

MECHANICAL ABBREVIATIONS

& /	AND	HB	HOSE BIBB
∠	ANGLE	HC	HANDICAPPED
○	AT	HD	HEAD
□	CENTER LINE	HDWE	HARDWARE
⌀	PROPERTY LINE	HL	HIGH
⌀	DIAMETER OR ROUND	HORIZ	HORIZONTAL
(E)	EXISTING	HP	HORSEPOWER
(N)	NEW	HW	HOT WATER
⊥	PERPENDICULAR	HWR	HOT WATER RETURN
#	POUND OR NUMBER	HWS	HOT WATER SUPPLY
⊖	THERMOSTAT	HVAC	HEATING, VENTILATING, AIR CONDITIONING
A/C	AIR CONDITIONING	ID	INSIDE DIAMETER (DIM.)
AP	ACCESS PANEL	INSUL	INSULATION
ABV	ABOVE	INT	INTERIOR
ADJ	ADJUSTABLE	LAV	LAVATORY
AF	ABOVE FINISH FLOOR	LBS	POUNDS
AE	ADJUSTABLE EXTRACTOR	LPG	LIQUID PETROLEUM GAS
AGGR	AGGREGATE	LPG	LIQUID PETROLEUM GAS
ALUM	ALUMINUM	LPG	LIQUID PETROLEUM GAS
APPROX	APPROXIMATE	LPG	LIQUID PETROLEUM GAS
APPT	APPOINTMENTS	LPG	LIQUID PETROLEUM GAS
ARCH.	ARCHITECTURAL	LPG	LIQUID PETROLEUM GAS
ARI	AMERICAN REFRIGERATION INSTITUTE	LPG	LIQUID PETROLEUM GAS
ASPH	ASPHALT	LPG	LIQUID PETROLEUM GAS
ASST	ASSISTANT	LPG	LIQUID PETROLEUM GAS
AUTO.	AUTOMATIC	LPG	LIQUID PETROLEUM GAS
BD	BALANCING DAMPER	LPG	LIQUID PETROLEUM GAS
BDD	BACKDRAFT DAMPER	LPG	LIQUID PETROLEUM GAS
BF	BELOW FINISH FLOOR	LPG	LIQUID PETROLEUM GAS
(BG)	BELOW FINISH GRADE	LPG	LIQUID PETROLEUM GAS
BLDG	BUILDING	LPG	LIQUID PETROLEUM GAS
BLKG	BLACKING	LPG	LIQUID PETROLEUM GAS
BM	BEAM	LPG	LIQUID PETROLEUM GAS
BTUH	BRITISH THERMAL UNIT/ HOUR	LPG	LIQUID PETROLEUM GAS
BTOT	BOTTOM	LPG	LIQUID PETROLEUM GAS
BP	BY-PASS TIMER	LPG	LIQUID PETROLEUM GAS
CA	COMBUSTION AIR	LPG	LIQUID PETROLEUM GAS
CD	CAPACITY	LPG	LIQUID PETROLEUM GAS
CFD	CEILING FIRE DAMPER	LPG	LIQUID PETROLEUM GAS
CFM	CUBIC FEET PER MINUTE	LPG	LIQUID PETROLEUM GAS
CHW	CHILLED WATER	LPG	LIQUID PETROLEUM GAS
CHWR	CHILLED WATER RETURN	LPG	LIQUID PETROLEUM GAS
CHWS	CHILLED WATER SUPPLY	LPG	LIQUID PETROLEUM GAS
CL	CEILING JOINT	LPG	LIQUID PETROLEUM GAS
CLG	CEILING	LPG	LIQUID PETROLEUM GAS
CLKG	CAULKING	LPG	LIQUID PETROLEUM GAS
CLR	CLEAR	LPG	LIQUID PETROLEUM GAS
CO	CLEANOUT	LPG	LIQUID PETROLEUM GAS
COL	COLUMN	LPG	LIQUID PETROLEUM GAS
COMP	COMPRESSED	LPG	LIQUID PETROLEUM GAS
CONC	CONCRETE	LPG	LIQUID PETROLEUM GAS
CONF	CONFERENCE	LPG	LIQUID PETROLEUM GAS
CONN	CONNECTION	LPG	LIQUID PETROLEUM GAS
CONST	CONSTRUCTION	LPG	LIQUID PETROLEUM GAS
CONT	CONTINUOUS	LPG	LIQUID PETROLEUM GAS
CORR	CORRIDOR	LPG	LIQUID PETROLEUM GAS
CSE	CALIFORNIA SEASONAL EFFICIENCY	LPG	LIQUID PETROLEUM GAS
CKS	COUNTERSUNK	LPG	LIQUID PETROLEUM GAS
CTR	CENTER	LPG	LIQUID PETROLEUM GAS
CV	CHECK VALVE	LPG	LIQUID PETROLEUM GAS
DBL	DOUBLE	LPG	LIQUID PETROLEUM GAS
DB	DRY BULD (TEMPERATURE)	LPG	LIQUID PETROLEUM GAS
DEPT	DEPARTMENT	LPG	LIQUID PETROLEUM GAS
DET	DETAIL	LPG	LIQUID PETROLEUM GAS
