SECTION 23 0500

BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The General Conditions of the Contract, including Supplementary Conditions, General Requirements, and Division 1 apply to the work specified in DIVISION 23.

1.02 DESCRIPTION

A. Furnish and install utilities; heating, ventilating, and air conditioning systems; plumbing systems; fire protection systems; special systems; and other related mechanical work, all as indicated on the drawings and as specified herein.

B. Provide all necessary labor, tools, equipment, and materials to accomplish this work.

C. Pay all required Local, State or Federal fees necessary because of such work; obtain and bear all costs of permits required.

D. The drawings indicate the general run of all piping and ductwork, the location of equipment, and the extent of work involved. Accessories required for the proper performance of the specified systems shall be furnished and installed as indicated on the drawings. All drawings are diagrammatic in nature and do not necessarily show all piping or duct fittings and offsets. In submitting a proposal for the work, the contractor agrees he has reviewed the plans and will furnish complete and operable systems with all necessary fittings and offsets without additional charges for such extra fittings or offsets as may be required.

1.03 CODES AND STANDARDS

A. The following codes and standards are hereby made a part of these specifications. Work and material furnished under these specifications shall be constructed and designed in accordance with the applicable requirements of these codes and standards.

B. Whenever a particular standard is referenced, it is the latest edition of that standard to which is referred. In addition to the following list, comply with all state and municipal building and safety laws, ordinances and regulations relating to public health and safety.

REFERENCE ABBREVIATION		NAME AND ADDRESS
1.	AABA	Associated Air Balance Council 1000 Vermont Avenue, NW Washington, D.C. 20005 USA
2.	ADA	Americans with Disabilities Act
3.	AFBMA	Antifriction Bearing Manufacturers Association 60 East 42nd Street New York, NY 10017 USA
4.	AGA	American Gas Association 1515 Wilson Boulevard Arlington, VA 22209 USA
5.	AISI	American Iron and Steel Institute 150 East 42nd Street New York, NY 10017 USA
6.	AMCA	Air Moving and Conditioning Assoc. 30 West University Drive Arlington Heights, IL 60004 USA
7.	ANSI	American National Standards Institute, Inc. 1430 Broadway New York, NY 10018 USA
8.	ARI	Air Conditioning and Refrigeration Institute 4100 North Fairfax Drive, Suite 200 Arlington, VA 22203 USA
9.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329 USA
10.	ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017 USA

11.	**ASTM**	American Society for Testing Materials 1916 Race Street Philadelphia, PA 19103 USA
12.	**AWS**	American Welding Society 2501 N.W. 7th Street Miami, FL 33125 USA
13.	**AWWA**	American Water Works Association 6666 West Quincy Avenue Denver, CO 80235 USA
14.	**CISPI**	Cast Iron Soil Pipe Institute 2020 K Street, NW Washington, D.C. 20006 USA
15.	**CTI**	Cooling Tower Institute 9030 IH-45 North Houston, TX 77037 USA
16.	**EEI**	Edison Electric Institute 90 Park Avenue New York, NY 10016 USA
17.	**Fed. Spec.**	Federal Specifications and Standards Superintendent of Documents U.S. Government Printing Office Washington, D.C. 20402 USA
18.	**HEI**	Heat Exchange Institute 122 East 42nd Street New York, NY 10017 USA
19.	**IEEE**	Institute of Electrical and Electronics Engineers 345 East 47th Street New York. NY 10017 USA
20.	**NEC**	National Electrical Code by NFPA
21.	**NEMA**	National Electrical Manufacturers Association 2101 L Street, NW Washington, D.C. 20037 USA

22. NFPA National Fire Protection Assoc.
Batterymarch Park
Quincy, MA 02269 USA

23. OSHA Occupational Safety and Health Act
c/o Department of Labor
200 Construction Avenue, NW
Washington D.C. 20210 USA

24. SMACNA Sheet Metal and Air Conditioning
Contractors National Association
8224 Old Courthouse Road
Tysons Corner, Vienna, VA 22180 USA

25. TEMA Tubular Exchanger Manufacturer's
Association
331 Madison Avenue
New York, NY 100717 USA

26. TIMA Thermal Insulation Manufacturer's Association
7 Kirby Plaza
Mt. Kisco, NY 10549 USA

27. UL Underwriters' Laboratories
333 Pfingston Road
Northbrook, IL 60062 USA

1.04 SHOP DRAWINGS AND SUBMITTED DATA

A. Submit in accordance with these specifications. A minimum of six (6) copies are required, unless specified otherwise. No work indicated on any shop drawing shall be started until such drawings have been reviewed and approved by the Owner and Engineer.

B. Submittal data shall be referenced to section and paragraph numbers of the specifications and to fixture and equipment numbers listed or scheduled, and shall be assembled in numerical order of the specification paragraphs. Submittals shall be bound in sets between cover and all sets within a section shall be identical. Identification marks on submittals shall be made in black ink. Each section of the submittal shall be divided by extra heavy dividers with index tabs. Each specification section shall have its own divider.

C. Where equipment manufacturers named as equivalent, or acceptable equal, are proposed for use by the Contractor, he shall be responsible to coordinate the change with all trades affected.

D. Submit for approval 1/4 inch scale working drawings for equipment rooms, plan and section, showing all equipment, piping, and clearances required by codes or for service. Coordinate with DIVISION 26 and show electrical equipment and required clearances on same drawing. This drawing shall be based on equipment proposed for installation, whether specified equipment or not.

E. Submit the following shop drawings for approval in accordance with these specifications.

Valves and Fittings.

Piping Specialties.

Vibration Isolation.

Testing and Balancing Documents (at completion).

Motors and starters.

Insulation Materials.

Piping Materials.

Plumbing Fixtures.

Equipment.

Ductwork Shop Drawings.

Sheet Metal Specialties.

Temperature Control Diagrams and Equipment.

Temperature Control Description of Operation.

Wiring Diagrams for Equipment Furnished on Job.

1.05 STRUCTURAL CONDITIONS

A. These specifications and the drawings accompanying same are intended to cover an installation which will not interfere with the structural design of the building, which will fit into the several available spaces, and which will insure a complete and satisfactory system.

B. The Contractor shall carefully examine the plans for all branches of the work and shall be responsible for the proper fitting of his material and apparatus into the building.

C. Should the particular equipment which any bidder proposes to install require other space conditions than those shown on the drawings, he shall arrange for such space with the Engineer before submitting his bid. Should changes become necessary on account of failure to comply with this clause, the Contractor shall make necessary changes at his (the Contractor's) own expense.

D. The Contractor shall submit working scale drawings of all his apparatus and equipment which in any way varies from these specifications and plans, which shall be checked by the Engineer and approved before the work is started, and any interferences with the structural conditions shall be corrected by the Contractor before the work proceeds.

1.06 ACCESS PANELS

A. Furnish access panels where indicated, or wherever required for accessibility to hand controlling valves, dampers, etc., wherever these valves, controllers, etc., may be concealed in walls, furred in areas, etc.

