Eagle Springs Golf Course Maintenance Facility
Live Oak Avenue Extension
Specifications

July 7, 2025

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CERTIFICATION

A. I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with the appropriate local codes and State of **Florida** codes regarding public infrastructure.

B. I hereby specify that the documents intended to be authenticated by my seal are limited to:

DIVISION 22	**PLUMBING**
22 00 00	GENERAL PLUMBING
22 05 00	BASIC MATERIALS AND METHODS
DIVISION 23	**HVAC**
23 00 00	HVAC EQUIPMENT
23 01 00	MECHANICAL GENERAL REQUIREMENTS
23 07 00	INSULATION OF MECHANICAL SYSTEMS
23 20 00	HEATING AND AIR CONDITIONING PIPING
23 30 00	AIR DISTRIBUTION

PROFESSIONAL SEAL

C. Signature: _____ Date: 7-2-2025

SECTION 22 00 00
PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

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

1.2 SUBMITTALS

A . Submit to A/E all fixtures, piping, water heaters, hangers, and plumbing accessories.

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

A. Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

A. Welding
Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1.

1.6 PRE-PLAN WORK - SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Architect of any discrepancy before performing any work.

1.7 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 Materials

A. Below Ground Waste, Sanitary Sewer:

Polyvinyl Chloride (PVC) pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564; primer shall conform to ASTM F-656.

B. Above Ground Waste, Vent:

1. Polyvinyl Chloride (PVC) pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564; primer shall conform to ASTM F-656.

2. Exterior Cleanouts: Smith 4231 series, Josam Series 56040, Zurn Z1420-27, or approved equal. Set in 15" x 15" x 6" concrete pad.

C. INTERIOR DOMESTIC WATER PIPING:

1. Copper tubing, hard-drawn, Type "L", conforming to ASTM B 88 with cast-brass or wrought-copper sweat joint fittings using ASTM B 32, tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more

than 0.2 percent lead; or with ANSI B16.26 flare joint fittings. Piping under concrete slabs shall be copper tubing, soft-drawn, Type "K", conforming to ASTM B 88, without joints.

2. Pipe shall be manufactured from cross-linked polyethylene (PEX) conforming to ASTM F876 & F877. Cold water piping shall be colored blue and hot water piping shall be colored red. Fittings shall be manufactured from solid brass and conform to ASTM F1807. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer. All pipe and fittings shall be manufactured in the United States. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61. Installation shall comply with the latest installation instructions published by the manufacturer.

3. Water Hammer Arresters: Permanently sealed mechanical device, pre-charged, threaded connection. ASSE 1010 – 2004 certified. Install as close as possible to quick-closing valve. No access panel shall be required. Unit shall be hard drawn sealed copper body with plastic rings and piston, threaded adapter equal to Sioux Chief 650 series.

4. Ball Valves: Valve shall have two piece forged brass or cast bronze body, blowout proof stem, PTFE seats/seals, chrome plated ball and full port design. Valves sizes 1/4" - 2" shall be pressure rated to 150 WSP/600Wog and conform to MSS-SP 110 and certified to CSA, UL, and FM. Valves Sizes 2 1/2" - 3" shall be pressure rated to 150 WSP/400 WOG and conform to MSS-SP 110. Provide extension through insulation as required. Valve shall be equal to Kitz valve #69.

5. Icemaker/water dispenser wall outlet, ABS body, ¼ turn brass valve with chrome plated brass ball, ½" sweat pipe connection by ¼", 3/8" compression fitting or ¾" hose bibb

6. Pipe Joint Materials**:** Solder containing lead shall not be used with copper pipe. Joints and gasket materials shall conform to the following:

    a. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

    b. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

    c. Solder Material: Solder metal shall conform to ASTM B32.

    d. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

    e. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

f. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

7. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

6. Copper tubing shall conform to ASTM B88, Type K, L or M

D. Miscellaneous Materials: Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be diaphragm or piston type.

b. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile non asphaltic and contain germicide and provide watertight, gastight, odor proof and vermin proof properties.

c. Icemaker/water dispenser wall outlet, ABS body, ¼ turn brass valve with chrome plated brass ball, ½" sweat pipe connection by ¼", 3/8" compression fitting or ¾" hose bibb threaded connection. Include water hammer arrester on valves and fire-rated box. Unit shall be equal to Sioux Chief # 696R1010MF.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application.

A. Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a flange with nozzle and painted aluminum wheel handle. A brass or bronze operating rod shall be provided within a galvanized iron or brass casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and

valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout.

2.4 FIXTURES

Fixtures shall be water conservation type. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Internal parts of flush and/or flushometer valves, lavatory waste drains, shall be copper alloy with all visible surfaces chrome plated.

A. WC-1, Watercloset:

1. General Description: 1.6 gal flush, Vitreous china, close coupled, rim fed , siphon jet, whirlpool action elongated rim bowl with vitreous china tank and cover, float valve, trip lever (no plastic handle), bolt caps, 3/8" angle supply with stop and flexible riser and brass nipple to wall, white open front seat and self-sustaining check hinge.
2. Fixture: American Standard Colony #2435.012
3. Seat: Beneke #523 SS
4. Supply: Brass Craft #OCR1912DLZ C

B. WC-2, Watercloset for Handicapped:

1. General Description: 1.6 gal flush, Vitreous china, close coupled, rim fed, siphon jet, whirlpool action elongated rim bowl with vitreous china tank and cover, float valve, trip lever (no plastic handle), bolt caps, 3/8" angle supply with stop and flexible riser and brass nipple to wall, white open front seat and self-sustaining check hinge.
2. Fixture: American Standard Colony #2435.012
3. Seat: Beneke #523 SS
4. Supply: Brass Craft #OCR1912DLZ C

C. L-1, Lavatory Wall Hung: Vitreous china lavatory, 20" x 27", concealed arms support, single faucet with aerator and 4" wrist blades, offset grid assembly, angle supplies with stops and flexible risers and 1-1/4" cast brass adjustable "P" trap with cleanout and waste to wall.

1. Fixture: American Standard "LUCERNE" #0355.021

2. Faucet, Manual: T&S Brass #B0871
3. Drain: Dearborn Brass #760-1
4. P-Trap: Dearborn Brass #707-1
5. Supply: Brass Craft #OCR1920AZ C

D. L-2, Lavatory Wall Hung: ADA Vitreous china lavatory, 20" x 27", concealed arms support, single faucet with aerator and 4" wrist blades, offset grid assembly, angle supplies with stops and flexible risers and 1-1/4" cast brass adjustable "P" trap with cleanout and waste to wall.

1. Fixture: American Standard "LUCERNE" #0355.021
2. Faucet, Manual ADA: T&S Brass #B0890
3. Drain: Dearborn Brass #760-1
4. P-Trap: Dearborn Brass #707-1
5. Pipe Insulation: Lav-Guard 102EZ
6. Supply: Brass Craft #OCR1920AZ C

E. MS-1, Mop Sink:

Mop Service Basin 24x24x10 Molded high density composite basin. Use shields around wall minimum 24" high. Chrome plated service faucet with integral stops, vacuum breaker, pail hook land 3/4" thread on spout with 30" hose/hose bracket and mop hanger.

1. Fixture: Zurn #Z1996-24
2. Faucet: Stern-Williams #T-15-VB
3. Hose/Bracket: Stern-Williams #T-35
4. Mop Hanger: Stern-Williams #T-40.

F. SH-1, Shower: Faucet hardware only with seat, rails, and shower stall by others. Faucet/Valve, ADA: Symmons Temptrol Shower System with hand spray, shower head, # C-96-X-1.5. Shower to be 1.5 gpm. Must have anti scald pressure balancing, screw stop for control handle operation, chrome finish, and in line vacuum breaker.

A. KS-1, Sink: Stainless steel, 18 gauge, 33" x 19 1/2" with two 14" x 14" x 7 1/2" compartment, self rimming with two handle wrist action faucet, 12" high gooseneck swing spout and aerator, 3-1/2" strainer and ground joints seat stopper, 1-1/2" cast brass adjustable "P" trap with cleanout and waste to wall, angle supplies with stops and flexible risers.

1. Fixture: Elkay LR 3319
2. Drain: Elkay LK35

3. Faucet: T&S Brass B-2866-01
4. P-Trap: Dearborn Brass #710-1
5. Supply: Brass Craft #OCR1920AZ C

2.5 PLUMBING SPECIALTIES: Furnish and install the following plumbing specialties:

1. FD-1, Floor Drain: Equal to Josam #30003-5A-50 #8803 adaptor, and #88250-10 trap seal primer, Smith #2005-C (3") auxiliary inlet #2696, with automatic trap primer #2699-CP, Zurn #Z415 with type B STRAINER trap primer.
2. FD-2, Floor Drain with Trap Primer: Equal to Josam #30003-5A-50 #8803 adaptor, and #88250-10 trap seal primer, Smith #2005-C (3") auxiliary inlet #2696, with automatic trap primer #2699-CP, Zurn #Z415 with type B STRAINER trap primer.
3. HB-1: Non-Freeze Hose Bibb: Woodford Model 25 or equal, cast brass, vacuum breaker, heavy duty, wall hydrant metal operating wheel, brass working parts, renewable nylon seat, 3/4" NPT hose outlet and T-handle.
4. EDF-1, Electric Drinking:

   Two-level wall mounted water cooler for use by the general public. Cooler shall have a capacity to cool 8 gallons per hour from 80 degrees F. to 50 degrees F. with 90 degrees F. ambient air. Tops shall be 18-8 stainless steel with anti-splash ridge; exterior cabinet finish shall be stainless steel. Provide with bottle filler. Motor shall be suitable for 120 volt operation. Provide trap, stops, and waste to wall. Unit shall be Elkay LZSTL8WSLK or approved equal.

2.6 PLUMBING APPLIANCES AND EQUIPMENT: Provide and install the following plumbing appliances and equipment where shown on the Drawings.