DF	DRINKING FOUNTAIN	LPG	LIQUID PETROLEUM GAS
DHW	DOMESTIC HOT WATER	LPG	LIQUID PETROLEUM GAS
DHWR	DOMESTIC HOT WATER RETURN	LPG	LIQUID PETROLEUM GAS
DIAMETER or	DIAMETER	LPG	LIQUID PETROLEUM GAS
DIR	DIRECTOR	LPG	LIQUID PETROLEUM GAS
DN	DOWN	LPG	LIQUID PETROLEUM GAS
DR	DOOR	LPG	LIQUID PETROLEUM GAS
DS	DOWNSPOUT	LPG	LIQUID PETROLEUM GAS
DSP	DRY STANDPIPE	LPG	LIQUID PETROLEUM GAS
DTR	DUCT THRU ROOF	LPG	LIQUID PETROLEUM GAS
DTW	DUCT THRU WALL	LPG	LIQUID PETROLEUM GAS
DWG	DRAWING	LPG	LIQUID PETROLEUM GAS
E	EAST	LPG	LIQUID PETROLEUM GAS
EA	EXHAUST AIR	LPG	LIQUID PETROLEUM GAS
EAG	EXHAUST AIR GRILLE	LPG	LIQUID PETROLEUM GAS
EDB	ENTERING DRY BULB	LPG	LIQUID PETROLEUM GAS
EE	ENERGY EFFICIENCY RATIO	LPG	LIQUID PETROLEUM GAS
ELEC	ELECTRICAL	LPG	LIQUID PETROLEUM GAS
ELEV	ELEVATION	LPG	LIQUID PETROLEUM GAS
EMER	EMERGENCY	LPG	LIQUID PETROLEUM GAS
ENCL	ENCLOSURE	LPG	LIQUID PETROLEUM GAS
EP	ELECTRICAL PANEL	LPG	LIQUID PETROLEUM GAS
EQ	EQUAL	LPG	LIQUID PETROLEUM GAS
EQUIP	EQUIPMENT	LPG	LIQUID PETROLEUM GAS
(E)	EXISTING	LPG	LIQUID PETROLEUM GAS
ESP	EXTERNAL STATIC PRESSURE	LPG	LIQUID PETROLEUM GAS
EWB	ENTERING WET BULB	LPG	LIQUID PETROLEUM GAS
EXPO.	EXPOSED	LPG	LIQUID PETROLEUM GAS
EXT	EXTERIOR	LPG	LIQUID PETROLEUM GAS
FA	FIRE ALARM	LPG	LIQUID PETROLEUM GAS
FC	FLEXIBLE CONNECTION	LPG	LIQUID PETROLEUM GAS
FD	FIRE DAMPER	LPG	LIQUID PETROLEUM GAS
FDN	FOUNDATION	LPG	LIQUID PETROLEUM GAS
FE	FIRE EXTINGUISHER	LPG	LIQUID PETROLEUM GAS
FEC	FIRE EXTINGUISHER CABINET	LPG	LIQUID PETROLEUM GAS
FHC	FIRE HOSE CAB.	LPG	LIQUID PETROLEUM GAS
FHMS	FLAT HEAD METAL SCREW	LPG	LIQUID PETROLEUM GAS
FIN.	FINISH	LPG	LIQUID PETROLEUM GAS
FLA	FULL LOAD AMPS	LPG	LIQUID PETROLEUM GAS
FLASH.	FLASHING	LPG	LIQUID PETROLEUM GAS
FM	FIRE MAIN	LPG	LIQUID PETROLEUM GAS
FOC	FACE OF CONCRETE	LPG	LIQUID PETROLEUM GAS
FOF	FACE OF FINISH	LPG	LIQUID PETROLEUM GAS
FFM	FEET PER MINUTE	LPG	LIQUID PETROLEUM GAS
FFPF	FIREPROOFING	LPG	LIQUID PETROLEUM GAS
FSC	FAN SPEED CONTROL	LPG	LIQUID PETROLEUM GAS
FSD	FIRE/SMOKE DAMPER	LPG	LIQUID PETROLEUM GAS
FSL	FIRE SPRINKLER LINE	LPG	LIQUID PETROLEUM GAS
FTR	FLUE THRU ROOF	LPG	LIQUID PETROLEUM GAS
FUNC	FUNCTION	LPG	LIQUID PETROLEUM GAS
FURR	FURRING	LPG	LIQUID PETROLEUM GAS
FUT	FUTURE	LPG	LIQUID PETROLEUM GAS
GA	GAUGE OR GAGE	LPG	LIQUID PETROLEUM GAS
GALV	GALVANIZED	LPG	LIQUID PETROLEUM GAS
GEN	GENERAL	LPG	LIQUID PETROLEUM GAS
GI	GALVANIZED IRON	LPG	LIQUID PETROLEUM GAS
GL	GLASS	LPG	LIQUID PETROLEUM GAS
GPM	GALLONS PER MINUTE	LPG	LIQUID PETROLEUM GAS
GR	GRADE	LPG	LIQUID PETROLEUM GAS
GRD	GROUND	LPG	LIQUID PETROLEUM GAS
G	GAUSS LINE	LPG	LIQUID PETROLEUM GAS

