insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints.
5. On insulated piping without vapor barrier and piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
6. Provide an insert not less than 6 inches long, of same thickness and contour as adjoining insulation between support shield and piping, but under the finish jacket, on piping 2 inches diameter or larger to prevent insulation from sagging at support points. Inserts shall be cellular glass or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
7. Neatly finish insulation at supports, protrusions and interruptions.
8. Where pipe hangers are equipped with rollers, provide a 16 ga. Galvanized shield, covering 180° of the insulation circumference between rollers and high density insert supported piping.
9. Jackets:
 - a. Indoor, Concealed Applications: Insulated pipes conveying fluids above ambient temperature shall have standard jackets, with or without vapor barrier, factory-applied or field-applied. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe and finish with glass cloth and adhesive. PVC jackets may be used.
 - b. Indoor, Concealed Applications: Insulated dual-temperature pipes or pipes conveying fluids below ambient temperature (including roof drains and condensate lines) shall have vapor barrier jackets, factory-applied or field-applied. Insulate fittings, joints and valves with molded insulation of like material and thickness as adjacent pipe, and finish with glass cloth and vapor barrier adhesive.
 - c. Indoor, Exposed Applications: For pipe exposed in mechanical equipment rooms or in finished spaces, insulate as for concealed applications. Finish with canvas jacket; size for finish painting. Do not use PVC jackets.

- d. Exterior Applications: Provide vapor barrier jackets. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement.

B. Refrigerant Piping Insulation:

1. For condensing units, install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve. For split system heat pump units, install insulation on above ground refrigerant liquid and suction piping and fittings. Install insulation on above ground hot gas bypass lines.
2. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations:
 - a. Insulate flexible pipe connectors.
 - b. Insulate thermal expansion valves with insulating tape.
 - c. Insulate fittings with sheet insulation and as recommended by Manufacturer.
3. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
4. Install insulation on lines through clamp assembly of pipe support. Do not butt insulation up against sides of clamp assembly. Install sleeve around insulation at each clamping location to prevent crushing of insulation when clamp is tightened.
5. Stagger joints on layered insulation. Seal joints in insulation.
6. Install insulation exposed outside building so "slit" joint seams are placed on bottom of pipe.
7. Paint exterior exposed insulation with two coats of specified exterior finish.

3.03 SCHEDULE OF INSULATION THICKNESS

Insulation thickness and conductivity shall be as required by the latest California Energy Commission Standards but not less than that indicated in the table below:

Fluid Temp. Range °F	Conductivity Range (in BTU Inch Per Hour Per SF °F	Insulation Mean Rating Temp. °F	Nominal Pipe Diameter (in inches)				
			1 & Less	1.25-2	2.50-4	5-6	8 & Larger
Service Water Heating Systems							
Above 105	0.24-0.28	100	1.0	1.0	1.5	1.5	1.5
Cooling Systems (Chilled Water & Refrigerant & Condensate Drain Lines)							
40-60	0.23-0.27	75	0.5	0.5	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.0	1.5	1.5	1.5

END OF SECTION

SECTION 15290

DUCTWORK INSULATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Ductwork insulation.
- B. Insulation jackets.
- C. Duct liner (thermal and acoustical).

1.02 QUALITY ASSURANCE

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience.
- B. Materials: UL listed; flame spread/fuel contributed/smoke developed rating of 25/50/50 in accordance with ASTM E84.
- C. Compliance: All insulating material shall meet the minimum requirements of California Energy Commission's latest Energy Efficiency Standards or California Mechanical Code, whichever is higher level, but not less than that specified in this section.

1.03 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Include product description, list of materials and thickness for each service, and locations.
- C. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS - INSULATION

- A. Knauf Fiberglass.
- B. Owens Corning Fiberglas.
- C. Certainteed Products Co.
- D. Johns Mansville.

2.02 MATERIALS

- A. Type A: Minimum 1-1/2" thick and 0.75 lb/cu.ft. minimum density. Flexible glass fiber; ASTM C612; commercial grade; with installed thermal resistance of 4.2. Vapor barrier material with a perm rating not exceeding 0.5 perm.
- B. Type B: Minimum 1-1/2" thick and 3.0 lb/cu.ft. minimum density. Rigid glass fiber; ASTM C612; Class 1; with installed conductive value of 0.16 at 75 degrees F or equivalent thermal resistance of 6.3. Vapor barrier material with a perm rating not exceeding 0.5 perm.
- C. Type C: Minimum 1" thick and 3 lb/cu.ft. minimum density. Expanded closed cell, fiber-free elastomeric foam; ASTM C534; with installed conductive value of 0.25 at 75 degrees F or equivalent thermal resistance of 4.2; coated air side for maximum 4,000 ft./min. air velocity.
- D. Type D - Vapor Barrier Jacket: Kraft Paper reinforced with glass fiber yarn and bonded to aluminum film.
- E. Type E - Jacket: 8 oz. canvas finished with lagging adhesive.
- F. Adhesives: Waterproof fire-retardant type.
- G. Lagging Adhesive: Fire resistive to ASTM E84.
- H. Impale Anchors: Galvanized steel, 12 gage, and self-adhesive pad.
- I. Joint Tape: Glass fiber cloth, open mesh.
- J. Tie Wire: Annealed steel, 16 gage.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install materials after ductwork has been tested and approved.
- B. Clean surfaces for adhesives.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Provide insulation with vapor barrier when air conveyed may be below summer ambient temperature.
- C. Exterior Insulation Concealed Duct Application:
 - 1. Adhere insulation to duct with spot application of fire retardant adhesive in sufficient quantities to prevent sagging.

2. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire retardant vapor barrier adhesive.
3. Secure insulation with 18 gauge corrosion resistant wire spaced on 12" centers or secured with outward clinch corrosion resistant staples on 4" center.
4. Duct with a width over 30" shall be further secured on the underside with mechanical fasteners on 18" maximum center.
5. Seal all breaks and punctures with vapor barrier tape and same type of fire retardant adhesive.
6. All transverse and longitudinal joints, seams and penetrations of the vapor barrier facing shall be covered with 4 oz. canvas stripping tape applied and sealer with fire retardant mastic.

D. Liner (Type C) Application:

1. Adhere insulation with adhesive for 100 percent coverage. Secure insulation with mechanical fasteners on 15-inch centers maximum on top and side of ductwork with dimension exceeding 20 inches. Seal and smooth joints. Do not use nail-type fasteners. Fasteners shall start within 3" of leading edge of transverse joints. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
2. Ductwork dimensions indicated are net inside dimensions required for airflow. Increase ductwork to allow for insulation thickness.
3. Line supply and return air plenums.

E. Continue insulation with vapor barrier through penetrations.

3.03 SCHEDULE

Ductwork	Type	Insulation Thickness – Inch
Concealed Supply and Return Ducts (between insulated roof and ceiling)	A,D	1-1/2"
Concealed Supply and Return Duct (between non-insulated roof and insulated ceiling or under non-insulated roof with fixed vents or openings to outside or unconditioned space including crawl space)	A,D	3"
Supply and Return Ducts, Exposed to Atmosphere	C	2"
Duct Liner for Supply & Return Duct (interior space between insulated roof and ceiling)	C	1"

END OF SECTION

SECTION 15330

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers design equipment, installation, testing and all materials required for the automatic fire sprinkler protection system.
- B. Contractor shall be responsible for the complete system design, layout, hydraulic calculations, preparation of shop drawings, field installation, coordination and completion in accordance with project requirements and applicable codes and standards.
- C. Work or equipment not indicated or specified which is necessary for the complete and proper operation of the work of this section in accordance with the true intent and meaning of the contract documents shall be provided by this Contractor and incorporated under this section of the work at no additional cost to the owner.

1.02 RELATED WORK

- A. Section 15140 - Supports and Anchors.
- B. Section 15190 - Mechanical Identification.
- C. Division 16 - Electrical

1.03 REFERENCES

- A. The system shall meet all requirements of the National Fire Protection Association (NFPA 13), Installation of Fire Sprinkler Systems, and all other applicable codes and ordinances, whichever are more stringent shall apply. All fire protection equipment shall be listed by Underwriters' Laboratories (UL) for fire protection use and/or approved by Factory Mutual (FM). Test system in accordance with requirements of the authority having jurisdiction with the fire inspector present for system certification.
- B. Prior to installation, the contractor shall submit his/her qualifications, shop drawings and hydraulic calculations stamped and signed by a California State Registered Professional Engineer or a C-16 Licensed Contractor, with a minimum of three (3) years related experience, to the authority having jurisdiction. No installation work shall be started until shop drawings and hydraulic calculations have been approved.
- C. California Building Code (CBC) Chapter 9, Fire Protection System

1.04 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.
- B. Interface system with building fire and smoke alarm system.
- C. Provide system to hazard occupancy classification required by the authority having jurisdiction.
- D. Provide fire department connection as indicated.

1.05 QUALITY ASSURANCE

- A. Shop Drawing and Product Data: Shop drawings, hydraulic calculations and product literature shall be furnished to the authority having jurisdiction in conformance with NFPA 13, Installation of Sprinkler Systems.
- B. Equipment and Components: Bear UL/FM label or marking and State Fire Marshal listing.
- C. Specialist Firm: Company specializing in sprinkler systems with three (3) years experience.