B. Furnish panels that will suit the construction and treatment of the areas where access panels are required. Type shall be appropriate for wall in which they occur - flush mounted panel, steel construction, factory primed, key operated, with inserts and anchorage devices, and fire rated in walls with 1-1/2 hour rating or greater. All panels shall be of similar design and material and of sufficient size to facilitate operation and maintenance of the valves, or other actuating device enclosed.

C. Furnish shop drawings of access panels for the approval of the Owner and Engineer before fabrication.

1.07 EQUIPMENT IDENTIFICATION

A. Furnish laminated phenolic engraved black plastic nameplates attached with screws or permanent adhesive to each piece of equipment identified by name or number on the drawings. Nameplate shall have condensed gothic letters no less than 1" high and be indented white on black background.

1.08 EQUIPMENT AND CONNECTIONS

A. All apparatus, equipment, devices and appliances which are indicated to have pipe connections or electrical rough-in shall be so equipped. Mechanical connections shall be valved or trapped. Electrical connections to have JB with cover or disconnect as shown on drawings.

1.09 CLEANING EQUIPMENT AND MATERIALS

A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care shall be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors and similar equipment.

B. All fixtures, piping, finished surfaces and equipment shall have all grease, adhesive labels and foreign materials removed.

C. All piping shall be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves and similar items shall be thoroughly cleaned. Owner and Engineer shall be given the option to witness the flushing process or to observe the cleaned system before it is filled. Remove, thoroughly clean, and reinstall, all liquid strainer screens after the system has been in operation ten (10) days.

D. Air, oil, and gas piping shall be blown out with clean compressed air or inert gas.

E. When connections are made to existing systems, the Contractor shall do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work. If drain down of existing systems is required to make equipment or piping connections, the Contractor shall be required to perform this drain down at his own expense.

1.10 USE OF ALLOCATED SPACES

A. Consult the drawings for spaces allocated to piping, conduits, ducts, etc. The mechanical plans are essentially diagrammatic indicating approximate location of system components. All trades must consult with one another to the end that the available space is best utilized by all. Due consideration shall be given to the pipe, duct and conduit locations so that the accessibility of all the installed lines from access doors, hand holes, etc., is preserved; and space shall not be unnecessarily used by any contractor to save fittings, offsets, etc., whereby any interference results with other trades. Each contractor shall consult the Owner and Engineer for space requirements for his material and equipment whenever same is not clearly indicated on the plans or otherwise provided for. Failure to obtain clearance will leave the contractor liable for removal and relocation of the affected material and equipment.

1.11 OPENINGS - CUTTING REPAIRING

A. Sleeves shall be furnished, accurately located and installed in forms before pouring of concrete. This Contractor shall pay all additional cost for cutting of holes as the result of the incorrect location of sleeves.

B. All holes through existing concrete shall be either core drill or saw cut. All holes required shall have the approval of the Owner and Engineer prior to cutting or drilling.

1.12 CONDITIONS OF FINAL INSPECTION

A. The following items must be accomplished and delivered to the Owner and Engineer before request for final inspection and final payment will be acknowledged:

1. Operating and Maintenance Instruction: Furnish three (3) complete sets of Operating and Maintenance Instructions for mechanical systems and all equipment furnished under this contract.

2. Furnish start-up, shut-down, and operating instruction for mechanical systems. Instructions to be in laminated plastic cover.

3. Deliver complete typed test and balance information.

4. Deliver all mechanical inspection receipts.

5. A minimum of seven (7) days has been logged on each individual major piece of equipment.

6. All work and materials as called for by the contract must be complete.

7. All filters shall be new; all equipment shall be lubricated.

8. Furnish original copies of the various warranties for mechanical and electrical equipment.

1.13 RECORD DRAWINGS AND MANUALS

A. Job record drawings showing accurate locations of all ducts and piping shall be kept up-to-date. Any changes of location in ducts and piping shall be recorded on the job record drawings. Master copy shall be kept on the job. Transmit job record drawings to the Owner and Engineer before final payment.

B. Operation and Maintenance manuals shall contain manufacturer's literature, cut sheets, performance data, and capacities for all equipment and systems. All items shall be numbered as per plans and specifications with appropriate job I.D. equipment number. Starting, operation, and maintenance data for all equipment shall be included. Bind in 3-ring hard back binder.

1.14 TEMPORARY CONDITIONING

A. Equipment furnished as a part of this contract shall not be used for temporary heating or cooling during sheetrock sanding. Temporary heating or cooling shall be designed and applied in a safe manner and shall be compatible with the general conditions of the contract. Where air handlers must be run during construction, the Contractor shall provide temporary filters including 2" cotton pleated media filters in unit and 2" cotton pleated pre-filter upstream of unit filter over all return air openings. Filters shall be provided under Division 23.

1.15 PRODUCT STORAGE AND HANDLING

A. Items specified herein shall be delivered to site properly crated and identified with mark number used on this project and with manufacturer's name and number. Protect all items from physical and weather damage. Rusted or damaged parts of items specified under this section will be cause for rejection.

B. Submit manufacturer's data on materials specified herein.

1.16 EXCAVATION AND BACKFILL

A. Provide excavation and backfill for installation of piping or equipment in accordance with these specifications. All trenches under paved areas or inside of building shall be backfilled with sand for a minimum of 6 inches over top of pipe, compacted by water flooding, and tamped to secure a stable base. Remainder of backfill in paved areas shall be in a similar manner unless specified otherwise.

1.17 INTERRUPTION OF SERVICES

A. While work is in progress, except for designated short intervals during which connections are to be made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

PART 2 - PRODUCTS

2.01 GENERAL

A. Meet all requirements of the materials and methods specified herein and in subsequent sections. All manufacturers of items furnished for this project shall be firms with not less than three (3) years successful production and operation experience, unless specified otherwise.

PART 3 - EXECUTION

3.01 GENERAL

A. Install all products specified in this section and subsequent sections in accordance with manufacturer's recommendations, in accordance with good and accepted engineering practice, and as specified herein.

B. Furnish and install safety guards, sheet metal or expanded metal, around all pieces of rotating equipment, fans, belts, shafts, etc., in accordance with requirements of governmental authorities.

C. This Contractor shall be responsible for furnishing and setting sleeves for all piping through concrete or masonry not otherwise provided for. Special attention is called to the cutting of all necessary holes in the walls, floors, or ceilings for running of ducts, pipes, etc.; should this become necessary, it shall be subject to approval of the Owner and Engineer.

D. Provide housekeeping pads under floor mounted equipment. This Contractor shall coordinate the location and size of concrete pads required for the support of equipment furnished under this division. Furnish and install all required anchor bolts in concrete bases. Bases shall extend a minimum of 3 inches beyond the equipment base, unless noted otherwise. Grout pump bases. Trowel smooth. Install anchor bolts in pipe sleeves.

E. All steel supports shall be made up of steel channels, angles, and pipe stands, of the proper size and connected by welding.

3.02 SYSTEM COMMISSIONING

A. As part of the initial startup, testing and checkout of the systems, the Division 23 contractor shall review all aspects of system operation and performance. Correct all deficiencies which are discovered. The contractor shall ensure all systems and equipment are clean. Wipe all equipment down with a wet cloth. Vacuum out the interior of equipment. The contractor shall develop punch lists of incomplete or incorrect work during a walk-through with his subcontractors and ensure that all work is corrected prior to requesting final observation.