1. WH-1, Water Heater: Automatic, electric, top connected, storage type water heater. The storage tank shall be 50 gallon capacity, shall be glass lined steel, and shall be insulated and jacketed. Unit shall be provided with ASME rated combination temperature and pressure relief valve. Unit shall be provided with (2) 4500 Watt, 208-3ph volt heating elements. Unit shall be U.L. tested and listed. Tank shall be provided with a replaceable magnesium anode rod.
2. ET-1, Expansion Tank: ASME rated Butyl bladder tank, for hot potable water. Tank shall be 5 gallon, with a max working pressure of 150 psi, max temperature of 240°F and a factory precharge pressure of 40 psi. Butyl Bladder shall be replaceable. Unit shall be equal to ELBI Model # DTS-19.
3. TMV-1, Tempering Valve: Thermostatic water mixing valve with minimum flow of 1 gpm with no less that 10 gpm flow @ 10 psi pressure drop. Unit shall have a color coded dial thermometer, outlet ball valve, combination check stops, unions, strainers on inlets, wall supports and cast lever handle. Unit shall have a high temperature limit stop set for 110°F. Unit shall be factory tested and assembled. Mixing valve shall be equal to Leonard # TM-26-BDT. Pipe tempering valve in accordance with manufacturer's requirements.

5. CP-1, Circulating Pump: Provide an all bronze inline circulating pump with a capacity of 10 gpm at 5 feet TDH. Provide a surface manual motor starter for the pump. Pump motor to be 120 volt, single phase. Provide cord for plug-in of motor to electrical receptacle. Pump to be Taco Model 110-3/4" or approved equal.

PART 3 EXECUTION

A. .INSTALLATION:

1. Tracer wire for any exterior piping shall be installed for plastic, ductile-iron pipe and fittings.
2. Install specialties in accordance with manufacturer's instructions.
3. 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.
4. Install water hammer arresters complete with accessible isolation valve.
5. Install each fixture with chrome plated rigid or flexible supplies with stops, reducers, and escutcheons.
6. Adjust stops or valves for intended water flow rate to fixture without splashing, noise, or overflow.
7. Install water heaters in accordance with manufacturer's instructions and to UL requirements. Coordinate with plumbing piping and related electrical work to achieve a satisfactory operating system.
8. There should be a minimum of 30 inches of cover for water mains.
9. While under construction, unattended exposed pipelines must have the ends capped. All materials to be used in construction shall be stored above the ground in a manner that will minimize the possibility of contamination.
10. Install tanks in accordance with manufacturer's instructions.

3.4 TESTS

3.4.1 Plumbing System

The following tests shall be performed on the plumbing system.

3.4.1.1 Waste and Drainage Piping:

The entire drainage and venting system shall have all necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold this water for 30 minutes without showing a drop greater than 4". Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except that a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with

water to maintain sufficient pressure or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty minutes. Contact the A/E representative for test verification.

3.4.1.3 Domestic Water Piping:

Upon completion of the roughing-in and before setting fixtures, the entire hot and cold water piping system shall be tested at a hydrostatic pressure of not less than 100 pounds per square inch gauge, and proved tight at that pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in the same manner as specified for the entire system. Contact the A/E representative for test verification.

End of Section

SECTION 22 05 00

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Section 23 01 00 - Mechanical General Requirements, with modifications and additions specified herein, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

A. Basic Piping Materials and Installation Procedures for All Piping Systems.

B. Identification, Labeling, and Marking.

C. Testing, Adjusting, and Balancing.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

A. Type of pipe and fittings are specified under each piping system.

1.4 SUBMITTALS:

A. Submit product data and shop drawings under provisions of Section 23 01 00.

B. Submit noise and vibration isolation equipment data.

C. Submit pipe hanger and support data along with certificate of compliance.

D. Submit qualifications of testing and balancing firm.

E. Include testing and balancing procedures (agenda) along with proposed forms.

F. Submit final test and balance report.

1.5 QUALITY ASSURANCE:

A. Agency: Testing and balancing agency shall be a company specializing in this type work for a minimum of three documented years and certified by AABC or NEBB.

B. Welder Certification: In conformance with AWS D1.1.

C. For each product, provide components by the same manufacturer throughout.

D. Use domestic pipe, pipe fittings, valves, and motors on this project when available unless other specified.

PART 2 - PRODUCTS

2.1 BASIC PIPING MATERIALS:

A. Gate Valves: Valves up to 2-inch size shall have bronze body, bronze trim, inside screw, rising stem with hand-wheel, single wedge or disc, solder or threaded ends, Crane No. 1324, NIBCO No. S-126 or equal. Valves over 2-inches shall have iron body, bronze trim, rising stem with hand-wheel, OS&Y, double wedge, flanged ends.

B. Globe Valves: Valves up to 2-inch size shall have bronze body, bronze trim, rising stem and hand-wheel, inside screw, renewable composition disc, solder or screw ends to match adjacent piping, with back-seating capacity, and repackable under pressure. Valves over 2-inch size shall have iron body, bronze trim, rising stem, hand-wheel, OS&Y, plug type disc, flanged ends, renewable seat and disc.

C. Ball Valves: Valves up to 2-inch size shall have bronze or stainless steel body, stainless steel ball, Teflon seats and stuffing box ring, lever handle, solder or threaded ends. Valves over 2-inch size shall have cast steel body, stainless steel ball, Teflon seat and stuffing box seals, lever handle, flanged ends.

D. Plug Cocks: Plug cocks up to 2-inch size shall have bronze body, bronze tapered plug, non-lubricated, Teflon packing, threaded ends, with wrench operator. Plug cocks over 2-inch shall have iron body and plug, pressure lubricated, Teflon packing, flanged ends, with wrench.

E. Swing Check Valves: Valves up to 2-inches shall have bronze body, 45 degree swing disc, solder or screwed ends. Valves over 2-inches shall have iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.

F. Strainers: Strainers up to 2-inches shall screwed brass or iron body, Y-pattern with stainless steel screen. Strainers over 2-inches shall have flanged iron body, Y-pattern with stainless steel screen.

G. Escutcheon Plates: One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium-plated finish on plates in finished spaces, paint on plates in unfinished spaces, and with set screws to anchor plates in place securely.

H. Unions: For pipe sizes under 2-inches use 150 psig malleable iron unions for threaded ferrous piping; bronze unions with solder joints for copper pipe.

I. Flanges: For pipe size over 2-inches use forged steel slip-on flanges conforming to ANSI B16.1, Class 125, for use in ferrous piping; Bronze flanges conforming to ANSI B16.22 or B16.24 for use in copper tubing. Gaskets shall be full face flat type synthetic rubber, except use neoprene gaskets for gas service and shall conform with ANSI B16.21

J. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, except both ends threaded for gas service, water impervious isolation. Use unions as manufactured by EPCO.

K. Access Doors: Provide, 12" x 12" minimum size, factory prefabricated flush face steel access doors including steel door frame with continuous hinges and turn-screw-operated latch. Door frame shall be for installation in dry walls, plaster walls, or masonry walls. Furnish doors under this section to provide proper access to concealed valves; install doors under the appropriate section of this specification.

L. Pipe Sleeves: Sleeves in masonry and concrete walls, partitions, floors, and roofs shall be constructed of, Schedule 40, hot-dipped galvanized, pipe conforming to ASTM A53. Sleeves in other type construction shall be constructed of steel sheet having a nominal weight of not less than 0.90 pounds per square foot.

M. Flashing: Flashing for pipes passing through roof or waterproofing membrane shall be fabricated from 4-pound per square foot sheet lead. Flashing for plumbing vents through metal roof shall be made water-tight by special flashing obtained from the roof

manufacture.

N. Pipe Hangers and Supports: Provide MSS SP-58 and MSS SP-69, Type 1 or 6 of adjustable type. Attachments to steel W or S beams shall be with Type 21, 28, 29, or 30 clamps. Attachments to steel angles and channels (with web vertical) shall be with Type 20 clamp with beam clamp channel adaptor. Attachments to steel (with web horizontal) shall be with drilled hole on centerline and double nut and washer. Attachment to concrete shall be with Type 18 insert or drilled hole with expansion anchor. Attachment on roof shall be structural design with mechanically attached foam base, saddle for aligning pipe, and use of 3/8" or ½" threaded rod, equal to Roof Top Blox. Hanger rods and attachments shall be full size of the hanger threaded diameter. Provide Type 40 insulation protection shields for insulated piping. Provide steel support rods. Provide nonmetallic, hair felt or plastic piping isolators between copper tubing and the hangers or use copper hangers.

O. Tracer Wire for Nonmetallic Pipe: Tracer wire shall be bare copper wire not less than 0.10 inch in diameter and shall be continuous over entire length of nonmetallic pipe.

2.2 Identification:

A. Stencils: With clean cut symbols and letters.

B. Stencil Paint: In accordance with Section 09900, semi-gloss enamel.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.3 Adjusting, Balancing & Testing:

A. General: The Contractor shall procure the services of an independent balance and testing firm, approved by the Architect which specializes in the balancing and testing of heating, ventilating and air conditioning systems; to balance, adjust, and test the mechanical systems performance in accordance with the contract plans and specifications.

B. Quality: The testing firm shall be a member of Associated Air Balance Council. All work by this firm shall be done under direct supervision of a qualified engineer employed by them. The air balance firm shall provide proof of having successfully completed at least five projects of similar size and scope. All instruments used by this firm shall be accurately calibrated and maintained in good working order. If requested, the tests shall be conducted in the presence of the Contracting Officer.

C. Testing: Balance and testing shall not begin until system has been completed and is in full working order. The Contractor shall put all heating, ventilation, and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.

D. Submittal: The Contractor shall submit six (6) copies of submittal data for the testing and balancing of the air conditioning, heating and ventilating systems.

E. Warranty: Balance firm shall include and extended warranty of 90 days, after completion of work, during which time the Architect, at his discretion, may request a re-check of resetting of any water flow, outlet, supply air fan, or exhaust fan as listed in test report.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING:

A. Preparation:

1. Ream pipe and tube ends. Remove burrs. Bevel plain end of ferrous pipe.
2. Remove scale and dirt, on inside and outside of piping before assembly.
3. Prepare piping connections to equipment with flanges or unions.
4. Coordinate cutting or forming of roof or floor construction to receive drains to required invert elevations.

B. Installation:

1. Provide non-conducting dielectric connections whenever jointing dissimilar metals. Locate in accessible locations.
2. Install piping to conserve building space and not interfere with use of space. Group piping whenever practical at common elevations. Route piping in an orderly manner, plumb, and parallel with the lines of the structure, and maintain gradient.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. Install specialties and equipment in accordance with manufacturer's instructions.
5. Install brass male adapters each side of valves in copper piped systems. Sweat solder adapters to pipe.
6. Provide clearance for installation of insulation and access to valves and fittings.
7. Slope water piping and arrange to drain at low point.