1.06 REGULATORY REQUIREMENTS

- A. Hydraulic Calculations, Product Data, and Shop Drawings: Bear stamp of approval of Fire Marshal.

1.07 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1, per 1999 NFPA 13.
- B. Include hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories, copy of DSA approved Underground Piping Plan, material data sheets and copies of CSFM listings for all fire alarm related devices..
- C. Submit shop drawings and hydraulic calculations to Fire Protection Plan Checker for approval. Submit proof of approval to Architect.

1.08 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Division 1.
- B. Contractor shall provide and keep up-to-date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this section of the specifications. This set shall include locations, dimensions, depth of buried piping, shut-off valves, etc. On completion of the work, this set of prints shall be delivered to the Owner.

1.09 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's operation and maintenance data under provisions of Division 1.
- B. Include written maintenance data on components of system, servicing requirements, and Record Drawings.
- C. Include maintenance, and inspection data, replacement and part numbers and availability, location and numbers of service depot.

1.10 EXTRA STOCK

- A. Provide extra sprinklers as required by NFPA 13.
- B. Provide suitable wrenches for each sprinkler type.
- C. Provide metal storage cabinet in location designated by the architect.

1.11 DESIGN REQUIREMENTS

- A. These specifications (Section 15330) are general and are not intended to define specific types of features, devices and appurtenances that are necessary to meet the requirements of the governing authorities mentioned herein.
- B. It shall be the contractor's complete responsibility to determine in advance of submitting a bid for the work under Section 15330 any areas requiring special consideration due to the type of occupancy or storage of materials. These special requirements shall be incorporated into the automatic fire sprinkler design as necessary to conform with the requirements of NFPA 13, Owner's Insurance Underwriter and all other authorities having jurisdiction.
- C. It is the contractor's responsibility to verify existing water supply flow and pressure at all points of connection and base hydraulic calculations on this information.
- D. Prior to design and installation of any work, the contractor shall carefully prepare complete working drawings of the automatic fire sprinkler system. The contractor shall examine the Structural, Architectural, Mechanical, Plumbing and Electrical drawings for the construction of the building in order to fully inform himself as to the scope and detail for the work which will be required of him before proceeding.

1.12 COORDINATION

- A. Clearances and Openings: Contractor shall cooperate and coordinate his/her work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The contractor shall, in advance of the work, furnish instructions to the general contractor as to his/her requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses,

chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this contractor.

- B. Piping runs found to be in conflict with work of other trades, as a result of neglected coordination, shall be removed and reinstalled in new locations designated by the architect at no additional expense to the owner.

1.13 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall repair all damage caused either directly or indirectly by his/her own work persons. Contractor shall also protect his/her own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his/her equipment and materials against direct, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the architect that his/her work has been accepted.

1.14 UNINSPECTED WORK

- A. Contractor shall not allow or cause of his/her work to be covered up before it has been duly inspected, tested and approved by the authorized inspectors having legal jurisdiction over his/her work. Should he fail to observe the above, he shall uncover his/her work and after it has been inspected, tested and approved, recover it at his/her own expense.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Fire Protection Piping, Buried Beyond 5 Feet of Building Select Either (1) or (2).
 - 1. Cast Iron Pipe: ANSI/AWWA C151.
 - a. Fittings: ANSI/AWWA C110, standard thickness.
 - b. Joints: ANSI/AWWA C111, rubber gasket.
 - c. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts and washers.
 - 2. Polyvinyl Chloride (PVC) Plastic Piping Six to Twelve Inches in Diameter: SDR 18 with Class 150 pressure rating manufactured in accordance with AWWA standard C900, unless otherwise noted.

- B. Buried Piping:
 - 1. Cast Iron Pipe: ANSI/AWWA C151.
 - a. Fittings: ANSI/AWWA C110, standard thickness.
 - b. Joints: ANSI/AWWA C111, rubber gasket.
 - c. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts and washers.
- C. Above Ground Inside Building Piping: Piping up to 2" diameter shall be steel, Schedule 40 black conforming to ASTM A53. 2-1/2" diameter piping and larger shall be Schedule 10 continuous welded steel pipe conforming to ASTM A-795. Schedule 40 piping shall be threaded using Class 125 cast iron fitting conforming to ANSI B16.4. Schedule 10 piping shall be grooved using approved grooved fittings and couplings.

2.02 PIPING SPECIALTIES

- A. Automatic Sprinkler Valve: Alarm check valves shall be provided with standard trimmings including retardant chamber, pressure gauges, dual contact/pressure switches, alarm switch, testing bypass, and all necessary pipe, fittings and accessories required for a complete trimming installation, in accordance with NFPA 13. Acceptable alarm check valve is "Grinnell" Model F200 or approved equal.
- B. Alarm Gong: Mechanical alarm (water motor and gong) complete with pelton wheel type, nylon bearings, cast aluminum gong finished in red and bright metallic paint and 3/4 inch strainer. "Reliable" Model C or approved equal.
- C. Waterflow Detectors: Waterflow detectors shall be the vane type and shall be equipped with control linkage and non-thermal type signal retarding device to prevent false alarms due to surges in the water system. "Reliable" Model A or approved equal.
- D. Fire Department Connection: Free standing type; brass thread size to suit fire department hardware; two way threaded dust cap and chain of same material and finish, 3/4 inch automatic drip connected to drain; marked "Sprinkler - Fire Department Connection".

2.03 ACCEPTABLE MANUFACTURERS - SPRINKLER HEADS

- A. Reliable
- B. STAR
- C. Gem Sprinkler Company

2.04 SPRINKLER HEADS

- A. All heads shall be quick-response type.
- B. Suspended Ceiling Type:
 - 1. Reliable Model F1FR recessed type with chrome plated finish with matching escutcheon.
 - 2. Reliable Model F1FR/CCP cover plate finish as selected by architect.
- C. Exposed Area Type: Reliable Model G standard upright type with chrome plated finish.
- D. Sidewall Type: Reliable model ZX-1 chrome plated finish with matching escutcheon.
- E. Guards: Reliable model C1 or C2, guard finish to match sprinkler finish.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate work of this Section with other affected work.

3.02 INSTALLATION - PIPING

- A. Supervision: The Contractor shall furnish the services of an experienced Superintendent who shall be qualified in all phases of the work of this section and who shall constantly be in charge of the work of this Section.
 - 1. All installations shall be per referenced standards. Follow manufacturer's directions and recommendations in all cases as required for all approvals and warranty enforcement.
 - 2. Any cutting of structure shall be subject to approval by the architect. Beams, decks and other structural components shall not be cut or altered in any way unless previously approved.
 - 3. Provide flexible couplings where required to provide extension capability and sway bracing for earthquake protection per NFPA 13.
 - 4. Entire sprinkler system shall be installed in such a manner so that it can be drained in accordance with NFPA 13. Drains shall be located at suitable points as approved by architect. No primary or auxiliary drain shall be located in any public area or electrical room. All drains shall discharge into dedicated receptors.
- B. Locate fire department connection with sufficient clearance from walls, obstructions or adjacent siamese connectors to allow full swing of fire department wrench handle.

- C. Locate outside alarm gong on building wall as indicated.
- D. Place pipe runs to minimize obstruction to other work.
- E. Place piping in concealed spaces above finished ceilings.
- F. Center heads in two directions in ceiling tile and provide piping offsets as required.
- G. Apply strippable tape or paper cover to ensure concealed sprinkler head cover plates do not receive field paint finish.
- H. No work shall be covered or enclosed until inspected, tested and approved by architect and authority having jurisdiction. Should any work be concealed before inspection, the contractor shall, at his/her own expense, uncover such work and after it has been inspected, tested and approved, provide for all repairs as may be necessary to restore any other affected work to its original and proper condition.
- I. Use best of workmanship in the installation of all piping and in particular all piping exposed in areas having no suspended ceilings. Install all piping as high as possible and where possible, install branch piping between structural framing and run main piping only below beams.
- J. Sprinkler head layout must accommodate ceiling mounted HVAC register and lighting locations. Coordination with work of these trades is the responsibility of contractor.
- K. Provide concrete thrust blocks for fire water mains and laterals. Construct thrust blocks per Water District's standards.
- L. Without exception, no piping shall be run under or through any skylight or skylight well. Any additional upright or pendent sprinklers, which may be required by skylight locations, shall be the responsibility of this contractor.
- M. All pipe penetrations at fire rated walls and floors shall be sealed with fire rated material in accordance with approved UL listed fire seal system assembly.

3.03 SPECIAL REQUIREMENTS FOR INSTALLATION OF PLASTIC PIPING:

- A. Install pipe and fittings in accordance with the applicable requirement of ASTM D2774 and ASTM D2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F402.
- B. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assembly joints in accordance with ASTM D2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer. Make push-on joints in accordance with the recommendations of the manufacturer.