B. As part of the balancing operation, the prime Division 23 contractor shall furnish to the test and balance subcontractor all sheaves, dampers, etc. required for proper system balance.

3.03 CLOSEOUT

A. Provide neatly arranged Operations and Maintenance Manuals before request for final payment. O & M manuals shall contain all maintenance and operation

data necessary for the equipment and systems installed. Include list of recommended spare parts. Manuals shall be in three-ring hardback binder. Provide three (3) copies.

B. Submit accurate job record drawings before request for final payment.

SECTION 23 0523

VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide and install valves where indicated on the drawings, or as required to make the systems complete per equipment specifications and manufacturer's recommendations. Valves shall be of the type indicated on the plans.

B. All valves shall be full line size unless otherwise noted. Valves 2" and smaller shall be screwed type; 2-1/2" and larger shall have flanged end connections, unless noted otherwise.

C. All branch water lines shall have isolation valves installed whether indicated on the drawings or not.

D. Valves shall be provided on inlet and outlet connections to all equipment. Exact locations shall be coordinated on the job site.

E. Valves shall be provided at inlet and/or outlet of all fixtures and apparatus.

F. Each specific type of valve used on the project shall be from a single manufacturer.

G. Provide necessary drain valves at low points in systems to drain all piping systems.

H. Further specific requirements for valves may be found in Section - PIPING SYSTEMS or sections relating thereto.

PART 2 - PRODUCTS

2.01 VALVES

A. Furnish and install all valves that are indicated on the plans or that may be necessary to make the system complete. Valves shall be same manufacture throughout job insofar as possible. Unless otherwise noted, valves shall be 150 pound pressure class.

B. On the top of all supply risers and at all other places where air may be trapped in the hydronic piping, furnish and install a manual air vent. Where automatic air vents are specified or used at the Contractor's discretion, pipe relief to floor drains.

C. All gate and globe valves shall be designed for repacking under pressure when fully opened. Packing boxes shall have adequate depth to allow space for sufficient amounts of stem packing. Stem packing for all bronze and iron valves shall be braided teflon.

D. Malleable iron handwheels and gland followers shall be furnished on all bronze gate and globe valves. The pressure-temperature rating of valves shall not be less than the design criteria applicable to all components of the system.

E. Bronze valves rated for 150 psig saturated steam shall have pressure containing parts made of materials with physical properties of not less than ASTM Specification B-62. Bronze globe, angle, check and gate valves rated for 300 psig saturated steam shall have pressure containing parts made of materials conforming to ASTM Specification
B-6l.

F. Check valves in pump discharge lines shall be spring-loaded non-slam type, with globe style body constructed of cast iron or semi-steel with stainless steel spring and screws and bronze trim.

G. Bronze ball valves rated for 150 psig saturated steam shall have pressure containing parts with physical properties not less than ASTM Specification B-584. Ball valves shall be two-piece, full port equipped with blowout proof stems, stainless steel ball, and separate packing nut with adjustable stem packing. Packing shall be Buna-N, Teflon or Teflon impregnated. No forged yellow brass (more than 15% zinc) valves will be allowed.

H. Iron valves shall have pressure containing parts conforming to ASTM Specification A-126, Grade B. Wedge and seat ring material for iron valves shall conform to ASTM Specification B-62 for 125 psig rated valves and ASTM Specification B62/B584 for 250 psig rated valves. OS&Y gates which fasten the wedge to the stem by threads shall be secured by a silicon bronze pin. Valves in steam service shall be OS & Y type.

I. Plug valves shall be lubricated plug type with cylindrical plug, semi-steel construction, 200 W.O.G., rectangular port full pipe area design. Balance valves in water service shall have dial indicator, pointer, and memory stop. Each valve shall be wrench operated and be furnished with a wrench.

J. Lug body butterfly valve, 150 psig ANSI rating. Ductile or cast iron body through 12” size, aluminum bronze disc, 416 S.S. shaft, 3 shaft support bushings, EPDM seat fully covering inside of body and act as flange gaskets, designed for full open end pressure shutoff, all sizes 6" and larger to have gear operator with position indicator. Above 12” size, body shall be ductile iron.

K. Unless noted otherwise, balance valves in water service shall have globe style body rated at 175 psig W.P. for iron and 240 psig W.P. for bronze at 250F. Valves 2" and smaller shall have bronze bodies with threaded ends. Valves 2-1/2" and larger shall have iron bodies with flanged ends, ANSI Class 125/150. Each valve shall have two metering/test ports with internal check valves and protective caps. Valves shall be equipped with visual position readout and concealed memory stops.

L. Submittal data required for valves shall consist of manufacturer's name, size, figure number, detailed technical drawings and appropriate engineering information.

M. On lines made up of copper tube, size 3" and less, the following schedule for 150 pound valves shall prevail:

150 Pound Bronze:

	Crane	Nibco	Misc
RS Gate	431UB	T-134 (UB)	-
Globe	7TF	T-235-Y	-
Swing Check	137	T-433-Y	-
Ball (Up to 2")	-	T-585-70-66	Hammond 8303A Apollo 77C Watts B6080SS
Balance (Up to 2")	-	T-1710	-

N. On lines made up of carbon steel, the following schedule for 125/150 pound valves shall prevail:

125/150 Pound Bronze and Iron: (2" and smaller valves)

	Crane	Nibco	Misc
RS Gate (Water)	431UB	T-134 (UB)	-
RS Gate (Steam)	634E	T-174-A	-
Globe (Water)	7TF	T-235-Y	-
Globe (Steam)	382P	-	-
Swing Check	137	T-433-Y	-
Ball	-	T-585-70-66	Hammond 8303A

			Apollo 77C
Balance	-	T-1710	-
Non-Slam Check	-	-	Metraflex Series 700
Lubricated Plug	-	-	Resun D-125

125/150 Pound Iron: (2-1/2" and larger)

	Crane	Nibco	Misc
NRS Gate (Water)	461	F-619	-
OS&Y Gate (Steam)	465-½	F-617-0	-
OS&Y Globe	351	F-718-B	-
Swing Check	373	F-918-B	-
Ball	-	F-510	-
Butterfly	Crane Quartermaster	LD-2000	Centerline Series 200
Balance	-	F-737	-
Non-Slam Check	-	F-910-B	Metraflex Series 900
Lubricated Plug	-	-	Resun D-126

PART 3 - EXECUTION

3.01 INSTALLATION

A. All valves shall be installed in accessible locations. Provide 1" diameter brass tags with black indented valve numbers secured with figure eight hooks for all major valves. Provide typewritten list of these valves with size, description, and location in equipment room. See valve chart and label specification.

B. Valves shall be installed in a manner consistent with the best workmanship practices, shall be neat in appearance, and grouped so all parts are easily accessible.

C. All valves shall be installed with unions or flanges so as to be removable.

D. All valves which have stems of insufficient length to extend through insulation (e.g., ball valves) shall have extended stems to allow lever or wheel handle to operate smoothly and satisfactorily without interference with pipe insulation. The Contractor shall coordinate this during field installation and supply necessary number of extended stems.