C. Application:

1. Install specialties in accordance with manufacturer's instructions.
2. Install brass male adapters each side of valves in copper piped systems. Sweat solder adapters to pipe.
3. Install globe, plug cock, or ball valves for throttling, by-pass, or manual flow control services.
4. Install tracer wire over underground nonmetallic pipe.
5. Threaded Connections: Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread tape, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.
6. Solder End Valves: Remove stems and washers and other items subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.
7. Pipe Hangers and Supports: Support horizontal piping as follows:

PIPE SIZE	MAXIMUM HANGER SPACING	HANGER ROD DIAMETER
½ TO 1-1/4 INCH	6'-0"	3/8"
1-1/2 TO 2 INCH	8'-0"	3/8"
2-1/2 TO 3 INCH	10'-0"	½"
4 TO 6 INCH	12'-0"	5/8"
8 TO 12 INCH	14'-0"	7/8"
PLASTIC – ALL SIZES	4'-0" & AT ELBOWS	3/8"
CAST IRON PIPE	5'-0" & AT JOINTS	5/8"

8. Pipe Sleeves: Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25-inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with plastic waterproof cement which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

9. Flashing: Pipes passing through roof or floor waterproofing membrane shall be installed through lead flashing within an integral skirt or flange. Flashing shall be suitable formed and the skirt or flange shall extend not less than 8-inches from the pipe and shall set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 8-inches. The annular space between the flashing and the bare pipe shall be sealed. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. A sheet-lead flashing shield shall be provided for floor drains and pipe sleeves with integral clamping devices that penetrate a membrane. Flashing shield shall be made from sheet lead and extend not less than 8-inches from the drain or sleeve in all directions. Flashing shall be inserted into the clamping device and made watertight.

10. Flanges and Unions: Flanges shall be faced true. Flanges shall be provided with gasket and made square and tight. Except where copper tubing is used, union or flange joints shall be provided in each line preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. A union shall be installed on the downstream of each valve.

11. Grading: Connections shall be carefully made to insure unrestricted circulation or flow, eliminate air pockets and permit draining of all systems. Hot and chilled water lines shall have a grade of not less than 1" in 40' up in the direction of flow to the high point air vent. Steam and steam condensate lines shall have a grade of not less than 1" in 20' down in the direction of flow. Use eccentric reducers to maintain top of heating and chilled water piping at proper grade and to maintain bottom of steam and steam condensate piping at proper grade.

12. Valve Stems: Valves in horizontal lines shall be installed with stems horizontal or above.

D. Welding

1. Welded Joints: Welded joints shall be fusion-welded in accordance with ANSI B31.1, Section 6. Mitering or notching of pipe to form elbows or tees or other similar construction will not be permitted.

2. Beveling: Field and shop bevels shall be in accordance with the recognized standards and shall be done by mechanical means or flame cutting. Where beveling is done by flame cutting, surfaces shall be cleaned of scale and oxidation prior to welding.

3. Alignment: Before welding, the components parts to be welded shall be aligned so that no strain is placed on the weld when finally positioned. Height shall be so aligned that no part of the pipe wall is offset by more than 20% of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operation.

4. Removing and Replacing Defective Welds: Shall be at no additional cost to the owner. Repairing defective welds by adding new materials over the defects or by peening will not be permitted.

5. Electrodes: Electrodes shall be stored in a dry heated area and shall be kept free of moisture or dampness during fabrication operations. Electrodes that have lost part of their coating shall be discarded.

6. Welding to Structure: Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

3.2 IDENTIFICATION, LABELING AND MARKING:

A. General: Piping, valves, controls, and equipment shall be labeled or marked. Manufactured name plates and labels such as Brady or Seton will be acceptable and the Contractor is invited to submit, for examination and test, samples of materials he proposes to use.

B. Piping: On all piping, stencil name of liquid or gas being handled, and direction of flow in contrasting colors. In general stencils shall be on piping at 20 foot intervals and near all operating valves & equipment. Lines less than 3/4" total diameter to be identified with brass tags, lines 1" to 2" to have 3/4" high stencils, lines 2-1/2" to 7" to have 1-1/2" high stencils and all larger lines to have 2" high stencils. Sizes given are after insulation is applied.

C. Equipment: All apparatus, equipment, machines, controlling devices, controlled devices, starters, and switches are to be identified by name and number. Do not place label on cover or shield which is removable or interchangeable with other pieces. On all major equipment it shall be painted in prominent spots as selected. Number all boilers, fans, pumps, etc., as well as label.

D. Valve Tags: All valves shall be provided with a nickel-plated brass tag not less than 1-1/2" in diameter with stamped numbers. Tag shall be secured to the valves with approved type S hooks. Also provide and mount under glass in the equipment room a typewritten valve list, listing functions of each valve, its location and service.

3.3 TESTING, ADJUSTING, AND BALANCING:

A. General Requirements: All equipment and apparatus necessary for balancing and testing shall be furnished by the Contractor. All defects disclosed by the tests shall be rectified without additional cost to the Owner. Field tests shall be made under the direction and subject to the approval of the Contracting Officer.

B. Piping Systems: Shall be tested after installation and before any insulation is applied. All controls and other apparatus that may be damaged by the test pressure shall be removed before the tests are made. Leaking screw and solder joints shall be remade. Welded joint leaks shall be repaired by cutting the section out of the system and rewelded. Tests shall be made by the Contractor and the results submitted for approval. Each system shall be hydrostatically tested as outlined in applicable codes and standards. Test pressure shall be maintained for no less than 2 hours. No tar, grease, paint or any other compound shall be used to repair leaks.

C. Operational Test: After the above testing all mechanical systems shall be started and operated to prove proper functioning of each type of equipment. Start-up and adjustment of the heat pumps shall be accomplished by the manufacturer's start-up Engineer. All operating tests shall be to the satisfaction of the Architect. Should any element not perform properly, the Contractor shall make all required corrections.

D. The balance and testing firm shall test, balance, adjust and record the following for all systems as applicable.

1. Test and adjust all blower RPM to design requirements.
2. Test and record all motor full load amperes.
3. Test and record system static pressure, suction and discharge.
4. Test and adjust system for design recirculated air, CFM.
5. Test and adjust system for design CFM outside air.
6. Test and record entering air temperatures.
7. Test and record leaving air temperatures.
8. Test and adjust each diffuser, grilles and register to within ten percent of design requirements. Each grille, diffuser and register shall be identified as to location and area. Size, type, and manufacture of diffusers, grilles, registers, and all test equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculation.
9. In cooperation with the control manufacturer's representative, setting adjustment of automatically operated dampers to operate as specified, indicated and/or noted. Testing agency shall check all controls for proper calibrations and list all controls requiring adjustment by control installers.

E. Performance Test: After completion of testing, balancing and adjusting the balance and testing firm shall make performance test of all mechanical system to determine compliance with the specification requirements. Any equipment that fails to equal or to exceed the specified performance shall be modified or replaced at no additional cost to the Owner.

F. Test Data: The Contractor shall furnish to the Architect four (4) copies of the schedules of readings taken during the balance and testing operation indicating the required to specified reading and the final balanced reading of all items.

END OF SECTION

SECTION 23 00 00

HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Section 23 01 00 - Mechanical General Requirements, with modifications and additions specified herein, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

A. Heat Pump Systems

B. Exhaust Fans and Accessories

1.3 QUALITY ASSURANCE:

A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Fan Sound Ratings: AMCA 301; tested to AMCA 300 and bear AMCA Certified Sound Rating Seal.

C. Fan Fabrication: Conform to AMCA 99 and/or ARI 430.

1.4 SUBMITTALS:

A. Submit product data and shop drawings under provisions of Section 23 01 00.

B. Submit manufacturer's installation instruction.

C. Provide one (1) extra set of filters.

PART 2 - PRODUCTS

A. HEAT PUMP:

1. General: Furnish and install an air-to-air electric heat pump system consisting of a fan coil unit, remote refrigeration unit, and supplementary electric heat. The system shall conform to the requirements of ARI Standard 240 and shall be UL approved.

2. Outdoor Section: The outdoor section shall consist of compressor unit, air-cooled coil, air circulatory fan, housing, controls, frame and cabinet. The coil shall be protected by a grille. The cabinet shall be finished with baked enamel or other suitable weatherproof finish. Provide with hail guards over condensing coils.

3. Indoor Section: The indoor section shall consist of a fan/coil unit. The coil shall be provided with a drain pan of nonferrous material or with a steel pan completely waterproofed with non-hardening type mastic on the water side. The supply air fan shall be of the centrifugal type, quiet in operation and capable of supplying the CFM and static pressure indicated. The fan/coil unit cabinet shall be insulated with mineral wool to prevent seating. The unit shall be mounted on vibration absorbing supports.

4. Supplementary Heat: Supplementary heat shall be of the electric resistance type and shall be installed downstream from the indoor coil. Heating elements shall have factory wired magnetic contactors and high temperature cutout devices. One stage of the heat shall be provided with an outside air thermostat.

5. Controls: The cooling/heating system shall be protected by high and low pressure stat, loss of charge and indoor coil freeze-up protection devices, current and temperature-sensitive compressor motor protectors, a device which prevents starting of the compressor more than once every 5 minutes, and a defrost circuit which senses for frost accumulation every 90 minutes and, if frost is present, automatically puts the unit into defrost cycle.

6. Thermostats: A deluxe wall mounted heating/cooling (two (2) stage heating, one (1) stage cooling) thermostat shall be installed. The thermostat shall be equipped with a system selector switch, blower switch for automatic or continuous operation and built-in heat and cool anticipation.

7. Energy Efficiency Ratio: The cooling system energy efficiency ratio (EER) shall be equal to, or greater than those ratios scheduled on the Drawing. Energy efficiency ratios shall be for the equipment combination specified and shall conform to the listings published in the current Air-Conditioning and Refrigeration Institute Directory.

2.2 EXHAUST FANS AND ACCESSORIES:

A. General: This Contractor shall furnish and install all exhaust fans. Fans shall be of the sizes and types shown on the Drawings and shall be complete with all accessories and specials scheduled. Fans shall be rated in accordance with AMCA Standards and shall be AMCA labeled. All fractional horsepower motors shall be provided with internal overload protections.