3.04 FABRICATION

- A. General: All pipe, fittings, etc., shall be prepared by qualified and trained personnel experienced with the products involved and the recommended methods of preparation. All cuts, threads and grooves shall be made according to applicable codes, standards and accepted good practices. Pipe shall be free of damage, flaws and burrs. Threads and groove shall not be excessively shallow or deep. Fittings shall be made onto pipe no tighter than necessary. Cracked or broken fittings shall be replaced by contractor, without exception. Excess dope and oils shall be removed before shipment to job site.
- B. Welding:
 - 1. All welding to be shop welded. Contractor shall obtain approval from the Inspector of Records prior to any welding on field.
 - 2. Welding methods shall comply with AWS D10.9, Level AR-3 and ANSI B31.1. Contractor shall be responsible for all welded joints and any qualifying procedures of certification required for welders and related personnel.
 - 3. Holes in pipe for welded outlets shall be cut to full inside diameter of fitting prior to welding in place. Holes shall be free of slag and welding residue and of smooth, continuous bore. Fittings shall not penetrate internal diameter of run piping. Holes shall be cut by hole saw or other rotary bit. Torch cutting of holes is strictly prohibited.
 - 4. All welded pipe shall be subject to inspection by the Inspector of Records before it is installed. Provide documentation of acceptance, as required, at time of project closeout.

3.05 CLEANING

- A. Thoroughly clean all parts of apparatus and equipment. Exposed parts that are to be painted shall be thoroughly cleaned of cement, plaster and other materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
- B. Exposed metal work shall be carefully brushed down with steel brushes to remove the rust and other spots, and left smooth and clean.
- C. All pipe to be free of cutting oil prior to installation.
- D. Flush entire piping system of foreign matter.

3.06 SYSTEM TESTS

- A. For pressure test, use a hydrostatic pressure of 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure not less than 2 hours.

Riverside County – Volunteers in Medicine Clinic
82-915 Avenue 48
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Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. Repair all leaks and replace piping, fittings and other system components as required, at no additional cost to the owner.

- B. Test shall be witnessed by authority having jurisdiction and Architect.

END OF SECTION

SECTION 15410

PLUMBING PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Pipe and pipe fittings.
- B. Valves.
- C. Sanitary sewer piping system.
- D. Domestic water piping system.
- E. Storm Drain Piping
- F. Natural gas piping system.
- G. Condensate drain piping system.

1.02 RELATED WORK

- A. Section 15121 - Expansion Compensation.
- B. Section 15140 - Supports and Anchors.
- C. Section 15190 - Mechanical Identification.
- D. Section 15245 - Vibration Isolation.
- E. Section 15260 - Piping Insulation.
- F. Section 15430 - Plumbing Specialties.
- G. Section 15440 - Plumbing Fixtures.
- H. Section 15450 - Plumbing Equipment.

1.03 REFERENCES

- A. ANSI B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- B. ANSI B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.
- C. ANSI B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- D. ASME Sec. 9 - Welding and Brazing Qualifications.

- E. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- F. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- G. ASTM B32 - Solder Metal.
- H. ASTM B88 - Seamless Copper Water Tube.
- I. AWS D1.1 - Structural Welding Code.
- J. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- K. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in. through 48 in., for Water and Other Liquids.
- L. AWWA C111- Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- M. ASME - Boiler and Pressure Vessel Code.
- N. ASTM A74 - Cast Iron Soil Pipe and Fittings.
- O. ASTM B88 - Seamless Copper Water Tube.
- P. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- Q. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- R. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- S. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedules 40.
- T. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
- U. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- V. ASTM D3033 - Type PSP PVC Sewer Pipe and Fittings.
- W. ASTM D3034 - Type PSM PVC Sewer Pipe and Fittings.
- X. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- Y. AWS A5.8 - Brazing Filler Metal.
- Z. AWS D1.1 - Structural Welding Code.
- AA. AWWA C601 - Standard Methods for the Examination of Water and Waste

Water.

- BB. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

1.04 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME Sec 9.

1.05 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Include data on pipe materials, pipe fittings, valves and accessories.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Deliver and store valves in shipping containers with labeling in place.

PART 2 - PRODUCTS

2.01 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: Hubless, ASTM A74 hub and spigot. Fittings: Cast iron. Joints: CISPI HSN compression type with ASTM C564 neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.
- B. Cast Iron Pipe: CISPI 301, hubless. Fittings: Cast iron. Joints: CISPI 301 stainless steel clamp-and-shield assemblies with neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.
- C. Polyethylene Encasement: ASTM D1248 polyethylene tube or sheet form to encase cast iron pipe, with minimum 0.008-inch (0.20 mm) thickness. Install encasement as per ASTM A74 and manufacturer's recommendations.

2.02 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

- A. Cast Iron Pipe: Hubless, ASTM A74, hub and spigot. Fittings: Cast iron. Joints: CISPI HSN compression type with ASTM C564 neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe

Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

- B. Cast Iron Pipe: CISPI 301, hubless. Fittings: Cast iron. Joints: CISPI 301 stainless steel clamp-and-shield assemblies with neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.

2.03 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Tubing: ASTM B88, Type K hard drawn. Fittings: ANSI B16.18, cast copper alloy solder joint pressure fittings. Joints: ASTM B32, solder, Grade 95TA.
- B. Cast Iron Pipe Sizes 4" & Larger: AWWA C151, cement lining as per AWWA C104. Fittings: Ductile iron, Class 52. Joints: AWWA C111, rubber gasket with 3/4-inch diameter rods.

2.04 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L hard drawn. Fittings: ANSI B16.18, cast copper alloy solder joint pressure fittings. Joints: ASTM B32, solder, Grade 95TA.

2.05 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A888. Fittings: Cast iron. Joints: CISPI HSN compression type with ASTM C564 neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.
- B. Cast Iron Pipe: CISPI 301, hubless. Fittings: Cast iron. Joints: CISPI 301 stainless steel clamp-and-shield assemblies with neoprene gaskets. Pipe and fittings shall be marked with the collective trademark of the cast iron Soil Pipe Institute. Acceptable Manufacturers: ABI, Charlotte and Tyler Pipe.
- C. Polyethylene Encasement: ASTM D1248 polyethylene tube or sheet form to encase cast iron pipe, with minimum 0.008-inch (0.20 mm) thickness. Install encasement as per ASTM A74 and manufacturer's recommendations.

2.06 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hubless. Fittings: Cast iron. Joints: CISPI 301 stainless steel clamp-and-shield assemblies with neoprene gaskets.
- B. All exposed storm drain pipe to be Schedule 40 galvanized steel screwed pipe with cast iron drainage fittings.

2.07 NATURAL GAS PIPING, BELOW GRADE

- A. Polyethylene Pipe: ASTM D2513, SDR 11.5. Fittings: ASTM D2683 or ASTM D2513 socket type. Joints: Fusion welded; plastic to steel connections with

ASTM D2513 transition fittings or risers. Pipe shall be buried 30 inches deep and backfill with sand, including identification tape and #14 insulated copper tracer wire.

- B. Transition riser from below grade polyethylene pipe to above grade steel pipe; ASTM D2513, Schedule 40 steel epoxy coated casing weld or threaded end, the polyethylene end shall be fusion welded, as manufactured by "Central" or equal.

2.08 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53, Schedule 40 black. Fittings: ANSI B16.3, malleable iron threaded fittings, or ASTM A234, forged steel welding type. Joints: Screwed with approved standard threads, or AWS D1.1 welded.
- B. Steel pipe exposed to weather shall be prime coated and painted. Color as selected by Owner.

2.09 CONDENSATE DRAIN PIPING, ABOVE GRADE

- A. DWV Copper Tubing: ASTM B88, Type L hard drawn. Fittings: ANSI B16.29, wrought copper solder joint drainage fittings. Joints: ASTM B32, solder Grade 95TA. Insulate concealed piping with one-inch thick fiberglass insulation with factory applied vapor barrier jacket.

2.10 FLANGES, UNIONS, AND COUPLINGS

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

2.11 ACCEPTABLE MANUFACTURERS - GATE VALVES

- A. Crane, Model 1320
- B. Stockham, Model B-104
- C. Milwaukee, Model 1145

2.12 GATE VALVES

- A. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS & Y, solid wedge flanged ends.

2.13 ACCEPTABLE MANUFACTURERS - GLOBE VALVES

- A. Crane, Model 1310
- B. Stockham, Model B-17
- C. Milwaukee, Model 1502

2.14 GLOBE VALVES

- A. Up to 2 Inches: Bronze body, rising stem and handwheel, inside screw, renewable composition disc, screwed ends, with backseating capacity.
- B. Over 2 Inches: Iron body, bronze trim, rising stem and handwheel, OS&Y, plug-type disc, flanged ends.

2.15 ACCEPTABLE MANUFACTURERS - BALL VALVES

- A. Apollo, Model 70-200 Series
- B. Nibco, Model TS585-70
- C. Stockham, Model S-216

2.15 BALL VALVES

- A. Up to 2 Inches: Bronze body, stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.
- B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.16 ACCEPTABLE MANUFACTURERS - GAS COCKS

- A. Peter Healey, Model 7005
- B. Conbraco, Model 50 Series

2.17 GAS COCKS

- A. Up to 2 Inches: Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends.
- B. Over 2 Inches: Cast iron body and plug, non-lubricated, teflon packing, flanged ends.

2.18 ACCEPTABLE MANUFACTURERS - SWING CHECK VALVES

- A. Crane, Model 1342.
- B. Stockham, Model B-309.
- C. Milwaukee, Model 1509.