SECTION 23 0553

PAINTING AND IDENTIFICATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. All finish painting shall be performed under the Painting Section of these specifications.

B. The protective painting of equipment and piping, etc., shall be performed under this section.

C. All equipment shall be delivered to job with a suitable factory finish. Damaged spots shall be refinished to present a neat and workmanlike appearance.

D. All piping exposed in mechanical and equipment rooms or in inhabitable spaces, or concealed in accessible pipe spaces, or in other accessible spaces shall be color coded.

E. Color coding shall be performed after finish painting has been completed. Color coding, stenciling, and identification shall be provided under DIVISION 23.

PART 2 - PRODUCTS

2.01 COATINGS

A. All underground and outdoor ferrous pipes shall be given a liberal coat of acid resisting paint having a bituminous base before back-filling.

2.02 PROTECTIVE PAINTING

A. Paint all natural gas piping exposed to weather with galvanized paint.

B. Paint and materials shall be equal to Pratt and Lambert. Use stenciled, painted letters and bands on piping for identification. Do not use tape or plastic bands.

PART 3 - EXECUTION

3.01 INSTALLATION

A. No nameplates on equipment shall be painted and suitable protection shall be given to same.

B. Color coding shall be as scheduled on plans. Bands to be on 20'-0" centers.

C. Arrows showing direction of flow shall be on the pipes at strategic points, and in general on each straight section of piping longer than 20'-0" and at each stencil label.

SECTION 23 0593

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all testing, adjusting, and balancing work required to achieve the satisfactory performance of the systems all in accordance with these specifications and applicable codes and standards.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all necessary calibrated equipment and qualified personnel to perform the required tests. The systems shall be complete and in full working order before balance work begins.

B. Air Balance.

1. Air balance shall be by a firm with at least ten years experience in this field. The firm shall be independent from the DIVISION 23 Contractor and shall not be a sheet metal sub-contractor.

C. Water Balance.

1. Water balance shall be by a firm with at least ten years experience in this field. The firm shall be independent from the DIVISION 23 contractor.

D. Balance contractor shall be AABC or NEBB licensed and certified with current certifications.

PART 3 - EXECUTION

3.01 TESTING - AIR SIDE

A. When the installations are completed, all equipment and ducts shall be cleaned of all debris. The control dampers, air control devices, units, etc., shall be adjusted and the whole system put in first class operating condition. Following this, the various systems shall be operated under actual load conditions for a period of one week, or more, for final adjustment and approval. This final test shall be made in the presence of the Owner's representative.

B. Furnish three (3) complete operating instructions for air conditioning system, heating systems and ventilation systems. Instructions shall be enclosed in laminated plastic covers, and shall be hung near equipment to which they apply.

3.02 TESTING - WATER SIDE

A. Before the piping of the various systems has been covered or furred in, hydrostatically test the systems to 125 psi, unless specified otherwise herein. Any and all leaks shall be repaired; caulking of pipe and fittings will not be permitted. Tests of all systems shall be for a 48 hour period and in the presence of the Engineer, Owner and Local Inspectors. After all leaks have been repaired and the work is acceptable to the Engineer and Owner, a second test of the entire system shall be made for 48 hours, with all equipment functioning as it will be after acceptance by the Owner. When this test is completed and accepted by the Owner and Engineer, the Contractor may install all insulation, and paint all equipment, as herein specified. The Owner's operators shall be made thoroughly acquainted with the functioning of the entire system and the various equipment during this testing period.

3.03 ADJUSTING AND BALANCING OF AIR CONDITIONING AND HEATING SYSTEMS - AIR SIDE

A. Air balance work shall be performed prior to other balance work, except where readings require otherwise. The Division 23 contractor shall furnish to the test and balance subcontractor all necessary sheaves, dampers, etc. for accomplishing the balance work. Prior to the request for final observation, the Contractor shall make the following tests and furnish a copy of the results to the Engineer for his approval:

1. Check the rotation of each piece of rotating equipment.

2. Check alignment of each piece of rotating equipment, including the alignment of V-belt drives, belt guards, couplings, etc.

3. Check the ampere input of each motor against the nameplate rating of that motor.

4. Check the heater coil in the starter against the size recommended for suitable protection by the starter manufacturer.

5. Check the speed of each belt driven piece of equipment against the manufacturer's recommendation as shown on shop drawings or certified performance curves.

6. Check the capacity of each fan from manufacturer's certified performance curves and speed data obtained on the job. Include copy of fan curve in

balance report. Mark design conditions and final balance conditions on curve.

7. Check the capacity of each fan by using an anemometer traverse across the coils or filters where physically possible.

8. Make Pitot tube traverse of main supply and obtain design CFM at fans within ±5%.

9. Test and record system static pressures and fan suction and discharge static pressures.

10. Test and adjust system for design CFM recirculated air.

11. Test and adjust system for design CFM outside air.

12. Test and record entering air temperatures (db heating and cooling).

13. Test and record entering air temperatures (wb cooling).

14. Test and record leaving air temperatures (db heating and cooling).

15. Test and record leaving air temperatures (wb cooling).

16. Air balance shall be accomplished by slowing the central fan to the lowest possible speed while still achieving diffuser air flow, then adjusting duct dampers, and finally adjusting diffuser dampers. Change sheaves, if necessary, to accomplish proper fan speed.

17. Adjust all main supply and return air ducts to proper design CFM.

18. Adjust all zones to proper design CFM, supply and return.

19. Test and adjust each diffuser, grille, and register to within 10% of design requirements.

20. Identify each diffuser, grille, and register as to location and area.

21. Identify and list size, type, and manufacturer of diffusers, grilles, registers, and all testing equipment. Use manufacturer's rating on all equipment to make required calculations.

22. In readings and tests of diffusers, grilles, and registers, include required FPM velocity and test FPM velocity, and required CFM and test CFM after adjustments.

23. As part of this contract, the Contractor shall make any changes in the pulleys, belts, and dampers, or add any dampers, as required for correct balance.

24. Check the adjustment and operation of all temperature control equipment on the job.

25. Eliminate all duct flutters, splitter noises, excessive vibration and other noises in the air distribution system.

26. Upon completion of air balance work, check with sling psychrometer the dry and wet bulb temperature in a sufficient number of locations to assure the lack of hot and cold spots.

27. Make any necessary adjustments to obtain satisfactory conditions in each and every space or portion thereof, in the opinion of the Engineer.

3.04 ADJUSTING AND BALANCING OF AIR CONDITIONING AND HEATING SYSTEMS - WATER SIDE

A. Prior to the request for final observation, the Contractor shall make the following tests and furnish a copy of the results to the Engineer for his approval:

1. Check the rotation of each piece of rotating equipment.

2. Check alignment of each piece of rotating equipment, including the alignment of drives, guards, couplings, etc.

3. Check the ampere input of each motor against the nameplate rating of that motor.

4. Check the heater coil in the starter against the size recommended for suitable protection by the starter manufacturer.