B. Ceiling Mounted Fans: Fans shall be of the centrifugal direct drive type. Each fan shall have a removable front grille and gravity discharge damper. Interior of fan housing shall be lined with sound deadening insulation. Provide appropriate roof jack or wall discharge grille and connecting ductwork. Fans shall be Greenheck Model SP-A, Cook Model GC, Twin City Fan Model T, Broan, or approved equal.

C. Sidewall Direct Propeller Fans: Wall fans shall be direct drive propeller type as indicated on schedule. Construction of fan panel shall be of steel with a baked high grade enamel finish. The guard shall be constructed of heavy gauge wire finished in a zinc plated surface. Rubber mounts shall be used to isolate noise from motor to guard. A wall mounting collar shall be furnished by fan manufacturer with a baked epoxy finish. Collar shall be not less than 14 gauge. All wall fans shall be furnished with a gravity backdraft damper. Fans shall be Greenheck Model AER or approved equal.

D. Sidewall Belted Propeller Fans: Wall fans shall be belted propeller type as noted on schedule. Construction of fan housing shall be heavy gauge steel with baked enamel finish. The propeller shall be die formed with a reinforced gusset welded to the back side of the blade. Blade and gusset assemblies are to be welded to a heavy gauge steel hub section with a continuous fillet mold. Motor and drive assembly frame to be constructed of angle iron. A wall mounting collar shall be furnished by fan manufacturer with a baked epoxy finish. Collars for fans shall not be less than twelve (12) gauge. All wall fans shall be furnished with a motorized backdraft damper with operator at same voltage as fan and

interlocked to operate with fan. Coordinate with electrical for this work. Fans shall be Greenheck Model SBE or approved equal.

2.3 HIGH VOLUME LOW SPEED FAN

A. General: The fan shall be equipped with six (6) Powerfoil airfoils of precision extruded aluminum alloy. The airfoils shall be connected by means of two (2) high strength locking bolts per airfoil. The airfoils shall be connected to the hub and interlocked with zinc plated steel retainers. The fan shall be equipped with six (6) Powerfoil winglets on the ends of the airfoils. The winglets shall be molded of a polypropylene blend. The standard color of the winglet shall be “BAF Yellow.” Fan shall use a VFD fan speed controller with user interface. Manufacturer shall be Big Ass Fans or equal with “Basic” Model.

B. Motor
1. The fan motor shall be an AC induction type inverter rated at 1725 RPM, 200–240/400–480 VAC, 50/60 Hz, three-phase.
2. The motor shall be totally enclosed, fan cooled (TEFC) with an IP56. A B5 standard frame shall be provided for ease of service. The motor shall be manufactured with a double baked Class F insulation and be capable of continuous operation in 5° F to 104° F (-15° C to 40° C) ambient conditions.

C. Gearbox
1. The gearbox shall be a helical gear reducer, precision finished from hardened steel for low noise and long service life with double lip seals to retain oil and prevent contamination. The gearbox shall be lubricated for life. The gear reducer shall have a standard backlash of less than 25 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-1/4” (3.2 cm) diameter.

D. . Motor Frame
1. The motor frame and mount shall be constructed of steel and powder coated for corrosion resistance and appearance.

E. Mounting System
1. The fan mounting system shall be designed for quick and secure installation on a variety of structural supports. The design of the upper mount shall provide two axes of rotation. This design shall allow for adjustments to be made after the mount is installed to the mounting structure to ensure the fan will hang level from the structure.
2. The upper mount shall be of ASTM A-36 steel, at least 3/16” thick, and powder coated for appearance and corrosion resistance. No mounting hardware or parts substitutions, including cast aluminum, are acceptable.
3. All mounting hardware shall be SAE Grade 8 or equivalent.

F. Hub
1. The fan hub shall be 19” (48 cm) in diameter and shall be made of precision cut aluminum for high strength and light weight. The hub shall consist of two (2) aluminum plates, six (6) aluminum spars, and one (1) aluminum spacer fastened with a pin and collar rivet system. The overall design shall provide a flexible assembly such that force loads experienced by the hub assembly shall be distributed over a

large area to reduce the fatigue experienced at the attachment point for the fan blade.

2. The hub shall be secured to the output shaft of the gearbox by means of a steel coupling interface. The hub shall incorporate three (3) safety retaining clips made of 1/4" (0.6 cm) thick steel that shall restrain the hub/airfoil assembly.

G. Safety Cables

1. The fan shall be equipped with an upper safety cable that provides an additional means of securing the fan assembly to the building structure. The upper safety cable shall have a diameter of Ø3/8" (1 cm).
2. The fan shall be equipped with two lower safety cables pre-attached to the fan hub that shall provide an additional means of securing the fan to the extension tube. The lower safety cables shall have a diameter of 1/4" (0.6 cm).
3. The safety cables shall be fabricated out of 7 x 19 galvanized steel cable. The end loops shall be secured with swaged Nicopress® sleeves, pre-loaded and tested to 3,200 lbf (13,345 N).
4. Field construction of safety cables is not permitted.

H. Variable Frequency Drive

1. The Variable Frequency Drive (VFD) shall be a NEMA 4X VFD that is factory programmed to minimize starting and braking torques. The VFD shall have touchpad controls and an LED display for controlling the fan's direction, operation, speed, and programming. The VFD may be equipped with an EMI/RFI filter to limit interference with other electronic equipment and a rotary switch disconnect for lock-out/tag-out requirements.
2. Onboard Variable Frequency Drive: The VFD may be mounted on the fan motor frame. A wall-mounted digital variable speed controller shall be provided for such installations, allowing access to all VFD functions.
3. Wall-Mounted Variable Frequency Drive: The VFD may be wall-mounted for ease of access.

I. Digital Variable Speed Wall Controller

1. The fan shall be equipped with a digital variable speed wall controller. The controller user interface shall be an intuitive touchscreen interface.
2. The controller shall be mounted to a standard rectangular or square outlet box.
3. A 150-ft (45.7-m) CAT5 cable shall be provided for connecting the controller to the fan's VFD and to provide power to the controller.
4. The controller mounting location shall meet the requirements of OSHA standard 29 CFR 1910.303(g) for accessibility minimum clearances.
5. The controller shall have an IP55 rating.
6. The controller shall provide fan start/stop, speed, and direction control functions.
7. The controller shall provide diagnostic and fault history information for the connected fan, as well as the ability to configure fan parameters with the assistance of Big Ass Fans Customer Service.
8. The controller interface shall be able to be secured with a passcode to prevent unauthorized access to fan controls and settings.
9. The controller shall operate out of the box without setup and upon connection to CAT5 cable.

L. Fire Control Panel Integration

1. Includes a 10–30 VDC pilot relay for seamless fire control panel integration. The pilot relay can be wired Normally Open or Normally Closed in the field.

L. Guy Wires

1. Included for installations with extension tubes 4 ft (1.2 m) or longer to limit the potential for lateral movement.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Install equipment in accordance with manufacturer's installation instruction.

B. Coordinate installation with architectural, structural, mechanical, and electrical work.

C. Pipe drains to floor drain.

D. Clean and flush system before placing in operation.

E. Verify that the proper utilities are connected and ready for use before operation of equipment.

END OF SECTION

SECTION 23 01 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. The general provisions of the Contract, including General and Supplementary Conditions, DIVISION 1 - GENERAL REQUIREMENTS, apply to the work specified in this Division, with additions and modifications specified herein.

1.2 APPLICATION: This section applies to all sections of Division 15 - Mechanical Work of these specifications, including modifications and additions specified in each individual section.

1.3 DESCRIPTIONS OF WORK:

A. Scope: The work covered by this Division of these Specifications consist of furnishing all plant, labor, equipment, appliances, and materials, and in performing all operations in connection with the mechanical work, including all items of special equipment specified herein, complete in strict accordance with this Division of these Specifications and the applicable Drawings.

B. Work Included: The work involves a complete mechanical system. Generally the work includes, but is not limited to the following items. Complete heating, ventilating and air conditioning system.

Complete heating, ventilating and air conditioning system

Domestic hot and cold water distribution system.

Waste and drainage system.

Plumbing fixtures, appliances, equipment, and specialties.

Temperature control system and Instrumentation.

Terminal and acoustical insulation.

Mechanical rough-in and mechanical connection of equipment furnished under other Divisions of this Contract.

Maintain a clean work area.

Testing, adjusting and balancing of the mechanical system.

Equipment and piping identifications.

Miscellaneous other work for a complete and operative mechanical system.

Structural steel for equipment supports.

1.4 Related Work Specified Elsewhere: Generally the following work is specified under other Divisions of the project Specifications.

A. Electrical power wiring and power connection to equipment.

B. All painting except restoring finish on equipment that has sustained damage during shipment or installation.

C. Receiving, uncrating and installing equipment furnished by others or the Owner.

1.5 SITE CONDITIONS: Before submitting a proposal for the work contemplated in these

Specifications and accompanying Drawings, each bidder shall examine the site and familiarize himself with all the existing conditions and limitations. No extras will be allowed because of the Contractor's misunderstandings as to the amount of work involved or his lack of knowledge of any condition in connection with the work.

1.6 FEES, PERMITS AND INSPECTIONS: This Contractor shall secure and pay all fees, permits and inspections required on work performed under this section of the contract Specifications. Fees shall include, but not limited to, sewer, water and/or gas taps and all gas/ water meter fees charged by the utility companies. He shall assume full responsibility for all assessments and taxes necessary for completion and acceptance of this work.