2.19 SWING CHECK VALVES

- A. Up to 2 Inches: Bronze 45 degree swing disc, solder ends.
- B. Over 2 Inches: Iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

2.20 ACCEPTABLE MANUFACTURERS - WATER PRESSURE REDUCING VALVES

- A. Watts
- B. Wilkins
- C. Spence

2.21 WATER PRESSURE REDUCING VALVES

- A. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric-reinforced diaphragm, strainer, threaded double union ends.
- B. Over 2 Inches: Cast iron body, bronze fitted, elastomer diaphragm and seat disc, flanged.

2.22 ACCEPTABLE MANUFACTURERS - RELIEF VALVES

- A. Watts
- B. Wilkins
- C. Conbraco

2.23 RELIEF VALVES

- A. Bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.

- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Underground metal piping shall be bonded for electrical continuity.
- B. Route piping in orderly manner and maintain gradient.
- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- F. Provide clearance for installation of insulation and access to valves and fittings.
- G. Provide access where valves and fittings are not exposed.
- H. Slope water piping and arrange to drain at low points.
- I. Establish elevations of buried piping outside the building to ensure not less than 1.5 ft. of cover.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean and apply one coat of zinc rich primer to welding.
- K. Prepare pipe, fittings, supports and accessories not prefinished, ready for finish painting.
- L. Establish invert elevations, slopes for drainage as indicated on drawings. Maintain gradients.
- M. Excavate in accordance with Division 2 for work of this Section.
- N. Backfill in accordance with Division 2 for work of this section.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Provide one plug cock wrench for every ten plug cocks sized 2 inches and smaller, minimum of one. Provide each plug cock sized 2-1/2 inches and larger with a wrench with set screw.
- Q. Provide firestopping at fire rated walls, floors or ceiling assemblies under provisions of Division 7.
- R. Underground metal piping shall be bonded for electrical continuity if rubber gasketed, mechanical, grooved end, or other nonconductive type joints are used.

3.03 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
- D. Install ball valves for shut-off and to isolate equipment or part of system.
- E. Install globe or ball valves for throttling, bypass or manual flow control services. Install access panel in hard ceilings and or walls as indicated on plans.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfection of potable water system shall comply with ANSI/AWWA C651-92.
- B. When hot and cold water piping, including fixtures, have been installed, tested and accepted. Disinfect the system using any of the three methods of chlorination explained in AWWA C651-92 standard.
- C. The basic disinfection procedure shall consists of:
 - 1. Preventing contaminating materials from entering the water piping system during storage, construction or repair.
 - 2. Removing, by flushing or other means, those materials that may have entered the water piping system.
 - 3. Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the piping system.
 - 4. Protecting the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures.
 - 5. Determining the bacteriological quality by laboratory test after disinfection. At least one water sample from the existing distribution system shall be tested.
 - 6. Final connection of the water piping system to the active distribution system.
- D. Submit Record of Compliance: The record of compliance shall be the bacteriological test results certifying the water sampled from the water piping system to be free of coliform bacteria contamination, and to be equal to or better than the bacteriologic water quality in the distribution system.
- E. Submit Record of Compliance: The record of compliance shall be the bacteriological test results certifying the water sampled from the new water piping to be free of coliform bacteria contamination.

3.05 TESTS

- A. Test entire piping systems, including valves and fittings in accordance with governing codes and ordinances, conduct testing in the presence of Owner's Representative and the local Inspector until satisfactory to both.
- B. Sanitary Soil, Waste, Storm Drain and Vent Piping: The system shall be tested with ten-foot head of water. The water shall be kept in the system for at least fifteen minutes before inspection starts. The system shall then be tight at all points.
- C. Domestic and Industrial Hot and Cold Water Piping Systems: The system shall be tested and proved tight under a water pressure not less than the working pressure under which it is to be used. The piping shall withstand the test without leaking for a period of not less than fifteen minutes.
- D. Gas System: The system shall be tested with air, CO₂ or nitrogen. The piping shall stand a pressure of not less than ten pounds per square inch gauge pressure, test pressure shall be held for not less than fifteen minutes, with not perceptible drop in pressure. For welded piping and for piping carrying gas at pressures in excess of fourteen inches of water column pressure, the test pressure shall be not less than 60 pounds per square inches and shall be continued for not less than thirty minutes.

3.06 CLEANING PIPING SYSTEMS

- A. After piping systems have been tested and proved tight, clean piping systems of dirt, scale, oil, grease, waste and other foreign substances that may have accumulated during the process of installation.

3.07 SERVICE CONNECTIONS

- A. Provide new sanitary sewer service. Before commencing work check invert elevations required for sewer connection, confirm inverts and ensure that these can be properly connected with slope for drainage.
- B. Provide new water service complete with sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to wall. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 2 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.
- C. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 8" water column.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Roof and floor drains.
- B. Cleanouts
- C. Water hammer arrestors.
- D. Thermostatic mixing valves.
- E. Hose bibb hydrants.
- F. Valve yard boxes.
- G. Access panels.

1.02 RELATED WORK

- A. Section 15140 - Supports and Anchors.
- B. Section 15410 - Plumbing Piping.
- C. Section 15440 - Plumbing Fixtures.
- D. Section 15450 - Plumbing Equipment.

1.03 REFERENCES

- A. ASSE 1011 - Hose Connection Vacuum Breakers.
- B. ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.
- C. ANSI A112.21.1 - Floor Drains.
- D. ANSI A112.21.2 - Roof Drains.
- E. ANSI A112.26.1 - Water Hammer Arresters.

1.04 QUALITY ASSURANCE

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

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Include component sizes, rough-in requirements, service sizes and finishes.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - ROOF DRAINS

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

2.02 ROOF DRAINS

- A. RD-1: ANSI A112.21.2; lacquered cast iron body with sump, removable cast iron dome strainer, membrane flange and membrane clamp with integral gravel stop with adjustable underdeck clamp roof sump receiver waterproofing flange leveling frame adjustable extension sleeve (for insulation) or perforated or slotted ballast guard extension for inverted roof; see Schedule on drawings for Model number.
- B. OD-1: Lacquered cast iron body and clamp collar and bottom clamp ring; cast iron dome; pipe extended to 2 inches above flood elevation; see Schedule on drawings for Model number.

2.03 ACCEPTABLE MANUFACTURERS - FLOOR DRAINS

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

2.04 FLOOR DRAINS

- A. ANSI A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, round, adjustable polished nickel-bronze strainer; and trap primer connection; see Schedule on drawings for Model number.

2.05 ACCEPTABLE MANUFACTURERS - CLEANOUTS

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

2.06 CLEANOUTS

- A. Exterior Surfaced Areas C.O.Y.B.: Round cast nickel bronze access frame and non-skid cover; see Schedule on drawings for Model number.
- B. Exterior Unsurfaced Areas G.C.O.: Line type with lacquered cast iron body and round epoxy coated gasketed cover; see Schedule on drawings for Model number.
- C. Interior Finished Floor Areas F.C.O.: Lacquered cast iron, two piece body with double drainage flange, weep holes, reversible clamping collar and adjustable nickel-bronze strainer, round with scoriated cover in service areas and round with depressed cover to accept floor finish in finished floor areas; see Schedule on drawings for Model number.
- D. Interior Finished Wall Areas W.C.O.: Line type with lacquered cast iron body and round epoxy coated gasketed cover and round stainless steel access cover secured with machine screw; see Schedule on drawings for Model number.

2.07 ACCEPTABLE MANUFACTURERS - WATER HAMMER ARRESTORS

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

2.08 WATER HAMMER ARRESTORS

- A. ANSI A112.26.1; sized in accordance with manufacturer's recommendation, precharged suitable for operation in temperature range - 100 to 300 degrees F and maximum 250 psig working pressure; see Schedule on drawings for Model number.

2.09 ACCEPTABLE MANUFACTURERS - HOSE BIBBS

- A. Acorn
- B. Woodford
- C. Josam

2.10 HOSE BIBBS

- A. Bronze or brass, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with vacuum breaker in conformance with ASSE 1011; see Schedule on drawings for Model number.

2.11 ACCEPTABLE MANUFACTURERS - TRAP PRIMERS

- A. J.R. Smith

- B. Zurn
- C. Josam

2.12 TRAP PRIMERS

- A. TP-1; ANSI A112.26; cast bronze with 1/2-inch connection. See Schedule on drawings for Model number

2.13 ACCEPTABLE MANUFACTURER'S – VALVE YARD

- A. Brooks Products, Inc.
- B. Alhambra Foundry, Company

2.14 VALVE YARD BOXES

- A. Precast concrete valve box, traffic resistant, armored body with a heavy cast iron ring and cast iron traffic cover. The cover shall be marked with the name of the service. Provide box extensions as required; Model 1.RT series as manufactured by Brooks Products, Inc.

2.157 ACCESS PANELS

- A. Door and frame shall be 16 gage galvanized steel with a prime coat finish. Door shall have a concealed pivoting rod hinge. Door latch shall be either screwdriver or allen key operated as indicated on drawings. Provide stainless steel construction assembly and cylinder lock as indicated on drawings.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION AND APPLICATION

- A. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install atmospheric and pressure type vacuum breaker in such a way that the critical level is minimum 6 inches above the flood level rim of the receptor.