5. Check the capacity of each pump from manufacturer's certified performance curves and head data obtained on the job. Include copy of pump curve in balance report. Mark design conditions and final balance conditions on curve.

6. Verify pump impeller size by closing pump discharge valve to create no-flow condition.

7. Adjust pump balance valve to design flow condition.

8. Bleed all air out of system before beginning water balance and verify water flow is clean and free from accumulations of dirt, scale, and sludge.

9. Check and report pressure drop across each system component where taps and/or gauges are provided.

10. Measure and report water temperature drop/rise across equipment under full heating and full cooling.

11. Verify and perform all test and balance work with specified solution liquid in pipes (e.g. water glycol mixture, etc.).

12. Balance water flow to each water coil and at each pump to flow rates specified.

3.05 SUBMITTAL FORMS

A. The Contractor must submit test and balance reports with all of the above field measured data included. The reports shall be signed and dated by the individual actually making the tests. The reports shall list specified conditions and actual measured conditions. Use SMACNA, NEBB, or AABC forms.

SECTION 23 0596

EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Refer to Section BASIC MATERIALS AND METHODS for requirements relating to equipment furnished under this section.

B. Furnish and install all equipment specified herein and as indicated on the drawings.

1.02 CODES

A. Equipment shall be manufactured and designed in accordance with all applicable local, state, federal, and industry codes and standards. Ratings and performance shall be guaranteed and certified by nationally recognized testing laboratories and institutes.

1.03 QUALITY ASSURANCE

A. Manufacturer of equipment shall have produced and placed into successful operation equipment of similar design to that furnished on this project for at least three (3) years prior to submitting bid.

1.04 PRODUCT STORAGE AND HANDLING

A. Equipment shall arrive to site properly crated and in perfect condition. Protect equipment on site from physical and weather damage. Coat metal parts, threaded connections, etc., with rust preventive material if to be stored for prolonged period. Damaged equipment due to Contractor's improper rigging or handling, due to manufacturing error, or any other reason must be replaced. Repaired equipment will not be accepted without the specific written approval of the Engineer.

B. Submit manufacturer's drawings giving capacity data, construction details, performance curves, noise levels, and other pertinent data as requested by the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

A. Refer to specific sections included herein for detailed specifications on equipment.

2.02 EQUIPMENT CONCRETE EXPANSION ANCHORS

A. The Contractor shall furnish and install stud type (male thread) concrete anchors for anchoring equipment to concrete pads or anchoring equipment to concrete for ceiling supported equipment with hanger rods.

B. Drilled-in concrete expansion anchors, complete with washers and nuts, shall be externally threaded wedge expansion bolt anchors (split ring or separate wedge pairs) complying with the dimensional requirements of Federal Specification FF-S-325 Group 11 Type 4 Class 1, Interim Amendment 3.

C. Anchor components shall be made from high strength carbon steel (except where stainless steel is otherwise specified). All carbon steel components shall be zinc plated and coated with a clear chromate treatment to meet or exceed the requirements of Federal Specification QQ-Z-325C Type II Class 3.

D. Expansion anchors shall be installed in accordance to the manufacturers' recommendations. A list of standard materials used in the manufacture of the anchor components, including designated material specifications (AISI, ASTM, etc.), as well as accredited pullout and shear values attained from tests in accordance with ANSI/ASTM E488-76 shall be submitted by the expansion anchor manufacturer for approval.

E. Acceptable Manufacturer: Hilti, Inc., KWIK-BOLT, or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in conformance with manufacturers' recommendations and good engineering practice. Maintain manufacturer's recommended clearance around equipment. Notify Engineer before submitting bid if the Contractor does not believe that they can install equipment and maintain recommended clearances.

B. The Contractor is responsible for providing for entry access of equipment into the building.

C. Furnish and install concrete bases, foundation bolts and anchors, vibration isolators, structural steel supports, etc., as required, to completely install and satisfactorily operate the equipment. Install all equipment, tube bundles, etc., to be completely removable utilizing unions or flanges at piping connections.

SECTION 23 0700

INSULATION, GENERAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install all thermal insulation specified herein and indicated on the Drawings.

B. Composite insulation product shall comply with UL 723 and NFPA 255 with a flame spread rating of 25 or less and smoke developed rating of 50 or less. Coatings, coverings, adhesives, and mastics shall be non-combustible. Do not use any asbestos products in any of the insulation furnished for this project.

C. Surfaces which may be at temperatures low enough to cause sweating shall be insulated.

D. Insulation thickness and thermal conductivities shall comply with ASHRAE Standard 90.1 and all local codes.

E. Deliver insulation, coverings, cement, adhesives, and sealants to site with manufacturer's stamp, label, fire and smoke rating, and thermal conductivity clearly visible.

F. Store insulation materials inside the building when on site and protect from damage. Where vapor barriers are penetrated, this must be repaired or replaced to the satisfaction of the Engineer.

1.02 QUALITY CONTROL

A. Insulation Contractor shall be a firm that specializes in this type of work and shall have been in business for a minimum of five (5) consecutive years prior to this project. Contractor shall upon request show evidence in writing of successful completion of 25 similar insulation projects.

B. Insulation contractor shall use experienced laborers. Foreman shall have a minimum of 10 years insulation experience. All workmen shall have a minimum of 4 years insulation experience and shall have completed an apprenticeship program.

PART 2 - PRODUCTS

2.01 INSULATION

A. Refer to the following sections for product specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Finish all insulation coverings round and smooth without bumps or depressions. Do not use broken or damaged sections.

B. Securely seal all joints in vapor barriers to maintain integrity of barrier.

C. Insulation laps and staples shall be made on the top side of the piping to provide for a neat and workmanlike appearance.

D. All insulated piping exposed to the weather shall have 26 gauge aluminum jacket banded in place.

SECTION 23 0713

DUCT WRAP INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install external duct insulation as specified herein and as noted on the drawings. Unless noted otherwise, all new supply, return, and outside air ducts shall be wrapped. Insulate over duct components, such as flexible connectors, heating coils, etc., installed in the ductwork system.

B. Insulation materials shall comply with the requirements of NFPA, SMACNA, TIMA, and other such regularly published and accepted standards.

PART 2 - PRODUCTS

2.01 DUCT WRAP

A. Ducts shall be insulated on the outside with flexible glass fiber blanket 2 inch thick, 1 pound density. Insulation shall be furnished with a factory applied foil-scrimkraft facing consisting of aluminum foil (minimum 0.7 MIL thick) reinforced with fiberglass yarn mesh and laminated to 40 pound chemically treated, fire resistant kraft. Insulation shall have a flame spread rating of 25 and smoke developed rating of 50 per ASTM E84.

B. Acceptable Manufacturer: Johns-Manville R Series Type FSK Microlite, or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Insulation shall be cut slightly longer than circumference of duct to insure full thickness at corners. All insulation shall be applied with edges tightly banded. Insulation shall be adhered to duct with fire resistant adhesive Benjamin Foster 85-20 or acceptable equal. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly. Lap covering 2 inches at joints.

B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of all ducts 18 inches or wider by means of welded pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor-barrier facing shall be thoroughly sealed with a vapor-barrier mastic or tape where the pins have pierced through.