1.7 APPLICABLE CODES AND STANDARDS: All materials, arrangements, and workmanship shall comply with all applicable codes, specifications, federal and state laws, local ordinances, industry standards and utility company regulations. In case of difference between building codes, Specifications, Federal and State laws, local ordinances, standards and utility company regulations and the Contract Documents, the most stringent requirement shall govern. The Contractor shall promptly notify the Architect in writing of such difference. Should the Contractor perform any work that does not comply with requirements of the applicable building codes, Federal and State laws, local ordinances, industry standards, and utility company regulations, he shall bear all costs arising in correcting the deficiencies. Applicable Codes and Standards shall include all state laws, State Board Health and State Rating Bureau, local ordinances, industry standards, and utility company regulations. Comply with applicable requirements of the following national accepted codes and standards as though they were copied herein fully:

ARI	Air Conditioning and Refrigeration Institute
ADC	Air Diffusion Council
AMCA	Air Moving & Control Association
AABC	American Air Balance Council
AGA	American Gas Association
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration & Air Conditioning Engineers - Handbook
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast-Iron Soil Pipe Institute
CTI	Cooling Tower Institute
FM	Factory Mutual System
HI	Hydronic Institute
FBC	Flotida Building Code
IEEE	Institute of Electrical and Electronic Engineers
IPC	International Plumbing Code
MSS	Manufacturer's Standardization Society
MPTA	Mechanical Power Transmission Association
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturers Association

NEBB	National Environmental Balancing Bureau
NFPA	National Fire Protection Association - Fire Codes
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act Standards
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal & Air Conditioning Contractors National Association
SAE	Society of Automotive Engineers
UL	Underwriters' Laboratories

1.8 APPROVAL OF MATERIALS AND EQUIPMENT:

A. Quality Standards: Whenever a material, article or piece of equipment is identified on the Drawings or in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, or the like, it is so identified for the purpose of establishing a standard of quality and shall not be construed as limiting competition. Any material, article or piece of equipment of other manufacturers or vendors which will perform adequately the duties impose by the design will be considered equally acceptable provided the material, article, or piece of equipment so proposed is, in the opinion of the Architect, of equal substance, appearance and function. It shall not be purchased or installed by the Contractor without the Architect's written approval. In order that all bidders, manufacturers, and vendors receive fair and equal consideration, the procedures described hereinafter shall be complied with.

B. Approval of Substitutions: Prior written approval by the Architect/Engineer is required for substitutions for all materials, articles and equipment specified without qualifications or followed by "or prior approved equal". Request for prior approval shall be submitted to the Architect, with copy to Engineer, at least ten (10) days before time of bid opening. Approved substitutions will be included in an addendum to the Specification or in writing at the discretion of the Architect. Request for approval for materials, articles, and equipment qualified with "equal to" or "or equal" shall be submitted within 30 days after award of contract but before purchase. IN CONNECTION WITH THE USE OF ANY ALTERNATE ITEM APPROVED BY THE ARCHITECT, IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO SEE THAT SUCH ITEMS MEET ALL REQUIREMENTS, AND THAT ANY ALTERATIONS TO CONNECTING OR ASSOCIATED ITEMS NECESSITATED BY USE OF THE ALTERNATE ITEMS ARE PROPERLY MADE WITHOUT ADDITIONAL COSTS TO THE OWNER. This includes but is not limited to added breakers, fuses, disconnects, wiring, or piping that is not indicated by scheduled equipment. Architect's opinion shall be final on quality of substituted items.

C. Manufacturer's Brochures and Shop Drawings: As soon as practicable after award of the contract and before starting installation of any materials or equipment, the Contractor shall submit to the Architect for approval six (6) copies of Manufacturer's brochures and shop Drawings giving rating, operating characteristics, wiring diagrams, power requirements, etc., of the material and equipment proposed for installation. A complete electrical connection diagram for each electrically controlled component shall be submitted for approval. The connection diagram shall identify each component and shall show all interconnected and interlocked components. Automatic temperature control diagrams shall be submitted. All data submitted shall be sufficiently complete to demonstrate conformance with the Specification requirements. Drawings showing all ducts, piping and installation details shall be submitted for approval with Material and

Equipment submittal if equipment is different from that indicated on the Drawings. Checking and approval of brochures and shop Drawings by the Architect shall not relieve the Contractor from the responsibility for deviations from the Drawings and Specifications unless he has in writing called the Architect's attention to such deviations at time of submission and secured his written approval, nor shall it relieve him of responsibility for errors or omissions in the shop Drawings. Checking and approval by the Architect is only for general conformance with design intent and contract requirements. It is the Contractor's responsibility to verify the accuracy of dimensions, obtaining field dimensions, by comparison and measurements in the field. Final shop Drawings shall indicate field verified dimensions.

1.9 DEVIATIONS:

A. Drawings: The Mechanical Drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The mechanical work shall conform to the requirements shown on all of the Drawings. General and Structural Drawings shall take precedence over Mechanical Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves and accessories as maybe required to meet such conditions. If major departures from the contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted as soon as practicable for approval. No major departures shall be made without prior written approval.

B. Space Conditions: Every attempt has been made to design the systems so as to cover the installation of all equipment and connections thereto without interference to the structural design of the building. Contractor shall note that space in some locations is critical, and shall prior to installing his work coordinate the location with all other trades. If interference results from failure of the Contractor to exercise such caution, work shall be relocated as the Engineer ascertains would most facilitate job progress. Relocation shall be at the expense of the Contractor whose work is relocated, and the decision of the Engineer shall be final. If Contractor is unable to achieve desired cooperation with other trades and/or subcontractors, he is cautioned not to proceed but to inform the Engineer as to his difficulties. Contractor shall make offsets, transitions and changes in direction in pipe, ducts, etc., as required to maintain proper grades, or essential elevations.

1.10 COOPERATION: Cooperate and coordinate with others in laying out work so that this phase of the work will properly fit the building and other contractors' requirements. Priority of locations shall be as follows:

Light Fixtures
Ceiling Mounted Air Control Devices
Fire Protection System
Ductwork
Plumbing Waste, Drain and Vent System
Mechanical Equipment
Electrical Equipment
Mechanical Piping Mains

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS:

A. Bound Instructions: Four (4) complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Owner. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time the test procedure is submitted, and the remaining sets shall be furnished before the Contract is completed. Flysheet shall be placed before instructions covering each subject. Flysheet shall be placed before instructions covering each subject. The instructions sheets shall approximately 8-1/2" by 11" with large sheets of Drawings folded in. The instructions shall include, but shall not be limited to the following:

1. System layout showing piping, valves, and controls.
2. Approved wiring and control diagrams, with date to explain the detailed operation and control of each component.
3. A control sequence describing startup, operation and shutdown.
4. Operating and maintenance instructions for each piece of equipment, including lubrication instructions.
5. Manufacturer's bulletins, cuts and descriptive data.
6. Parts lists and recommended spare parts.

B. Framed Instructions: Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. In addition, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Proposed diagrams, instructions and other sheets shall be submitted for approval prior to posting.

C. Field Instructions: Upon completion of the work and at a time designated, the services of one project engineer shall be provided by the Contractor to instruct the representative of the Owner in the operation and maintenance of the mechanical systems.

D. Temporary Equipment: Mechanical Contractor shall not run HVAC equipment during duration of project when dust from construction is present. When space is properly cleaned, the Engineer will inspect space conditions and approve the use of HVAC equipment. If temporary heating/cooling is necessary for construction of project, Mechanical Contractor will need to notify other trades that it will not be provided by them.

1.12 RECORD DRAWINGS:

A. This Contractor shall provide record Drawings at completion of job. Drawings to show all significant changes in piping, equipment, wiring, etc. The actual location of all piping drains, clean-outs, apparatus and equipment shall be indicated. These Drawings are to be turned over to the Architect at completion. All cleanouts and concealed equipment (below grade) to be dimensioned from building lines, etc.

1.13 CONNECTION OF EQUIPMENT FIXTURES FURNISHED BY OTHERS:

A. This Contractor shall provide all necessary materials and labor to connect to the mechanical systems all equipment and fixtures having mechanical connection and which are specified in other Divisions of the project Specifications. Drainage connections shall be trapped. The supply and return lines for each item of equipment or fixture, except control valves with integral stops, shall be provided with cut-off valves to enable isolation of the item for repair and maintenance without interfering with the operation of other equipment or fixtures. Refer to other Divisions of the project Specifications for additional requirements. Actual rough-in dimensions shall be obtained from shop Drawings or measurements of the equipment or fixture.

B. The unpacking, assembling and setting of equipment furnished by the Owner or under other than Mechanical Sections of these Specifications will not be performed under this Division of the Specifications.

C. Due to the fact that the manufacture of the equipment actually purchased may vary slightly from that specified in the above lists and therefore require some rearranging of equipment different from that indicated on the Drawings, the Contractor shall make connections to such rearranged equipment without additional cost to the Owner. That is, for an initial installation arrangement other than that indicated on the Drawings. Equipment will be furnished complete with faucets, waste strainer and tailpiece. This Contractor shall supply traps, supplies, and stops for above equipment.

1.14 ELECTRICAL:

A. Refer to the Electrical Drawings and Division 16, ELECTRICAL WORK, for the characteristic of the available electrical power. All motors and equipment under this contract to be compatible with the local voltages.

B. For each and every motor installed under this section of the contract, furnish to the Electrical Contractor for installation the proper motor starter, where not specified to be furnished by the electrical contractor and where required, pushbuttons or hand-off automatic controls, or other required relays or control devices. All motors which start and stop automatically or as specified, shall be furnished with magnetic starters, pushbuttons and relays as required. The Electrical Contractor will wire from service to starter to motor. Any additional secondary control circuits, such as remote control stations, and temperature control wiring shall be provided under this Division. Each and every wire in each and every junction box, starter, pull box or where else terminating or connecting or visible shall be color coded and numbered using Brady Stick-On numbers or equivalent. Upon completion of all wiring, including control and secondary wiring, Contractor shall furnish finished shop Drawing showing each wire number and connecting points for each and every unit. Contractor shall 'meg' every circuit to determine leaks or shorts and correct same before calling for inspection by Engineer.

C. All wiring installed under the responsibility of this Contractor shall be in conduit and in strict accordance with the National Electrical Code and DIVISION 16, ELECTRICAL WORK of the project Specifications.

1.15 WORKMANSHIP:

A. All work shall be executed in a neat and substantial manner by skilled workmen well qualified and regularly engaged in the type of work required. Substandard work shall be removed and replaced by the Contractor at no cost to the Owner.

1.16 CUTTING AND PATCHING:

A. This Contractor shall provide all cutting, digging, etc., incident to his work and shall make all required repairs thereafter to the satisfaction of the Architect, but in no case shall the Contractor cut into any major structural element beam or column without written approval of the Architect. Pavements, sidewalks, roads, curbs, walls, ceilings, floors and roofs shall be cut, patched, repaired and/or replaced as required to permit the installation of the work and such cutting, patching, repairing, and replacing shall be the responsibility of and paid for by the Contractor under this section of the Specifications.