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- E. Install water hammer arrestors in the hot and cold water supply to each fixture, fitted with a quick closing valve (flush valve, self-closing metering valve, etc.) or in header water supply when applicable.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Mop sinks.

1.02 REFERENCES

- A. ANSI A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
- E. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures.
- F. ANSI A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- G. ARI 1010 - Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- H. CBC Section 1115B, Table 1115B-1 and Section 1118B.

1.03 QUALITY ASSURANCE

- A. Fixtures: By same manufacturer for each product specified throughout.
- B. Trim: By same manufacturer for each product specified throughout.
- C. Accessible plumbing fixtures shall comply with all the requirements of CBC section 1115B.
- D. Heights and location of all fixtures shall be according to CBC table 1115B-1.
- E. Fixture controls shall comply with CBC section 1118B.

1.04 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Include fixtures, sizes, utility sizes, trim and finishes.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit 4 copies of operation and maintenance data.

1.06 WARRANTY

- A. Provide 1-year manufacturer's warranty.
- B. Warranty: Include coverage of electric water cooler compressor.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - FIXTURES

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

2.02 ACCEPTABLE MANUFACTURERS - FIXTURE TRIM

- A. Chicago Faucet

2.03 ACCEPTABLE MANUFACTURERS - FLUSH VALVES

- A. Sloan

2.04 ACCEPTABLE MANUFACTURERS - WATER CLOSET SEATS

- A. Olsonite
- B. Beneke
- C. Church

2.05 ACCEPTABLE MANUFACTURERS - FIXTURE CARRIERS

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

2.06 ACCEPTABLE MANUFACTURERS - MIXING VALVES (PRESSURE BALANCED)

- A. Symmons
- B. Leonard
- C. Powers

2.07 WATER CLOSET, FLOOR MOUNTED, NORMAL

- A. Bowl: ANSI A112.19.2; 1.6 gallons per flush, siphon jet, vitreous china closet bowl with elongated rim, 1-1/2" spud and china bolt caps. For model number see schedule on drawings.
- B. Flush Valve: ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, dual flush type escutcheon, seat bumper, integral screwdriver stop, vacuum breaker. For model number see schedule on drawings.
- C. Seat: Solid white plastic, open front with self-sustaining hinge, brass bolts. For model number see schedule on drawings.

2.08 WATER CLOSET, FLOOR MOUNTED, ACCESSIBLE

- A. Bowl: ANSI A112.19.2M; 1.6 gallon per flush, siphon jet, vitreous china closet bowl with elongated rim, 17-1/4" high for accessibility, 1-1/2" top spud and china bolt caps. For model number see schedule on drawings.
- B. Flush Valve: ANSI A112.18.1; exposed chrome plated, diaphragm type with oscillating handle, dual flush valve type escutcheon, seat bumper, integral screwdriver stop, vacuum breaker. For model number see schedule on drawings.

2.09 URINAL, WALL HUNG, ACCESSIBLE

- A. Urinal: ANSI A112.19.2; vitreous china, 1/8 gallon per flush low consumption with flushing rim, integral trap, removable stainless steel strainer, 1-1/4 inch top spud. For model number see schedule on drawings.
- B. Flush Valve: ANSI A112.18.1; exposed chrome plated, battery powered automatic sensor type, escutcheon, integral screwdriver stop, vacuum breaker. For model number see schedule on drawings.
- C. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs. For model number see schedule on drawings.

2.10 LAVATORY, COUNTER TOP, ACCESSIBLE

- A. Basin: ANSI A112.19.2; vitreous china lavatory, with drillings on 4 inch centers, self-rimming oval basin with front overflow. For model number see schedule on drawings.

- B. Trim: See schedule on drawings.

2.11 LAVATORY, WALL HUNG ACCESSIBLE

- A. Basin: ANSI A112.19.2; vitreous china lavatory 20 x 18 inch minimum, with 4 inch high back, drillings on 8 inch centers, rectangular basin with splash lip front overflow and soap depression. For model number see schedule on drawings.
- B. Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs. For model number see schedule on drawings.

2.12 SINK, SINGLE/DOUBLE COMPARTMENT, ACCESSIBLE

- A. Bowl: ANSI A112.19.3; 5 inch deep outside dimensions, 18 gage thick, Type 302 stainless steel, self-rimming with undercoating, single hole punching, 3-1/2 inch No. LK-18 strainer, ledgeback drilled for trim. For model number see schedule on drawings.
- B. Trim: See schedule on drawings.

2.13 SINK, SINGLE COMPARTMENT UTILITY

- A. To be determined.
- B. To be determined.

2.14 MOP SINK, FLOOR MOUNTED

- A. Bowl: 28 x 28 inch white enameled cast iron, with 3" IPS drain and flat chrome strainer and vinyl rim guard. For model number see schedule on drawings.
- B. Trim: ANSI A112.18.1; chrome plated fitting with vacuum breaker, pail hook and hose thread outlet. For model number see schedule on drawings.

PART 3 - EXECUTION

3.01 INSPECTION

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

3.02 INSTALLATION

- A. Accessible plumbing fixtures shall comply with all the requirements of CBC section 1115B. Heights and location of all fixtures shall be according to CBC Table 1115B-1. Fixture controls shall comply with CBC Section 1118B.
- B. Install each fixture with trap, easily removable for servicing and cleaning.

- C. Provide chrome plated rigid supplies to fixtures with loose key stops reducers and secured escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with wall carriers and bolts.
- F. Caulk fixtures to wall and floor surfaces with sealant as specified in Division 7, color to match fixture. Remove and wipe clean excess sealant.
- G. Install flush valves in such a way that the vacuum breaker critical level is minimum 6 inches above the flood level rim of the receptor.

3.03 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.
- B. At completion, clean plumbing fixtures and equipment.
- C. Adjust accessible lavatory faucet flow for 10-second minimum duration.

3.04 PROTECTION OF FINISHED WORK

- A. Protect finished work.

END OF SECTION

SECTION 15450

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Water heaters.
- B. Circulation pumps.

1.02 RELATED WORK

- A. Section 15140 - Supports and Anchors.
- B. Section 15242 - Vibration Isolation.

1.03 REFERENCES

- A. UL 174 - Household Electric Storage Tank Water Heaters.

1.04 QUALITY ASSURANCE

- A. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
 - 1. Underwriters Laboratories (UL).

1.05 REGULATORY REQUIREMENTS

- A. Conform to UL 174 requirements for water heaters.

1.06 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Submit manufacturer's installation instructions under provisions of Division 1.
- D. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.

1.07 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.

- B. Include operation, maintenance and inspection data, replacement part numbers and availability and service depot location and telephone number.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 WARRANTY

- A. Provide three-year manufacturer's warranty.
- B. Warranty: Include coverage of commercial water heaters.

PART 2 - PRODUCTS

For Equipment Model Numbers see Schedule on Drawings.

2.01 ACCEPTABLE MANUFACTURERS - WATER HEATERS

- A. A.O. Smith.
- B. Lochinvar.
- C. Rheem.

2.02 WATER HEATERS

The equipment hereinafter described is to be furnished and installed complete by this Contractor. See "Equipment Schedule" on drawings for size, capacity and model.

- A. Gas-Fired Water Heater: Shall bear the A.G.A. label and shall have the manufacturer's name, serial number, capacity in gallons, BTU input rating and date of installation firmly fastened thereto. The heater shall be complete with gas cock; fully automatic burner, pilot light with automatic safety control, ASME approved pressure and temperature relief valve, snap acting automatic thermostat, draft diverter, vent thimble, vent cap and counterflashing as required. Pipe relief drain to nearest approved floor sink or as indicated on drawings. For size and capacity see drawings.

2.03 ACCEPTABLE MANUFACTURERS-IN-LINE CIRCULATION PUMPS

- A. Bell and Gossett, Series HV.

2.04 IN-LINE CIRCULATION PUMP

- A. All bronze construction rated for 125 psig working pressure.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install water heaters in accordance with manufacturer's instructions and to AGA, ANSI/NFPA 54, UL requirements.
- B. Coordinate with plumbing piping and related fuel piping, gas venting, electrical work to achieve operating system.

END OF SECTION

SECTION 15535

REFRIGERANT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 PRINCIPLE WORK IN THIS SECTION

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Filter-driers.
- E. Expansion valves.
- F. Flexible connections.

1.02 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASTM and Section 15140.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
- D. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- E. Permanent Filter-Driers:
 - 1. Use in low temperature systems.
 - 2. Use in systems utilizing hermetic compressors.
- F. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate schematic layout of system, including equipment, piping, critical dimensions, and sizes.
- B. Product Data: Catalog cuts giving general assembly of specialties and data including load capacity.
- C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

1.04 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.05 QUALIFICATIONS

- A. Design piping system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the state where the Project is located.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Dehydrate and charge components such as piping and receivers, seal prior to shipment, and maintain seal until connected into system.

1.07 MAINTENANCE MATERIALS

- A. Provide two refrigeration oil test kits each containing everything required to conduct one test.