C. Staple all joint laps securely in place and seal with 2 inch wide vapor-barrier tape or strips using a fire resistive, Benjamin Foster 85-20 or acceptable equal. Any cuts or tears shall be sealed with strips of vapor-barrier jacket applied with adhesive or pressure sensitive tape. Apply trowel grade mastic over staples and all seams or joints in the insulation.

D. Do not use gray duct tape in any portion of the work. Tape, where used, shall be foil backed SMACNA approved type.

SECTION 23 0719

PIPING INSULATION, HVAC HYDRONIC SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide and install insulation on all heating water piping. All insulation shall have composite (insulation, jacket and adhesive used to adhere the jacket to the insulation) Fire and Smoke hazard rating as tested under procedure ASTM E-84, NFPA 255 and UL 723, not exceeding Flame Spread 25 - Smoke Developed 50. Accessories, such as adhesives, mastics, cements, fabric cloth for fittings, shall have the same component ratings as listed above.

B. Insulated piping exposed to weather shall have 26 gage aluminum jacket banded in place.

PART 2 - PRODUCTS

2.01 HEATING WATER PIPE INSULATION

A. Mains.

1. Cover with 4 pound density, 1-1/2 inch thick glass fiber pipe covering with white flame retardant vapor barrier jacket (FRJ) with longitudinal joints firmly butted and covered with a 4 inch wide strip of jacket material heavily coated with vapor barrier cement of same color as jacket. Temperature limit: 850F. K factor of 0.23 at 75F mean temperature.

2. Adhesive shall be Bondmaster K-218 or equal.

3. Fittings and valves shall be covered with mitered pipe insulation or molded fittings to the same thickness as adjacent piping. All irregularities shall be smoothed out with insulating finishing cement with 6 ounce canvas. Apply an even coat of fire retardant vapor barrier coating to entire fitting surface. Imbed into wet coat fiberglass tape extending 1-1/2" minimum onto adjacent pipe covering. Apply finish coat of same fire retardant vapor barrier coating over entire surface of piping equal to CP-30. Fittings must receive hardcast finish. PVC fitting covers with double factory fiberglass insulation inserts may be used on heating water piping only if such piping is concealed above ceilings, except in return air plenums.

4. Acceptable Manufacturers. Johns-Manville, Owens Corning, Philip Carey Mfg. Co., or acceptable equal.

B. Runouts to equipment.

1. Insulate all piping from equipment isolation valves to equipment with closed cell insulation complying with MIL-C-3133B. Attach and seal all insulation with Armstrong 520 adhesive. For lines 1 inch and smaller, insulation thickness shall be 3/4 inch. For lines 1-1/4 inch and larger insulation thickness shall be 1 inch.

2. Scope: Work included in this paragraph pertains to piping to terminal units, pumps, cooling and heating coils, etc. All piping insulation within 8 feet of floor to air handlers shall be closed cell type complying with this paragraph.

3. Acceptable Manufacturer: Armstrong Armaflex AP, or acceptable equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Insulation shall be applied with all joints carefully fitted to eliminate voids. Where voids occur, insulation shall be refitted and/or replaced.

B. No insulation shall be installed prior to satisfactory pressure tests on piping systems.

C. Outside of piping shall be cleaned before applying insulation.

D. The application of insulation in the field shall be subject to inspection and approval by the Engineer.

E. The utmost care is to be taken to ensure that the installed insulated pipe is of the best possible workmanship. Any section of insulation which becomes damaged, whatever the cause, shall be cut out and replaced. Protect insulation at hanger and supports with suitable saddles. The utmost care shall be taken to install all valves, piping and equipment in such a manner that freeze protection is inherent in the installation.

F. Staple all joints to provide a neat and workmanlike appearance.

SECTION 23 3000

AIR DISTRIBUTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install all air distribution systems specified herein and as indicated on the drawings. Air distribution systems include, but are not limited to, ductwork and sheet metal specialties.

B. Provide submittals of manufacturer's data on products specified herein.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide products in accordance with these specifications. Provide all accessories required for installation of complete and operable systems to allow accurate air balance, and quiet operation. This shall include volume dampers, extractors, splitter dampers, etc., as required. Refer to other sections of these specifications for descriptions of the products.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install all products in accordance with manufacturer's recommendations and the referenced standards. Test and balance air distribution systems in accordance with these specifications.

SECTION 23 3113

SHEET METAL DUCTWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes sheet metal ductwork. Unless otherwise identified on the drawings or in these specifications, sheet metal ductwork will be considered as having air velocities below 2,000 feet per minute and static pressure not exceeding 2 inch w.g. The SMACNA "HVAC DUCT CONSTRUCTION STANDARDS METAL AND FLEXIBLE," 2005 Third Edition are hereby made a part of these specifications and shall govern duct construction and installation except where more stringent conditions are listed in these specifications.

B. The size, approximate location, and extent of all ductwork is indicated on the drawings. All sheet metal ductwork shall be furnished and installed under this section. Ductwork drawings are essentially diagrammatic and the Contractor shall carefully coordinate the exact location of ductwork with other trades before installing. One quarter inch scale shop drawings shall be submitted to the Engineer for approval of ductwork. Shop drawing shall show all ductwork, turning vanes, air distribution devices, and other sheet metal specialty items. Ducts shall be dimensioned from fixed reference points in the horizontal and vertical plane. Length of duct sections and all duct sizes shall be shown. Reproduction of the contract drawings is not acceptable. Where ducts are specifically dimensioned from a fixed reference point, this location shall be maintained unless otherwise approved by the Engineer. Submittal shall include manufacturer's data on flexible connections.

C. Systems of ductwork specified in this section include, but are not limited to, the following:

1. Heating and ventilating supply and return.

2. Air conditioning supply and return.

3. Outside air.

4. Exhaust and relief.

D. Ductwork shall be adequately protected from weather and physical damage prior to erection. Dirt, debris, rust, other foreign matter accumulated on ducts, or irreparable deformation, will be cause for rejection and replacement of the ductwork.

1.02 CODES AND STANDARDS

A. Ductwork specified under this section shall comply with the requirements of ASHRAE and SMACNA, as well as local codes where more stringent conditions must be met.

PART 2 - PRODUCTS

2.01 DUCTWORK

A. Sheet metal ductwork shall be constructed of Cop-R-Loy, Keystone, Tennessee, or Armco galvanized copper bearing steel sheets, complying with ASTM A653, Lockforming Quality, with ASTM A924 G90 zinc coating. Mill markings shall be visible outside after duct fabrication. All duct sizes indicated on the drawings are clear inside dimension.

2.02 LOW VELOCITY DUCTWORK

A. Rectangular sheet metal low velocity ductwork shall be fabricated in accordance with 2" static pressure rating, SMACNA 2005 HVAC Duct Construction Standards. Longitudinal seams in low pressure rectangular ductwork shall be Pittsburg Lock, unless otherwise approved by the Engineer. In no cases shall lighter than 26 sheet gage be used on any part of the work.