B. The Contractor shall bear the expense of all cutting, painting, patching, repairing or replacing of the work of other trades required because of his fault, error or tardiness or because of any damage done by him.

1.17 CLEANING AND PAINTING:

A. The respective Contractors or Sub-contractors for the various phases of the work shall clear away all debris, surplus materials, etc., resulting from their work or operations, leaving the job and equipment furnished under any or all Contracts in a clean first class condition.

B. All plumbing fixtures shall be thoroughly cleaned of all plaster, stickers, rust stains and other foreign matter or discoloration, leaving every part in an acceptable condition and ready for use. The surfaces of all pumps, motors, floor drains, cleanouts and other equipment shall be cleaned and each item shall be left in a first class condition.

C. Painting of materials and equipment furnished under the mechanical portion of the Contract is specified under the General Construction Contract as described in other Sections. The Mechanical Contractor shall, however, refinish and restore to the original conditions and appearance, all mechanical equipment which has sustained damage to manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the requirements described for other painting.

1.18 MECHANICAL DEMOLITION: Contractor shall visit the building to determine the existing conditions and review the items of work required to establish the planned and specified construction work. The Mechanical Contractor shall coordinate his demolition with the General Contractor, in establishing his schedule and shall consider the requirements that all activities of the existing building shall, during normal operating hours, with designated representatives of the Owner, and The Architect. All utility outages shall be approved through the Owner's Engineering Department. Contractor shall terminate and cap all active utility lines to the demolished areas, except that the Contractor shall maintain active lines that supply or drain the existing building to remain. Any damage during this contract, to existing utility lines serving the existing building to remain, shall be properly repaired and reactivated at no expense to the Owner. Contractor shall haul all debris, equipment, and fixtures from the site before any significant accumulation appears. Removal shall be done without undue noise, dust, and shall be accomplished without interfering with normal plant operations.

1.19 EQUIPMENT SAFETY: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, rotating parts, and other power transmission apparatus, located so that any person can come in close proximity thereto, shall be fully enclosed or properly guarded in accordance with OSHA 1910.219. Provide positive means of locking out equipment so that it cannot be accidentally started during maintenance procedures. High-temperature equipment and

piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type as specified. Ensure that access openings leading to equipment are large enough to carry through routine maintenance items such as filters and tools.

1.20 DELIVERY AND STORAGE: Equipment and materials shall be handled, stored, and protected to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Architect/Engineer. Damaged or defective items shall be replaced.

1.21 STANDARD PRODUCTS/SERVICE AVAILABILITY:

A. Materials and Equipment: Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size.

B. Experience Required: The two-year experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures.

C. Service Support: The equipment items shall be supported by service organizations. The Contractor shall submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

D. Manufacturer's Nameplate: Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.22 EXISTING UTILITIES, STRUCTURES AND OTHER PROPERTY: Prior to any excavation, it shall be the responsibility of the Contractor to locate and avoid damage to any and all existing water, gas, sewer, electric, telephone and all other underground utilities or structures. The Contractor shall contact the various local utility departments or other responsible agencies and obtain location Drawings, or other assistance in the locations of existing underground work. The Contractor shall repair or pay for all damage caused by his operations to all existing property, public or private, whether it is below or above ground, and shall settle in total cost all damage suits which may arise as a result of his operations.

1.23 GUARANTEE: This Contractor shall guarantee to Owner, all work performed under this contract to be free from defects in workmanship and materials for a period of one year from date of final acceptance by Architect and Owner. Any defects arising during this period will be promptly remedied by the Contractor without cost to the Owner. Compressors shall have a five (5) year warranty.

PART 2 - NOT APPLICABLE

PART 3 - NOT APPLICABLE

END OF SECTION

SECTION 23 07 00

INSULATION OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Section 23 01 00 - Mechanical General Requirements, with modifications and additions specified herein, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

A. Piping Insulation, Jackets, and Accessories.

B. Equipment Insulation and Covering.

C. Ductwork Insulation, Jackets and Lining.

1.3 QUALITY ASSURANCE:

A. Applicator: A company specializing in insulation application with three years minimum experience.

1.4 SUBMITTALS:

A. Submit product data under the provisions Section 23 01 00.

B. Include product description, list of materials and thickness for each service, equipment and location.

C. Submit manufacturer's installation instructions.

1.5 MANUFACTURER'S STAMP OR LABEL:

A. Every package of insulation, jackets, cement, adhesives, and coatings delivered to the project site must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material.

1.6 FLAME SPREAD AND SMOKE DEVELOPED RATINGS:

A. In accordance with NFPA 255, ASTM E 84, or UL 723, the materials shall have a flame - spread rating of not more than 25 and a smoke - developed rating of not more than 50.

B. Materials Tests: UL label or satisfactory certified test report from a testing laboratory will be required to indicate that the fire hazard ratings for the materials proposed for use do not exceed those specified. Test factory-applied materials as assembled. Field-applied materials may be tested individually. Flame-proofing treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.

C. Materials Exempt From Fire-Resistant Rating: Nylon anchors and PVC fitting covers.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS INSULATION:

A. Piping systems requiring insulation, types of insulation required, and insulation thickness

shall be as listed in Tables I and II herein. Insulate all fittings, flanges, and valves with factory premolded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Use factory premolded, precut, or field-fabricated insulation of the same thickness and conductivity as used on adjacent piping. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling.

B. Pipe Insulation:

1. Glass Fiber Insulation: ANSI/ASTM C547; `K' value of .24 at 75 degrees F.; noncombustible.

2. Flexible Unicellular Insulation: ASTM C 534. Adhesive shall be as recommended by the insulation manufacturer and applied in accordance with the manufacturer's published instructions.

C. Pipe Insulation Finishes:

1. All-Purpose Jacket: Except calcium silicate and unicellular insulation, provide a factory applied all-purpose jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting without sizing. Allow a maximum water vapor permeance of 0.05 perm per ASTM E 96, a puncture resistance of not less than 50 Beach units, and a minimum tensile strength of 35 pounds force per inch of width in accordance with ASTM D 828.

2. Vapor Barrier Materials: Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Resistant to flame, moisture penetration, and mold growth. Provide vapor-barrier materials on pipe as required in Table I.

2.2 DUCTS AND PLENUMS (HVAC) INSULATION:

A. Duct Insulation in Concealed Spaces: Insulation shall be blanket type flexible mineral fiber conforming to ASTM C 553, Type I, Class B-3, 1.0 pounds per cubic foot nominal, and 2.0 inches thick. Flexible insulation shall be used in concealed spaces only.

B. Duct Insulation Exposed in Mechanical Rooms: Insulation shall be mineral fiber board per ASTM C 612, Class 2, 6 pounds per cubic foot average density, one-inch thick.

C. Acoustically Lined Ducts: Ductwork indicated or specified in Section 23 30 00, Air Distribution, to be acoustically lined shall not be insulated.

D. Duct Insulation Finishes:

1. All-Purpose Jacket: Provide a factory applied all-purpose jacket with integral vapor barrier as required by the services. Provide jackets in exposed locations in equipment rooms with a white surface suitable for field painting without sizing.

2. Vapor Barrier Material: Scrim foil facing. Materials shall be resistant to flame, moisture penetration, and shall not support mold growth. Provide vapor barrier on all HVAC duct insulation. All-purpose jacket shall have a maximum water vapor permeance of 0.05 perm per ASTM E 96; a puncture resistance of not less than 50 Beach units; and a tensile strength of not less than 35 pounds-force per inch width in accordance with ASTM D 828.

2.3 ADHESIVE, SEALANTS, AND COATING COMPOUND:

A. Adhesive for Securing Insulation to Metal Surfaces and Vapor Barrier Lap Adhesive: ASTM C 916, Type I, (and adhesive in which the vehicle is nonflammable in the liquid state and which will pass the burning test).

B. Mineral Fiber Insulation Cement: ASTM C 195, thermal conductivity 0.85 maximum at 200 degrees F. mean when tested per ASTM C 177.

C. Vapor Barrier Coatings: Manufacturer's recommendation for indoor on surface temperature of 60 degrees and above, color white.

D. Flexible Unicellular Insulation Adhesive: Compatible with the Insulation.

E. Finishing Cement: ASTM C 449.

2.4 ACCESSORIES:

A. Staples: ASTM A 167, Type 304 or 316 stainless steel, outside-clinch type.

B. Insulation Bands: 3/4-inch wide: 0.20-inch aluminum.

C. Glass Cloth and Tape: Tape shall be 4-inch wide rolls, shall be 405 ounces per square yard. Open weave glass membrane may be used in lieu of glass cloth.

D. Wire: Soft annealed stainless steel, 0.047-inch nominal diameter.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Do not insulate materials until all system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and dried. Insulate return ducts, outside air intakes and supply ducts to the room outlets, exhaust ducts, flexible run outs, plenums, casings, mixing boxes, filter boxes, coils, fans, and the portion of air terminals not in the conditioned spaces. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handle, safety relief, etc. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Keep insulation dry during the application of any finish. Bevel and seal the edges of exposed insulation. Unless otherwise indicated, do not insulate the following:

1. Factory pre-insulated flexible ductwork.

2. Factory insulated ductwork, plenums, casing, mixing boxes, and filter boxes.

3. Vertical portion of interior roof drain pipelines, chrome plated pipes, and fire protection pipes.

4. Vibration isolating connections.

5. Adjacent insulation.

6. ASME stamps.

7. Equipment name plates.

8. Access plates in fan housing.

3.2 PIPING INSULATION:

A. General: Insulation shall be continuous through sleeves, wall and ceiling openings. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Bevel and seal the edges of exposed insulation.

B. Glass Fiber Pipe Insulation: Place sections of glass fiber pipe insulation around the pipe and joints tightly butted into place. Secure jacket with fire resistant adhesive or factory applied self-sealing lap. Cover circumferential joints with butt strips, not less than 3-inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. When a vapor barrier jacket is required, as indicated in TABLE I, or on the ends of section of insulation that butt against flanges, unions, valves, and fittings, and joints, use a vapor-barrier coating. Apply this vapor barrier coating at all longitudinal and circumferential laps. At penetrations by pressure gauges and thermometers, fill the voids with the vapor barrier coating. Seal with a brush coat of the same coating.