PART 2 - PRODUCTS

2.01 PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: ASTM B32, Braze, AWS BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480oF.
- B. Pipe Supports and Anchors:
 - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 In.: Carbon steel, adjustable swivel, split ring.
 - 2. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

3. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.02 REFRIGERANT

- A. Refrigerant: ASHRAE 34; R-410A: Pentafluoroethane/Difluoromethane.

2.03 MOISTURE AND LIQUID INDICATORS

- A. Indicators: Single port type, UL listed, with brass body, solid copper flared or soldered ends, sight glass, color coded 3% relative humidity indicator and plastic cap; for maximum working pressure of 650 psig, and maximum temperature of 200oF.

2.04 FILTER-DRIERS

- A. Permanent Straight Through Type:
 1. ARI 750, UL listed, steel shell with compacted bead filter core, for maximum working pressure 650 psig.

2.05 EXPANSION VALVES

- A. Angle or Straight Through Type: ARI 750, UL listed; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, non-adjustable superheat setting, with capillary tube and remote sensing bulb and remote bulb well.

2.06 FLEXIBLE CONNECTORS

- A. Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9 in. long with copper tube ends; for maximum working pressure 700 psig.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

- C. Install piping to conserve building space and not interfere with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Pipe Hangers and Supports:
 - 1. Support horizontal piping as scheduled.
 - 2. Install hangers to provide minimum 1/2 in. space between finished covering and adjacent work.
 - 3. Place hangers within 12 in. of each horizontal elbow.
 - 4. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 6. Provide copper plated hangers and supports for copper piping.
- G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40% in direction of flow.
- H. Provide access to concealed valves and fittings.
- I. Flood piping system with nitrogen when brazing.
- J. Insulate piping and equipment.
- K. Follow ASHRAE procedures for charging and purging of systems and for disposal of refrigerant.
- L. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- M. Fully charge completed system with refrigerant after testing.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME.

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- B. Pressure test system with dry nitrogen to a high-side pressure of 400 psig and a low-side pressure of 150 psig. Perform final tests using an electronic leak detection. Test to no leakage.

END OF SECTION

SECTION 15781

PACKAGED ROOF TOP AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Packaged roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Roof mounting frame and base.
- E. Maintenance service.

1.02 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- C. Indicate electrical service and duct connections on shop drawings or product data.
- D. Submit manufacturer's installation instructions.

1.03 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listing.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Protect units from physical damage by storing off site until roof mounting frames are in place, ready for immediate installation of units.

1.05 WARRANTY

- A. Provide one year manufacturer's warranty.

- B. Warranty: Include coverage of 5 year refrigeration compressors warranty and 10 year heat exchangers warranty. Warranty certificates with expiration date shall be given to the Owner after equipment start-up.

1.06 MAINTENANCE SERVICE

- A. Furnish complete service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments and recalibrations.
- D. Submit copy of service call work order or report and include description of work performed.

1.07 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies: Each unit shall be UL labeled and certified by the California Energy Commission.

1.08 EXTRA MATERIALS

- A. Provide two (2) sets of filters.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Carrier.
- B. Trane.
- C. Lennox.
- D. York.

2.02 MANUFACTURED UNITS

- A. Provide roof-mounted units having gas burner and electric refrigeration.
- B. Unit shall be self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- C. Include accessories as shown or specified herein or on drawings.

2.03 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, access doors or removable access panels with quick fasteners screwdriver operated flush cam type. Structural members shall be minimum 18 gage, with access doors or removable panels of minimum 20 gage.
- B. Insulation: 1/2 inch thick neoprene coated glass fiber on surfaces where conditioned air is handled. Protect edges from erosion.
- C. Heat Exchangers: Low NOx aluminized steel of welded construction.
- D. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted motor.
- E. Air Filters: Two inch thick glass fiber pleated media in metal frames MERV 13 rating.
- F. Roof Mounting Frame: Galvanized steel, channel frame with gaskets, nailer strips and seismic mounting clips.

2.04 BURNER

- A. Gas Burner: Induced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, direct spark ignition, flame sensing device and automatic 100 percent shut-off pilot.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor and after air flow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, or adjustable time delay relays with switch for continuous fan operation.

2.05 EVAPORATOR COIL

- A. Provide copper tube/aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circulating for units 7.5 tons cooling capacity and larger.

2.06 COMPRESSOR

- A. Provide fully hermetic compressor, 3600 rev/min maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports and filter drier.
- B. Five minute timed off circuit shall delay compressor start.

2.07 CONDENSER

- A. Provide copper tube aluminum fin coil assembly with subcooling rows.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.
- C. Provide refrigerant pressure switches to cycle condenser fans.

2.09 SUPPLY/RETURN CASING

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper shall fail to closed position. Relief dampers may be gravity balanced.
- D. Gaskets: Provide tight fitting dampers with edge gaskets, maximum leakage 5 percent at 2 inches pressure differential.

2.10 OPERATING CONTROLS

- A. Electric solid state microcomputer based room thermostat, located as indicated in service area with remote sensor located as indicated.
- B. Room Thermostat Shall Incorporate:
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set-up for four separate temperatures per day.
 - 4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - 5. Short cycle protection.
 - 6. Programming based on weekdays, Saturday and Sunday.
 - 7. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

C. Room Thermostat Display Shall Include:

1. Time of day.
2. Actual room temperature.
3. Programmed temperature.
4. Programmed time.
5. Duration of timed override.
6. Day of week.
7. System Model Indication: Heating, cooling, auto, off, fan auto, fan on.
8. Stage (heating or cooling) operation.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting frame level.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up and shut-down during first year of operation, including routine servicing and check-out.

END OF SECTION

SECTION 15783

SPLIT TYPE AIR CONDITIONING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Split type air conditioning units.
- B. Controls.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 16180 - Equipment Wiring Systems: Installation of thermostats and other control components.

1.03 RELATED SECTIONS

- A. Section 16180 - Equipment Wiring Systems: Electrical supply to units.

1.04 REFERENCES

- A. ARI 210 - Unitary Air-Conditioning Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation System.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Indicate refrigerant, drain and electrical rough-in connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions under provisions of Division 1.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions and maintenance and repair data.

1.07 QUALITY ASSURANCE

- A. Units shall be constructed in accordance with UL standards and shall carry the UL label of approval. Units shall have CSA approval.

- B. Air-cooled condenser coils shall be leak tested at 350-psig air pressure with the coil submerged in water.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.
- C. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.09 WARRANTY

- A. Provide one-year manufacturer's warranty.
- B. Provide six years manufacturer's warranty on refrigeration compressor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Mitsubishi.
- B. Sanyo.
- C. Fujitsu

2.02 SYSTEM DESCRIPTION

- A. The air conditioning system shall be split type system. The system shall consist of an indoor unit, wall mounted, direct expansion fan coil with an outdoor-mounted, air-cooled split system outdoor section suitable for roof-top installation. Unit shall consist of a hermetic compressor, an air-cooled coil, propeller-type blow-thru outdoor fans, accumulator, holding refrigerant charge, and control box. Unit shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling and heating system.

2.03 INDOOR UNIT

- A. General: Indoor, direct-expansion, wall mounted fan coil. Fan coil shall be shipped complete with cooling coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, interconnecting cable for outdoor to indoor unit, and mounting brackets.
- B. Unit Cabinet: Cabinet shall be zinc-coated bonderized steel finished with a baked enamel paint. Inlet grilles shall be attractively styled, high-impact polystyrene. Matching mounting brackets shall be provided.

- C. Fans: Fans shall be centrifugal blower type with air intake in the bottom rear of the unit and discharge in the front. Automatic motor-driven vertical air sweep shall be provided.
- D. Coils: Coils shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for attachment of piping to remove condensate.
- E. Motors: Motors shall be permanently lubricated with inherent overload protection. Fan motor shall be 3-speed.
- F. Controls: Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 64 F to 84 F. The unit shall have the following functions as a minimum:
 - 1. An automatic restart after power failure at the same operating conditions as at failure.
 - 2. A timer function to provide a minimum 15-hour timer cycle for system Auto. Start/Stop.
 - 3. Temperature-sensing controls shall sense return air temperature. Indoor air high discharge temperature shutdown shall be provided.
 - 4. Indoor coil freeze protection.
 - 5. Wired or wireless infrared remote control to enter setpoints and operating conditions (required accessory).
 - 6. Filter status indication after 250 hours of indoor fan operation.
 - 7. Test mode button to run self-diagnostics and aid in troubleshooting.
 - 8. Auto. Stop features shall have integral setback control.
 - 9. Automatic air sweep control provides on or off activation of air sweep louvers.
 - 10. Fan only operation provides room air circulation when no cooling is required.
 - 11. Diagnostics provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit and at the remote controller.
 - 12. Fan speed control shall be user-selectable: high, medium, low, or microprocessor automatic operation during all operating modes.
 - 13. A time delay shall prevent compressor restart in less than 3 minutes.

14. Outdoor unit high temperature protection shall be provided to detect excessive condenser discharge temperatures.
 15. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.
- G. Filters: Unit shall have filter track with factory-supplied cleanable filters.
- H. Electrical Requirements: Unit shall operate on power supply as specified on the equipment schedule.