B. Fabricate round steel ductwork installed above grade in accordance with SMACNA 2005 HVAC Duct Construction Standards for 2" W.G. static positive pressure. In no case, shall lighter than 26 sheet gage be used in any part of the work. All branch duct take-offs from round ducts shall be with 45 degree lateral taps. Tees are not acceptable.

2.03 MEDIUM PRESSURE DUCTWORK

A. All medium pressure ductwork shall be constructed of sheet metal flanged joint duct system construction. All joints shall have approved gaskets. Longitudinal seams in medium pressure rectangular ductwork shall be Pittsburg Lock, unless otherwise approved by the Engineer. Duct system shall meet minimum standards of SMACNA 2005 HVAC Duct Construction Standards, Seal Class A for pressure 4" positive, 3" negative and 4000 feet per minute air velocity, comparable to SMACNA Class J transverse joint construction.

B. Medium pressure ductwork shall be the Ductmate Duct Connection System as manufactured by Ductmate Industries, Inc., or acceptable equal. Install in accordance with manufacturer's recommendations and these specifications.

C. Fabricate round steel ductwork installed above grade in accordance with Table 3-2A of the SMACNA 2005 HVAC Duct Construction Standards for 10" W.G. static positive pressure. Use spiral seam ductwork. Elbows shall be stamped,

welded seam type. In no case, shall lighter than 26 sheet gage be used in any part of the work.

2.04 MISCELLANEOUS DUCTWORK MATERIALS

A. Provide miscellaneous materials as specified herein and as indicated on the drawings. If items are not specified herein or indicated on the drawings, provide all miscellaneous materials required for a complete and workable ductwork air distribution system, all in accordance with good engineering practice and the Codes and Standards referenced herein.

C. Turning Vanes. Provide two piece turning vanes in all rectangular ductwork elbows with bends of 45 degrees or greater. Submit sample for approval before fabrication. Where duct dimensions do not exceed 10 inches in any direction, turning vanes may be single vane.

D. Hangers. Duct hangers to be hot-dipped galvanized steel fasteners, straps, trim, etc., for hanging and supporting ductwork unless specifically noted otherwise.

2.05 FABRICATION

A. Ductwork to be shop fabricated in sections where possible. Rectangular ductwork fabrication, reinforcement, seams, joints, etc., to comply with SMACNA standards unless noted otherwise. Bead or cross break flat surfaces greater than 18 inches dimension.

B. Fabricate duct fittings such as elbows, take-offs, transitions, etc., to be same gage as adjoining duct section. Branch takeoff to be full size of register unless noted otherwise. Angle of transitions to be no greater than 15 degrees with the air stream.

PART 3 - EXECUTION

3.01 DUCTWORK

A. Ductwork shall be installed in accordance with the recommendations of the SMACNA Standards and recognized industry practices to achieve air tight and quiet operation. Align ductwork to within 1/8" tolerance. All internal surfaces to be finished smooth. Hangers must be suitable for the type, size, and pressure class of ductwork being supported. All openings for ductwork must be coordinated prior to the time of concrete pour or masonry work. All ductwork shall be located in order to avoid interferences with piping which must maintain an even grade. Locate ducts in concealed spaces insofar as possible, positioning runs in vertical and horizontal positions. Locate diffusers as indicated on drawings, maintaining even and pleasing pattern in ceiling.

B. When ducts pass through full height walls, patch space between wall construction and duct with sheet metal closure angle.

C. Install volume extractors, air scoops, dampers, splitters, and other such devices in accordance with manufacturer's recommendations and accepted industry practice.

D. Ductwork is to be supported from the building structure. Do not support off of piping or other miscellaneous items. Vertical ducts are to be supported similarly from the building structure on 12'-0" centers minimum.

E. Hangers for rectangular duct shall be turned 1 inch around bottom corner of duct and fastened with sheet metal screws per SMACNA Standards. Where concrete inserts or expansion anchors are used, the applied load shall not exceed one-fourth of the proof test load listed in FED. SPEC. FF-S-325. Inserts/anchors shall be manufactured by Hilti or acceptable equal. Extend 1-1/2 inch x 16 gauge strap hangers for over head round ducts completely around the ducts. Where reinforcing rings are used, bolt hangers to rings or duct flanges.

3.02 CLEANING AND TESTING

A. Clean dust and debris from internal surfaces of ducts during installation. External surfaces to be clean at time of completion. All ductwork shall be tested for leaks and pressure drop upon completion of system installation. See Test and Balance Section.

SECTION 23 3300

SHEET METAL SPECIALTIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes sheet metal specialties, including ductwork accessories. Furnish and install all items specified under this section.

B. The size, location, and quantity of all sheet metal specialties are indicated on the drawings. Items shall be delivered to site in first class condition, undamaged and properly crated. Coordinate location of all sheet metal specialties with other trades on project as necessary to assure adequate clearance, necessary framing for openings, and access doors in furred spaces where necessary to provide access to operators or control rods. Contractor shall verify all sheet metal specialties will fit into the allotted space before fabrication or purchase.

C. Protect all items on job from physical and weather damage. Rusted or damaged parts on any item specified under this section will be cause for rejection.

D. Submit manufacturer's data on sheet metal specialties.

1.02 CODES AND STANDARDS

A. Comply with the requirements and standards of NFPA, UL, NEC, AMCA, SMACNA, ASHRAE, ADC, and other applicable codes and standards.

PART 2 - PRODUCTS

2.01 GENERAL

A. All sheet metal specialties specified herein indicate the levels of quality and performance to be furnished. Items on job must meet or exceed these levels.

2.02 FIRE DAMPERS

A. Provide fusible link (212F unless otherwise noted) type fire dampers of the size indicated on the drawings. Furnish 20 gage galvanized casing construction, dynamic style damper, with 20 gage integral sleeve and mounting angle, positive lock in closed position, curtain type steel blade for single section fire dampers. For larger dampers or multiple section dampers, or ducts exceeding 2,000 FPM velocity, use air foil multi-blade design. Provide fire dampers in ductwork and other openings passing through fire rated ceilings and fire walls and where indicated on drawings. Unless noted otherwise, dampers shall carry 1-1/2 hour UL fire damper label. Maintain 100% free area duct opening at each curtain type

fire damper. Units for vertical installation shall have gravity closure. Units for horizontal installation shall have closure springs. Dampers shall have breakaway connection. Use 10 gage sleeves where damper cannot be mounted in wall.

B. Acceptable Manufacturers: Ruskin Mfg. Co. DIBD2, Style B, LR, LO, C, CR, and CO (curtain type) and Ruskin FD60 (air foil type).

2.03 ACCESS DOORS

A. Provide access doors where indicated on drawings and as specified herein. Minimum dimension of access door to be 12 inches in any direction unless ductwork is less than 12 inches in one direction. In that case, access door shall be same size as duct dimension by 12 inches in other direction. Provide access door at each fire and smoke damper whether door is indicated on drawings or not. Where ducts are insulated, access doors shall be double thickness insulated type. All access doors shall have rubber gasket for tight seal. Doors may be of the hinged or removable type at the Contractor's option and as required by clearance conditions, except doors over 30 inches in any dimension shall be hinged with appropriate handle and locks. Furnish handle (Ventlock No. 260) operable from inside and outside. Provide angle iron framing where required to insure rigid duct installation. Construct access door skin of 22 gage galvanized steel with frames of 16 gage galvanized steel. Stencil fire damper access doors with 1 inch high red letters "FIRE DAMPER ACCESS".