C. Flexible Unicellular Insulation: Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheet-metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of vinyl lacquer finish to flexible unicellular insulation in outside locations.

D. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP-58, Type 40 galvanized steel shields or MSS SP-58, Type 39 protection saddles conforming to MSS SP-69. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Vapor seal insulation around anchors. Insulation inserts shall be of calcium silicate, cellular glass (minimum 8 pcf), molded glass fiber (minimum 8 pcf), or other approved material of the same thickness as adjacent insulation. Inserts shall have sufficient compressive strength to support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Insulation inserts shall cover the bottom half of the pipe circumference 180 degrees and be not less in length than the protection shield. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Where protection saddles are used, fill all voids with the same insulation material as used on the adjacent pipe

E. Sleeves: Where penetrating interior walls, extend a metal jacket 2 inches out on either side of the wall and secure on each end with a band. Where penetrating floors, extend a metal jacket from a point below the back-up material to a point 10 inches above the floor with one band at the floor and one not more than one inch from end of metal jacket. Where penetrating exterior walls, extend the metal jackets through the sleeve to a point 2-inches beyond the interior surface of the wall.

F. Flanges, Unions, Valves and Fittings Insulation for Hot Piping: Factory fabricated removable and reusable insulation covers may be used. For domestic hot water, heating hot water, A/C condensate drains, steam and condensate return systems; exposed hot water piping and drains in handicap areas, place factory premolded, precut

or field-fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. Elbows insulated using segments shall have not less than three segments per elbow. Place and joint the segments with manufacturer's recommended water vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Upon completion of installation of insulation, apply two coats of lagging adhesive with glass tape embedded between coats. Where unions are indicated not to be insulated, taper the insulation to the union at a 45 degree angle. Coat the insulation and all-purpose jacket with two coats lagging adhesive and with glass tape embedded between coats. Factory pre-mold one-piece PVC fitting covers may be used in lieu of two coats of adhesive with tape embedded between coats. Factory premolded field-fabricated segment or blanket insert insulation shall be used under the fitting covers. Install factory premolded one-piece PVC fitting covers over the insulation and secure by stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers.

G. Flanges, Unions, Valves, Anchors, Fittings for Cold Piping: Factory-fabricated removable and reusable insulation covers may be used. For piping insulation, domestic cold water, refrigerant suction, drinking fountain drain piping to sewer tie-in, and exposed lavatory drains, coat pipe insulation ends with vapor barrier coating not more than six inches from each flange, union, valve, anchor or fitting. Place insulation of the same thickness and conductivity as the adjoining pipe insulation (either premolded or segmented) around the item, butting the adjoining pipe insulation. Elbows insulated using segments shall not have less than 3 segments per elbow. Apply two coats of vapor barrier coating with glass tape embedded between coats. Overlap tape seams one inch. Extend the coating out onto the adjoining pipe insulation 2 inches. Seal the insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to the pipe for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface. At the option of the Contractor, premolded, one-piece polyvinyl chloride (PVC) fitting covers may be used in lieu of the embedded glass tape. Factory premolded insulation or filed-fabricated insulation segments shall be used under the fitting covers. Secure the covers with adhesive and vapor barrier tape, or with tacks made for securing PVC covers. Then coat all tape seams and tacks with vapor barrier coating.

3.3 DUCTS AND PLENUMS (HVAC) INSULATION:

A. General: Insulate return ducts, outside air intakes, supply ducts to the room outlets, exhaust ducts, flexible run outs, plenums, casings, mixing boxes, filter boxes, coils fans, and the portion of air terminals not in the conditioned spaces. Insulation shall be continuous through sleeves, wall and ceiling openings. Extend all surface finishes to protect all surfaces, ends, and raw edges of insulation. Provide a moisture and vapor seal where insulation terminates against metal hangers, anchors and other projections through the insulation on surfaces for which a vapor seal is specified. Bevel and seal the edges of exposed insulation.

B. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Cut off protruding ends of pins, after clips are sealed with coating compound.

C. Flexible Blanket Insulation: Apply insulation with all joints tightly butted. Secure insulation to ductwork with adhesive in 6-inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. For ductwork over 24-inches on horizontal duct runs, provide pins, washers and clips. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation will not be permitted. Cut off protruding ends of pins after clips are secured and sealed with coating compound. Vapor seal all joints and staple.

D. Insulation Finishes and Joint Sealing: Fill all breaks, punctures, and voids with vapor barrier coating compound. Vapor seal all joints by embedding a single layer of 3-inch wide open weave glass membrane, 20 by 20 mesh maximum size between two 1/16-inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1-1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in the insulation with vapor barrier coating. Brush a coat of vapor barrier coating on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcing, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over the projection.

E. Access Plates and Doors: On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, provide insulation-filled hollow steel panels and doors for access openings. Bevel insulation around access plates and doors.

TABLE 1 INSULATION MATERIAL FOR PIPING					
SERVICE	MATERIAL	SPECIFICATION	TYPE	CLASS	VAPOR BARRIER REQUIRED
Refrigerant Suction	Flexible Unicellular	ASTM C 547	I or II	1	No
Domestic Hot Water	Mineral Fiber	ASTM C 547		1	No
Domestic Cold Water	Mineral Fiber	ASTM C 547		1	Yes
A/C Condensate Drain	Flexible Unicellular	ASTM C 534	I or II		No
Drinking Fountain Drain	Flexible Unicellular	ASTM C 534	I or II		No
Exposed Domestic Hot Water Piping & Drains to Areas for Handicapped Personnel	Flexible Unicellular	ASTM C 534	I or II		No
Exterior Backflow Preventer and Exposed Water Piping	Flexible Unicellular	ASTM C 534	I or II		Yes

TABLE 2

INSULATION SIZES FOR PIPING

SERVICE	MATERIAL	1/4" - 1-1/4"	1-1/2" - 3"	4" - UP
Refrigerant Suction	Flexible Unicellular	¾"	¾"	¾"
Domestic Hot Water	Mineral Fiber	1"	1"	1/2"
Domestic Cold Water	Mineral Fiber	½"	½"	½"
A/C Condensate Drain	Flexible Unicellular	½"	½"	½"
Drinking Fountain Drain	Flexible Unicellular	½"	½"	½"
Exposed Domestic Hot Water Piping & Drains to Areas for Handicapped Personnel	Flexible Unicellular	½"	½"	½"
Exterior Backflow Preventer and Exposed Water Piping	Flexible Unicellular	¾"	¾"	¾"

END OF SECTION

SECTION 23 20 00

HEATING AND AIR CONDITIONING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Section 23 01 00 - Mechanical General Requirements, with modifications and additions specified herein, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

A. Refrigerant Piping

B. Drain, Vent, and Overflow Piping.

1.3 SUBMITTALS:

A. Submit product data and shop drawings under provisions of Section 23 01 00.

B. Submit certification of pipe conformance to Specification.

C. Submit well installers qualifications.

1.4 Quality Assurance

A. Welders' Certification: In conformance with AWS D1.1.

B. For each product, provide components by same manufacturer throughout.

PART 2 - PRODUCTS

2.1 BASIC MATERIALS:

A. Refer to Section 22 05 00, BASIC MATERIALS AND METHODS, for basic piping materials.

B. General: All piping in conjunction with the heating and air conditioning system shall be complete as indicated on the drawings or as required for the proper operation of the system.

2.2 REFRIGERANT PIPING:

A. Hard Drawn:

1. Tubing: Type ACR hard drawn conforming to ASTM B 280.

2. Fittings: Wrought copper fittings conforming to ANSI B16.22.

3. Joints: Silver brazed joints conforming to ANSI A5.8.

B. Soft Drawn (Accepted Up To 3ft Maximum Length):

1. Tubing: Type K copper tubing conforming to ASTM B88

2. Fittings/Joints: Flared tube end with compression type fittings conforming to ASME/ANSI B16.26.

C. Sight Glass: A combination moisture and liquid indicator, double port type, UL listed. The indicator shall have a glass port for complete view of the refrigerant flow and moisture sensitive indicator of the type that changes color. Sight glass shall be equal to Sporlan "See-All".

D. Driers: Permanent type liquid line dehydrator with inlet and outlet shut-off valves. Driers shall be equal to Sporlan "Catch-All".

E. Expansion Valves: The valves shall be of the stainless steel diaphragm type with external equalization and external super-heat adjustment set for 10°F super-heat.

F. Shut-Off-Valves: Manual valves shall be for refrigeration service with back seating construction and cap seals. Valves shall be Mueller Brass or approved equal.

2.3 DRAIN, VENT, AND OVERFLOW PIPING: Materials: Schedule 40 PVC or copper tubing, Type L, conforming to ASTM B 88 with cast-brass or wrought-copper sweat joint fittings. Drains at air handling units shall be provided with water seals, depth equal to the total static pressure of the blower, constructed of two tees and an appropriate U-bend with open end of each tee plugged. Pipe and equipment drains with valves shall provide complete draining of all systems. Pipe to nearest open-sight drain, floor drain, wet vent, or as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Piping shall comply with the general piping installation specified in Section 22 05 00, Basic Materials and Methods.

B. Install specialties in accordance with manufacturer's instructions to permit intended performance.

C. Support tanks inside building from building structure.

D. Provide relief and safety valves on all pressure tanks, make up assemblies, heat exchangers, and expansion tanks. Select relief valves above operating pressure. Pipe to nearest floor drain or safe exterior location.

E. Dry refrigerant systems per manufacturers direction. Purge all systems with inert gas similar to nitrogen prior to pulling vacuum and charging system.

END OF SECTION

SECTION 23 30 00

AIR DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Section 23 01 00 - Mechanical General Requirements, with modifications and additions specified herein, apply to the work specified in this Section.

1.2 SECTION INCLUDES:

A. Ductwork and Ductwork Accessories.

B. Grilles and Registers

C. Louvers & Block Vents.

1.3 SUBMITTALS:

A. Submit product data and shop drawings under provisions of Section 23 01 00.

1.4 REGULATORY REQUIREMENTS:

A. Construct Ductwork to recommendations in SMACNA Duct Construction Manual, and to the requirements of NFPA 90A.

PART 2 - PRODUCTS

2.1 DUCTW0RK MATERIALS:

A. Sheet Steel for Ducts: ASTM A 525 and ASTM A 527 galvanized sheet steel, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A 90.