2.04 OUTDOOR UNIT

- A. General: Factory assembled, single piece, air-cooled heat pump outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge of refrigerant, and special features required prior to field start-up.
- B. Unit Cabinet:
1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked enamel finish.
 2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
 3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.
- C. Fans:
1. Outdoor fans shall be direct-drive propeller type, shall discharge air horizontally, and shall blow air through the outdoor coil.
 2. Condenser fan motors shall be totally enclosed, single-phase motors with Class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
 3. Shaft shall have inherent corrosion resistance.
 4. Fan blades shall be corrosion resistant and shall be statically and dynamically balanced.
 5. Outdoor fan openings shall be equipped with PVC coated protection grille over fan and coil.
- D. Compressor:
1. Compressor shall be fully hermetic reciprocating or scroll type.

2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over temperature and over current. Scroll compressors shall also have high discharge gas temperature protection if required.
 3. Motor shall be NEMA rated Class F, suitable for operation in a refrigerator atmosphere.
 4. Reciprocating compressors shall be equipped with crankcase heaters to minimize liquid refrigerant accumulation in compressor during shutdown and to prevent refrigerant dilution of oil.
 5. Compressor assembly shall be installed on rubber vibration isolators and shall have internal spring isolation.
 6. Compressors shall be single phase.
- E. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to internally enhanced, seamless copper tubes which are cleaned, dehydrated and sealed.
- F. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader-type fittings with brass caps, accumulator, bi-flow filter drier, pressure relief, and a full charge of refrigerant.
- G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control function shall include:
1. Controls:
 - a. Time delay restart to prevent compressor reverse rotation on single-phase scroll compressors.
 - b. Automatic restart on power failure.
 - c. Three-pole contactors.
 - d. Safety lockout if any outdoor unit safety is open.
 - e. High pressure and liquid line low-pressure switches.
 - f. Automatic outdoor fan motor protection.
 - g. Start capacitor and relay (single-phase units without scroll compressors).
 2. Safeties:

- a. High condensing temperature protection.
 - b. System diagnostics.
 - c. Compressor motor current and temperature overload protection.
 - d. High pressure relief.
 - e. Outdoor fan failure protection.
- H. Electrical Requirements:
1. Unit shall operate on single-phase, 60 cycle power at 208V.
 2. Unit electrical power shall be a single point connection.
 3. Unit control voltage to the indoor-fan coil shall be 24V.
 4. All power and control wiring must be installed per NEC and all local building codes.
 5. High and low voltage terminal block connections.
- I. Special Features (Field Installed):
1. Compressor Cycle Delay: Compressor shall be prevented from restarting for a minimum of 5 minutes after shutdown.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturers' instructions.
- B. Coordinate installation of units with architectural and electrical work.
- C. Supply units fully charged with refrigerant and filled with oil.
- D. Scheduled performance is based on ARI 210 test conditions. Scheduled sound rating is based on ARI 270.

END OF SECTION

SECTION 15875

VENTILATORS AND EXHAUST FANS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Cabinet exhaust fans.

1.02 RELATED WORK

- A. Section 15890 - Ductwork.
- B. Section 15910 - Duct Accessories.

1.03 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- D. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.

1.04 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Conform to AMCA 99.

1.05 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 1.
- B. Provide product data on wall and roof exhausters, and ceiling and cabinet fans.
- C. Provide fan curves with specified operating point clearly plotted.
- D. Submit sound power levels for both fan inlet and outlet at rated capacity.
- E. Submit manufacturer's installation instructions under provisions of Division 1.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cook.
- B. Greenheck.
- C. Penn Barry.
- D. Substitutions: Under provisions of Division 1.

2.02 CABINET EXHAUST FANS

- A. Centrifugal Fan Unit: V-belt or direct driven, with formed galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.
- C. Grille: Molded white plastic or aluminum with baked white enamel finish.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings. An exchange of sheaves and belts shall be supplied at no additional charge if required for air balance.
- E. Drive assembly and wheel shall be hinged to swing out without dismantling the unit. The fan inlet shall be spun venturi throat overlapped by a backward curved centrifugal wheel with spun cone.
- F. Motors shall be totally enclosed fan cooled mounted on the hinged size exterior isolated from the air stream. See equipment schedule for horsepower characteristics.
- G. Fans shall be equipped with factory suspension brackets, motor cover and insulated housings.
- H. Motors:
 - 1. All motors shall be open drip-proof with ball bearings.
 - 2. Fractional horsepower motors shall be split phase or capacitor start and have a resilient base.
 - 3. Integral horsepower motors shall be induction with rigid base.
 - 4. See equipment schedule for horsepower and characteristics.
- I. Drives: Shall be v-belt designed for 150% of motor horsepower and be complete with variable pitch motor drives.

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- J. Motors shall be selected at 15% greater than the brake horsepower, including drive loss, at design conditions.
- K. Accessories: Shall be as noted on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with lag screws to roof curb or as detailed on the drawings.

END OF SECTION

SECTION 15890

DUCTWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. 2.0" pressure class ducts.

1.02 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. Pressure-Velocity Classification: Duct construction pressure classification shall comply with SMACNA HVAC Duct Construction Standards.

1.03 REGULATORY REQUIREMENTS

- A. Duct system shall be constructed, installed, sealed and insulated as provided in Chapter 6 of the California Mechanical Code.
- B. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 standards.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Indicate duct fittings, particulars such as gages, sizes, welds and configuration prior to start of work for air distribution, kitchen hood exhaust, glass fiber duct systems as applies.
- C. Submit samples of diffuser outlet boxes.
- D. Submit manufacturer's installation instructions for glass fiber ducts.
- E. Submit manufacturer's certificate that installation of glass fiber ducts meets or exceeds recommended fabrication and installation requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site.
- B. Store and protect products.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS - FOR FLEXIBLE DUCTS

- A. Casco flexible duct.
- B. Thermaflex flexible duct.

2.02 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq ft for each side in conformance with ASTM A90.
- C. Flexible Ducts: Fully encapsulated, galvanized steel wire; rated to 2 inches WG positive and 0.5 inches WG negative. Flexible ducts shall consist of fully insulated blanket of fiberglass insulation, R-4.2 (K = .29 @ 75 degrees F), sealed between two layers of tough polymer material with polyethylene jacket externally applied. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.

Flexible ducts shall be supported at or near mid-length with 2" wide 28 ga. steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets. The maximum length will be seven feet and can be used at the terminal ends only, except that flexible ducts properly installed may be used to cross-seismic joints without offsets.

- D. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
- E. Fasteners: Rivets, bolts or sheet metal screws.
- F. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape or heavy mastic.
- G. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end or continuously threaded.

2.03 2.0" PRESSURE DUCTWORK (SUPPLY, RETURN, EXHAUST)

- A. Fabricate and support in accordance with SMACNA Pressure Duct Construction Standards for 2.0" pressure classification and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide turning vanes.

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Connect flexible ducts to metal ducts with approved adhesive plus sheet metal screws.
- F. Use crimp joints with or without bead for joining round duct sizes 12 inch and smaller with crimp in direction of airflow.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Special terminal boxes are required for all ceiling diffusers which exceed SMACNA Standards. Refer to details on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Obtain manufacturer's inspection and acceptance of fabrication and installation of glass fiber ductwork at beginning of installation.
- B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. Connect diffusers to ducts with 5 feet maximum length of flexible duct. Hold in place with strap or clamp.
- E. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- F. Neck connection of diffuser or register shall not be made directly into main trunks. Where direct duct neck connection are required due to space limitations, main duct shall be lined 5 feet each side of neck connection.

3.02 DUCTWORK APPLICATION SCHEDULE

<u>Air System</u>	<u>Material</u>
Up to 4.0" Low Pressure Supply	Steel
Return and Relief	Steel
General Exhaust	Steel
Outside Air Intake	Steel

3.3 ADJUSTING AND CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that may be harmed by excessive dirt with temporary filters or bypass during cleaning.
- B. Clean duct systems with high power vacuum machines. Protect equipment that may be harmed by excessive dirt with filters or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

SECTION 15910

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Volume control dampers.
- B. Combination fire and smoke dampers.
- C. Back draft dampers.
- D. Air turning devices.
- E. Flexible duct connections.
- F. Duct access doors.
- G. Duct test holes.
- H. Cable controls systems and volume dampers.

1.02 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Provide shop drawings for shop-fabricated assemblies indicated, including volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.
- C. Submit manufacturer's installation instructions for fire dampers and combination fire and smoke dampers where required on the drawings.

PART 2 - PRODUCTS

2.01 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards for pressure classification, in which it will be installed.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of double thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4-inch diameter rod in self-aligning, universal joint action flanged bushing with setscrew.
- D. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inch.

- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- H. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases or adapters.

2.02 APPROVED MANUFACTURERS - COMBINATION FIRE AND SMOKE DAMPERS

- A. California Aire.
- B. Ruskin.
- C. Pottorff.