2.04 TURNING VANES

A. Use two piece turning vanes where duct elbows are 75 degrees or greater. Turning vanes shall be same material as duct and designed for low pressure drop.

2.05 VOLUME EXTRACTORS

A. At each rectangular branch take off, provide a 45 degree fitting complying with SMACNA Figure 4-6, 2005 SMACNA Duct Standards. At each round branch takeoff, provide 45 degree rectangular entry transitioned to round high efficiency takeoff fitting complying with SMACNA Figure 4-6, SMACNA Duct Standards. Optionally, conical or bellmouth spin-in fittings complying with SMACNA Figure 4-6 are acceptable for round branch takeoffs. All branch take offs shall have dampers with full continuous rods with rod bearings on both ends. Construct of minimum 26 gauge galvanized sheet metal. Damper rods shall extend a minimum of two inches outside housing and have spacer to prevent insulation collapse.

2.06 FLEXIBLE CONNECTIONS

A. Provide flexible connections at the inlet and outlet of each piece of air moving equipment such as fans and air handlers. Mold in place with airtight collar and metal band. At least three inches (3") of fabric shall be exposed. Fabric to be non-combustible and comply with UL Standard 214 and NFPA 90A. Weight: 30 ounce per square yard.

B. Acceptable Manufacturer: Vent Fabrics, Inc., Ventglass, where not exposed to weather, or acceptable equal. Vent Fabrics, Inc., Ventlon, where exposed to weather, or acceptable equal.

2.07 VOLUME DAMPERS

A. Construct damper frames from galvanized channels 5" X 1" X 16 gauge. Frames shall be corner braced where any dimension exceeds 24 inches and shall be sized to fit the construction where they are to be installed. Damper frames shall be duct sheet metal size.

B. Damper blades shall be of the opposed blade type with exposed linkage. Blades shall be fabricated from 16 gage galvanized steel. Blade widths shall not exceed 8 inches and all blades shall be formed with 1/2 inch V-grooves along their longitudinal center line and along both edges. Formed edge grooves shall provide for a 3/8 inch interlock between adjacent blades. Clearances between blade ends and supporting channel frames shall not exceed 1/8 inch. Polyurethane foam seals shall be attached to all blade edges and wind stops.

C. Damper blade shafts or axles shall be 1/2 inch carbon steel and shall extend completely through the bearings. Bearings shall be of the self-lubricating type.

D. Dampers shall be operated by a manual locking device mounted on the exterior of the sheet metal duct, Ventlock 641.

E. Acceptable Manufacturer: Ruskin Mfg. Co., MD-35 (MD-25 if 12” or smaller) (rectangular); CDR-25 (round); CDO-25 (oval), or acceptable equal. Ruskin MDRS25 manual volume dampers in ductwork designed for 2” pressure class or less.

2.08 GRILLES, REGISTERS, AND DIFFUSERS

A. Provide grilles, registers, and diffusers of the sizes and types indicated on the drawings. All supply and return registers and diffusers shall have opposed blade damper matched to air diffusion device. The static pressure drop required to obtain the indicated capacity shall not exceed 0.1 inch water gage or that of the diffusion device specified, whichever is less. See Drawing Schedule of Grilles, Registers, and Diffusers for type, color, and accessories. Apply rust-proofing

procedure to devices before prime coating. Ratings must be by ADC approved testing lab in accordance with ADC Standards. All louvered faced supply diffusers with neck sizes 8" diameter and larger shall have the entire face area louvered for air distribution; i.e., 12" by 12" cores are not acceptable with 8" neck diffusers.

B. Acceptable Manufacturers: Titus, Price, or acceptable equal.

2.09 FLEXIBLE DUCTWORK

A. Flexible duct shall meet UL 181 Class 1, NFPA 90A and B requirements for air duct. Provide low pressure flexible ductwork where indicated on drawings. Flexible ductwork shall be insulated type with 1 inch fiberglass insulation and vapor barrier. Hold flexible ducts in place with crimp type duct tie bands. In general, duct connection to all round neck supply diffusers shall be flexible duct, unless indicated otherwise. Flexible duct shall meet the requirements of NFPA 90A. Flexible duct length shall not exceed 4 feet. Flexible duct shall meet the flame spread 25 and smoke developed 50 rating of ASTM E84.

B. Acceptable Manufacturers: Genflex Type SLR-181, Flexmaster, Thermoflex Type MK-E, or acceptable equal.

2.10 FLUES

A. Provide Class B double wall flues from all atmospheric gas burning equipment vented through roof, unless noted otherwise. Flue caps shall be provided for each flue. Flue size shall be same size as outlet at equipment unless noted otherwise. Pressurized gas flues shall be suitable for the combustion gas pressure encountered. Flue caps shall have UL label.

B. Acceptable Manufacturers: Pressurized gas flue: Metalbestos Model PS, or acceptable equal. Flue cap: Hart & Cooley Metlcap, or acceptable equal.

manufactured by Air Monitor Corporation, Santa Rosa, California.

PART 3 - EXECUTION

3.01 GENERAL

A. Install all sheet metal specialties specified herein in accordance with manufacturers' recommendations and in accordance with good industry practice. Install all screws, gaskets, pins, etc., to assure a complete and working installation. Appearance must be neat, professional, and workmanlike. Test all dampers for proper operation at the specified conditions. Replace any dampers that rattle or produce other undesirable noise. Eliminate whistle from air diffusion devices if condition occurs. Adjust air diffusion devices to provide even

air flow without objectionable drafts. Do not use gray duct tape in any portion of the work.

3.02 COORDINATION

A. Coordinate the installation and location of all sheet metal specialties with other work. Center diffusers in ceiling tiles, soffits, etc., to satisfaction of the Engineer, unless indicated otherwise.

3.03 FLEXIBLE DUCT

A. Support flexible duct with integral tabs provided by manufacturer.

B. Where no tabs are available, support with 2" wide sheet metal strap.

C. Sharp bends, crimps and unnecessary turns in flexible duct will not be allowed.

D. Position flexible duct so that air to diffuser enters diffuser neck at even velocity across neck.

3.04 VOLUME DAMPERS

A. Place permanent mark on exterior of duct to indicate full open, full closed, and balanced damper handle positions of all new or rebalanced dampers.

SECTION 23 3400

VENTILATION EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Furnish and install the fans as scheduled and as indicated on the plans. Provide factory fabricated, insulated roof curb with all roof mounted fans. Coordinate curb cants with other trades. Units shall be UL listed.

B. Submit performance curves and sound data on all fans.

C. Ventilation equipment shall be rated in accordance with AMCA Standard Test Code and shall bear the AMCA Seal. Equipment arriving on project site without AMCA Seal will be rejected and must be returned to the factory by the Contractor at the Contractor's expense. Acceptable equipment shall be delivered to site with proper seals before final approval will be given.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. See following sections for equipment specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in conformance with manufacturer's recommendations and these specifications.