B. Galvanized Steel Hot Dipped After Fabrication: ASTM A 123.

C. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

2.2 LOW PRESSURE DUCTS: All ducts except high pressure supply ducts from the central air handling unit serving variable volume terminal units.

A. General: Construction, metal gauge, and reinforcements shall conform to NFPA 90A and SMACNA LPDCS. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Air leakage shall be less than 5 percent of system capacity. Construct ductwork of galvanized steel.

B. Curved Elbows: Make curved elbows with a centerline radius not less than 1-1/2 times the width or diameter of the duct.

C. Joints and Laps: Make substantially airtight. Make laps at joints in the direction of air flow. Button-punch or bolt-connection in standing seams shall be spaced at fixed

centers not greater than 6 inches. "Button Punch Snap-Lock" may be used instead of Pittsburgh Lock.

2.3 FLEXIBLE DUCT

A. Characteristics of flexible duct:

1. Approved as UL-I81 Class 1 air duct.

2. Flame spread rating less than 25 and smoke developed rating less than 50.

3. Rated for 10" wg. positive pressure, 4" wg. negative pressure, and 4000 fpm air velocity.

4. Tear and puncture resistant reinforced duct fabric mechanically locked together with a corrosive resistant galvanized steel helix.

5. Insulated with minimum l/2"thick fiberglass insulation with vapor barrier jacket.

B. Seal off the insulation jacket at its ends and at joints with mastic, equal to Hardcast Duct-Seal 321. Sealants, mastics used for flexible duct connectors shall be listed and labeled in accordance with UL-18lB. Replace flexible duct if jacket is punctured.

C. Flexible duct is NOT to be used for run outs where it must pass through walls or through smoke or fire partitions. Flexible duct is not to be used in exposed application. Flexible duct lengths shall not exceed 6 feet at each connection.

D. No bends shall be made in flexible duct with the center line radius less than one and one-half duct diameter and only one bend may occur per 6 foot length of duct material.

2.4 DUCTWORK ACCESSORIES:

A. DAMPERS

1. Automatic Control Dampers: All automatic control dampers to be furnished by Control Subcontractor and installed by this Contractor (except unit mounted dampers).

a) Automatic control dampers to be low-leak, galvanized steel or aluminum construction parallel blade type, Ruskin Model CD36 or approved equal.

b) Dampers to be complete with minimum 4" deep, 16 gage hat-shaped channel frame, minimum 16 gage blades on maximum 6" centers, 1/2" diameter shafts, and corrosion resistant bearings.

c) Dampers to have extruded vinyl blade seals and stainless steel or aluminum flexible metal compression type jamb seals to limit leakage to a maximum of 1/2% (maximum of 5.4 cfm/sq. ft. leakage for 48" x 48" size damper) when tested in accordance with AMCA Standard 500,

d) Motor actuator to be oil immersed gear train, 120-volt line voltage type with spring return. to closed position on power interruption. Provide Honeywell Model M445/845 or approved equal complete with damper linkages.

2. Manual Volume Dampers (MVD): Manual volume dampers to be hand-operated type dampers constructed of galvanized steel, minimum 22 gauge for duct widths 18" and less, minimum 16 gauge for duct widths greater than 18". Dampers for ducts to 12"

height and 12" diameter to be single blade carried on a 3/8" round steel rod mounted inside of duct without frame and fitted with locking type quadrant and brass end bearing plate accurately drilled and secured to duct. Dampers for ducts greater than 12" height to be multiblade type, 12" maximum blade width up to 30" blade length and 10" maximum blade width over 30" blade length. Blades to be mounted on frame with brass sleeve bearings interconnected for operation from one locking type hand quadrant. Round pivot rods to have section faced flat to receive locking setscrew in locking quadrant. Refer to SMACNA manual Figures 2-14 and 2-15.

B. FLEXIBLE CONNECTORS: Install UL listed flexible duct connectors between duct and fan/equipment connections. Flexible duct connectors to be made of 28 ounce, heavy glass fabric double coated with neoprene. Seal duct connection with mastic equal to Hardcast Duct-Seal 321. Sealants, mastics used for flexible duct connectors shall be listed and labeled in accordance with UL-I8IB.

C. DUCT SLEEVES: Duct sleeves shall be provided for all ducts passing through floors, walls, ceilings, or roof and shall be installed by the contractor for this Section during the construction of the building. Sleeves Shall be wood, galvanized sheet steel, or other approved materials to meet the conditions encountered.

D. DUCT CLOSURE COLLAR: A collar constructed of galvanized sheet steel not less than 4-inches wide shall be provided on each side of floors, walls, partitions, and under ceilings at each duct sleeve except where grilles, registers, or diffusers are installed. Collar shall be installed and secured tight against the surfaces. Collars at fire and smoke dampers shall be 1-1/2-inch by 1-1/2-inch by 10-gauge steel angles as indicated in the SMACNA Guide.

E. TURNING VANES: Turning vanes shall consist of double thickness curved metal blades or vanes rigidly mounted in a runner, arranged so as to permit the air to make the abrupt turns without appreciable turbulence, shall be the manufacturer's standard products and shall be quiet and free from vibration when the system is in operation.

F. DUCT ACCESS DOORS

1. Duct access doors to be provided for access to all coils, fire, fire/smoke, and smoke dampers, automatic and backdraft dampers, duct smoke detectors, static pressure and air volume sensing devices, and other equipment installed in ducts and at other points indicated on drawings.

2. Access door construction and air tightness must be suitable for the duct pressure class used (low, medium, or high).

3. Access doors to be double-panel, galvanized steel construction with minimum 1" rigid insulation between panels. Access doors in exhaust duct and unlined return duct may be un-insulated single panel, galvanized steel construction. Doors to mount in rigid frame constructed of formed galvanized steel. Angle iron bracing to be used as required to provide rigid assembly. Doors to hinge on one side with door latch on opposite side.

4. Access doors in ductwork shall fully comply with Figure 2-10 and 2-11 of SMACNA manual. Casing access doors shall fully comply with Figure 6-11 and 612 0f SMACNA manual.

5. Doors to close against gasket seal.

2.5 Grilles, Registers, and Diffusers

A. Manufacturers: Price, Titus, Nailor, or approved equal.

B. SQUARE CEILING DIFFUSERS: Provide Titus TDC-AA or approved equal round or square neck, louvered face ceiling diffusers at all locations designated by schedule on drawings. Diffusers to be all aluminum construction each complete with opposed-blade volume damper. Frame to be flush mount for diffusers in "hard" ceilings and lay-in T-bar mount for diffusers in lay-in ceilings. Finish to be baked-on, off-white enamel.

C. SIDEWALL SUPPLY REGISTERS: Provide Titus 1700-07 or approved equal at locations indicated on drawings. Registers to be all aluminum construction complete with opposed-blade volume control, removable and rotating fixed horizontal blade core, and attached rear set of individually adjustable vertical blades. Finish to be baked-on, off-white enamel. Border to be curved, Titus Type C.

D. SIDEWALL RETURN REGISTERS: Provide Titus 1700 or approved equal at locations indicated on drawings. Registers to be all aluminum construction complete with opposed-blade volume control and removable and rotating fixed horizontal blade core. Finish to be baked-on, off-white enamel. Border to be curved, Titus Type C.

E. CEILING RETURN & EXHAUST REGISTERS: Provide Titus Model 50-F or approved equal at locations designated on drawings. Registers to be complete with 1/2" cube egg-crate aluminum grid, and opposed-blade volume damper. Finish to be baked-on, off-white enamel. Border to be flush mounted frame style.

2.6 AIR LOUVERS AND BLOCK VENTS:

A. Outside air stationary air louvers to be rain resistant, extruded aluminum construction, fixed drainable blade type as manufactured by Ruskin, Greenheck, or approved equal. Louvers to be constructed of minimum 0.081" thick frame and blades. Louver depth to be 5" with equal blade spacing. Blade construction to provide built-in rain stops. Provide 1/2" mesh expanded aluminum screen with removable frame mounted on inside face of louver. Design basis shall be Ruskin Model ELF-375X for rectangular louver. All air louvers shall be provided by DIV 15. Reference mechanical and architectural drawings. Color as selected by Architect.

B. Adjustable motor-operated louvers to be extruded aluminum construction, adjustable drainable blade type as manufactured by Ruskin, Greenheck, or approved equal. Louver to be constructed of minimum 0.081 11 thick frame and blades. Louver depth to be 6" with equal blade spacing. Finish shall be anodized with color selected by Architect. Provide 1/2" mesh expanded aluminum screen with removable frame mounted on inside face of louver. Louver to include extruded vinyl blade seals and stainless steel or aluminum flexible metal compression type jamb seals for low leakage. Motor actuator to be oil immersed gear train, l20-volt line voltage type with spring return to closed position on power interruption. Provide Honeywell Model M445-845 or approved equal complete with damper linkages.

C. BRICK VENTS: Brick vents to be constructed of heavy extruded aluminum frames and blades. Blades to be supported on vertical aluminum rods. Vent to include continuous

overhanging weather-guard visor at top of frame to prevent water from running down wall into face of vent. Vent to include continuous overhanging weatherguard sill at bottom of frame to drain water out and away from wall below. Bottom frame member to include integral water stop. Finish shall be primer, suitable for painting. Provide extruded aluminum bird screen mounted on inside face of vent.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Installation shall conform to NFPA and SMACNA. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors and dampers. Install ductwork accessories as indicated in accordance with the manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service.

B. Ductwork: Install airtight. When air distribution systems are operated, there shall be no chatter, vibration, or dust marks.

C. Duct Supports: Ducts shall be supported by not less than two 1-inch wide by 1/16-inch thick galvanized strap of sheet steel hangers located one on each side of duct, spaced not over 5-feet on centers for round ducts and not over 6-feet on centers for ducts up to 24-inches wide and not over 3-1/2-feet on centers for ducts over 24-inches wide. Support flexible ducts every 3 feet. Provide sway bracing. Anchor risers in the vertical run to allow ends of riser free vertical movement. Attach supports only to structural framing members and concrete slabs. Provide suitable metal intermediate framing where supports are required between structural framing members.

END OF SECTION