2.03 COMBINATION FIRE AND SMOKE DAMPERS

- A. Fabricate in accordance with NFPA 90A and as indicated.
- B. Provide factory sleeve for each damper. Install damper operator on exterior of sleeve and link to damper operating shaft.
- C. Fabricate with multiple blades with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade tops, lock and 1/2 inch actuator shaft.
- D. Dampers must be rated under the latest editions of UL 555 & 555S for leakage class two at 360°F.
- E. Electric spring return actuators must be U.L. rated at 350°F under U.L. 555S. They must be certified for continuous operation for fire/smoke applications, and come with a five year manufacturer's warranty. Provide end switches to indicate damper position. Motor must reopen damper regardless of power interruption length of time. Belimo or equal.

2.04 APPROVED MANUFACTURERS - BACKDRAFT DAMPERS

- A. California Aire.
- B. Ruskin.
- C. Pottorff.

2.05 BACKDRAFT DAMPERS

- A. Gravity back draft dampers furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced back draft dampers of 16 gage galvanized steel, or extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure; Model BD-50 by Pottorff or equal.

2.06 APPROVED MANUFACTURERS - AIR TURNING DEVICES

- A. Duro Dyne.
- B. Elgin.
- C. or equal.

2.07 AIR TUNING DEVICES

- A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.08 APPROVED MANUFACTURERS - FLEXIBLE DUCT CONNECTIONS

- A. Duro-Dyne.
- B. Elgin.
- C. or equal.

2.09 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 20 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.
- C. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.10 APPROVED MANUFACTURERS - DUCT ACCESS DOORS

- A. California Aire.
- B. Ruskin.

C. Pottorff.

2.11 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards suitable for pressure classification in which it will be installed.
- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one-inch thick insulation with sheet metal cover.
- D. Access doors smaller than 12 inches square may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- F. Access doors with sheet metal screw fasteners are not approved.

2.12 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.13 BOWDEN CABLE CONTROL SYSTEMS AND VOLUME DAMPERS

- A. Manual volume dampers, round or rectangular, with cable control or manual quadrant, Pottorff Model RCS-10/10R or equal.
- B. General: All volume dampers above inaccessible ceilings shall be provided with remote cable controls as manufactured by Pottorff or Young Regulator Company, no known third equal. Dampers mounted in diffuser inlets or requiring ceiling access panels for adjustment are not acceptable.
- C. Construction:
 - 1. Round and Rectangular balancing dampers will have. "V" style blade(s), and will be provided with nylon bearings that require no lubrication and that prevent rattling and minimize leakage.
 - 2. The remote control cable assembly will be factory attached to the damper to eliminate any field assembly. The opening in the ceiling/wall for remote adjustment will not exceed one inch in diameter and will be provided with finishing cover.

- D. Manual Quadrant: Manual quadrant shall be commercial quality, locking type for 3/8" square or 1/2" round shaft and shall be available on an extended base for externally insulated ductwork.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on supply, return and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- E. Provide back draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Flexible connections shall have a minimum of 1" slack in fabric material with a minimum space of 1-1/2" between metal edging strips.
- G. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.
- H. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION

SECTION 15940

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Diffusers
- B. Registers/grilles.

1.02 REFERENCES

- A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. SMACNA - HVAC Duct Construction Standard.

1.03 SUBMITTALS

- A. Submit product data under provisions of Division 1.
- B. Provide product data for items required for this project.
- C. Submit schedule of outlets and inlets indicating type, size, location, application and noise level.
- D. Review requirements of outlets and inlets as to size, finish and type of mounting prior to submitting product data and schedules of outlets and inlets.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS - CEILING DIFFUSERS

- A. Titus
- B. Metalaire
- C. Price

2.02 RECTANGULAR CEILING DIFFUSERS (SQUARE 360')

- A. Ceiling Diffusers: Shall be square with 3 inner cones and constructed of aluminum (or in steel) with baked off-white enamel over prime coat construction. Diffusers shall be provided with 24 x 24 extended shells or filler panel suitable for use in ceilings as indicated on drawings. Verify frame type with Architect prior to ordering. Diffusers shall be as manufactured by Titus "TMS" or approved equal.
- B. Provide frame as required for ceiling type. No perforated face allowed.

- C. Fabricate of steel or aluminum with baked enamel finish, color as specified by Architect.

2.03 ACCEPTABLE MANUFACTURERS - CEILING REGISTERS/GRILLES

- A. Titus
- B. Metal Aire
- C. Price

2.04 CEILING/WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Ceiling Return and Exhaust Registers and Grilles: Titus "350R" with baked off-white enamel over prime coat construction and 35° blade deflection angle. Cores shall be without indents. Where located in tee ceilings provide with 24 x 24 extended shell or filler panel as shown on drawing. Verify frame types with Architect before ordering.
- C. Frame type shall be compatible with ceiling. No perforated face allowed.
- D. Fabricate of steel or aluminum with baked enamel finish, color as specified by Architect.

2.05 ACCEPTABLE MANUFACTURERS - WALL REGISTERS/GRILLES

- A. Titus
- B. Metal Aire
- C. Price

2.06 WALL SUPPLY REGISTERS/GRILLES (DOUBLE DEFLECTION)

- A. Streamlined and individually adjustable blades, depth of which exceeds 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection; Model 300RS manufactured by Titus.
- B. Sidewall supply registers shall be double deflecting type with baked off-white enamel over prime coat construction.
- C. Fabricate 1-1/4 margin frame with countersunk screw mounting and gasket.
- D. Fabricate of steel or aluminum with 20 gage minimum frames and 22 gage minimum blades or aluminum extrusions with factory baked enamel finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.
- C. Install diffusers to ductwork with airtight connection.
- D. Provide balancing dampers on duct take-off to diffusers, grilles and registers, regardless of whether dampers are specified as part of the diffuser or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Testing, adjustment and balancing of air systems.
- B. Testing, adjustment and balancing of hydronic systems.
- C. Measurement of final operating condition of HVAC systems.

1.02 RELATED SECTIONS

- A. Section 15890 - Ductwork
- B. Section 15940 - Air Outlets and Inlets

1.03 REFERENCES

- A. AABC - National Standards for Field Measurement and Instrumentations, Total System Balance.
- B. NEBB – Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

1.04 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- C. Submit test reports.
- D. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.

1.05 REPORT FORMS

- A. Submit reports on AABC National Standards for Total System Balance.
- B. Forms Shall Include the Following Information:
 - 1. Title Page:

- a. Company name
 - b. Company address
 - c. Company telephone number
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
2. Instrument List:
- a. Instrument
 - b. Manufacturer
 - c. Model
 - d. Serial number
 - e. Range
 - f. Calibration date
3. Air Moving Equipment:
- a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Return airflow, specified and actual
 - f. Outside airflow, specified and actual
 - g. Total static pressure and total external, specified and actual
 - h. Inlet pressure
 - i. Discharge pressure
 - j. Fan RPM
4. Exhaust Fan Data:

- a. Location
 - b. Manufacturer
 - c. Model
 - d. Air flow, specified and actual
 - e. Total static pressure (total external), specified and actual
 - f. Inlet pressure
 - g. Discharge pressure
 - h. Fan RPM
5. Electric Motors:
- a. Manufacturer
 - b. HP/BHP
 - c. Phase, voltage, amperage; nameplate, actual, no load.
 - d. RPM
 - e. Service factor
 - f. Starter size, rating, heater elements
6. V-Belt Drive:
- a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave, diameter and RPM
 - f. Center to center distance, maximum, minimum and actual
7. Air Distribution Test Sheet:
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type

- d. Terminal size
 - e. Area factor
 - f. Design airflow
 - g. Test (final) airflow
 - h. Percent of design air flow
8. Cooling Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Water flow, design and actual
 - k. Water pressure drop, design and actual
 - l. Entering water temperature, design and actual
 - m. Leaving water temperature, design and actual
 - n. Air pressure drop, design and actual
9. Flow Measuring Station:
- a. Identification/station
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model

- f. Design flow rate
 - g. Design pressure drop
 - h. Actual/final pressure drop
 - i. Actual/final flow rate
 - j. Station calibrated setting
10. Sound Level Report:
- a. Location
 - b. Octave bands - equipment off
 - c. Octave bands - equipment on
11. Vibration Test: Air Moving Equipment
- a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
 - c. Normally acceptable readings, velocity and acceleration
 - d. Unusual conditions at time of test
 - e. Vibration source (if non-complying)

1.06 PROJECT RECORD DOCUMENTS

- A. Submit record documents.

1.07 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum three years experience. Perform Work under supervision of AABC or NEBB Certified Test and Balance Engineer.
- B. Total system balance shall be performed in accordance with AABC "National Standards for Field Measurement and Instrumentation, Total System Balance" or NEBB "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems".
- C. Provide a Quality Assurance Program to assure Owner and specify design professional that the testing, adjusting and balancing will perform in accordance with the current applicable NEBB Procedural Standards, or equivalent by AABC. Program shall remain in effect or 12 months after submission of the "Final" balance report to the specifying design firm.

1.08 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before date of Substantial Completion.

1.09 AGENCY QUALIFICATIONS

- A. Testing, adjusting and balancing agency shall be certified by AABC or NEBB. Agency must be an independent agency and not a subsidiary of, or affiliated with any firm who performs services other than testing, adjusting and balancing.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable.
- B. Report any defects or deficiencies noted during performance of services to the Engineer.
- C. Promptly report abnormal conditions in mechanical systems or conditions, which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.