SYMBOLS

SYMBOL	DESCRIPTION
	AIR CONDITION UNIT
	SUPPLY AIR CEILING DIFFUSER
	SUPPLY AIR CEILING DIFFUSER
	SUPPLY VARIABLE AIR CEILING DIFFUSER HEAT & COOL
	RETURN AIR CEILING REGISTER
	EXHAUST AIR CEILING REGISTER
	SUPPLY AIR WALL DIFFUSER
	RETURN AIR WALL REGISTER
	EXHAUST AIR WALL REGISTER
	TRANSFER GRILLE
	DUCTWORK (RECTANGULAR)
	DUCTWORK (ROUND)
	LINED DUCTWORK
	TURNIG VANE
	FLEXIBLE DUCTWORK
	FLEXIBLE CONNECTION
	MANUAL AIR VOLUME DAMPER
	FIRE DAMPER
	SMOKE FIRE DAMPER
	OUTSIDE AIR INTAKE MIN. CFM
	ROOM THERMOSTAT - SUBSCRIPT INDICATES UNIT CONTROL
	BYPASS TIMER
	TIME CLOCK
	ON/OFF SWITCH
	FAN SPEED CONTROL
	DUCT SMOKE DETECTOR
	POINT OF CONNECTION
	CEILING EXHAUST FAN
	FURNACE (VERTICAL)
	FURNACE (HORIZONTAL)
	CONDENSING UNIT

GENERAL MECHANICAL NOTES

SECTION 1
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Labor, materials, tools, and services for a complete installation of equipment and system contained in the Contract Documents.
- B. Principal features of the work included are:
 1. Heating, ventilating, air conditioning systems, controls, and mechanical system insulation.
 2. Roof curbs for HVAC systems, intake hoods, louvers, supply fans, and relief vents furnished and set under this Division.
 3. Refrigerant piping, connections, refrigerant and refrigerant charges.
 4. Excavating and backfilling for mechanical work, coordinate with appropriate trade.
 5. Anchor bolts, sleeves, supports and similar items to be built into concrete or masonry.
 6. Preparation for testing and balance of mechanical systems and correcting deficiencies.
 7. Preparation and submittal of shop drawing and product data.
 8. Maintaining a record set of blue line prints and making them to indicate locations of concealed items, and deviations made to suit conditions and production of mechanical as-built (record) drawings.

1.2 JOB CONDITIONS.

- A. Submittal of bid implies bidder has read applicable paragraphs of the specifications and will be bound by their conditions.

1.3 LOCAL CONDITIONS

- A. Conform with local conditions. Coordinate with local utilities on size of utility service.

1.4 INTENT

- A. The contract documents (drawings and specifications) describe the mechanical work of this project any items mentioned in one part shall be as binding as though mentioned in both.
- B. The contract documents form a guide for a complete mechanical installation. Where an item is reasonably necessary but not specifically mentioned, such as duct hangers or transitions, piping offsets, drains, etc., for a complete system, provide same.
- C. Mechanical layouts indicated on drawings are diagrammatic only. Exact locations of ducts, and equipment shall be governed by the drawings of related trades.

1.5 DEVIATIONS

- A. No deviations from specifications and drawings shall be made without full knowledge and written consent of Construction Manager.
- B. Should Contractor find, during progress of work, conditions which dictate a modification of any particular requirements, report such item promptly for decision of instructions.

1.6 QUALITY ASSURANCE

- A. Comply with applicable local, state and federal codes.
- B. Comply with applicable requirements of recognized industry associations with promulgate standards for the various trades. (see individual sections of division 15)
- C. Employ only qualified journeymen for this work. Employ competent, qualified mechanics to supervise the work.

1.7 CODES AND STANDARDS

- A. Perform work specified in Division 15 in accordance with the applicable codes and standards listed below, and such standards that may be specified in other sections, when these specifications are more stringent, they take precedence. in case of conflict, obtain a decision from the Mechanical Engineer.
 1. NFPA 54: National Fuel and Gas Code.
 2. NFPA 90A: Air Conditioning and Ventilation Systems.
 3. NFPA 101: Life Safety Code.
 4. Applicable State Building Code.
 5. Applicable state Mechanical Code.
 6. Handicapped Code ANSI A117.1 and ADA
 7. Applicable State Energy Code.
 8. ASHRAE: American Society for Heating, Refrigeration and Air Conditioning Engineers.
 9. ANSI: American National Standards Institute.
 10. ASHRAE: American Society for Heating, Refrigeration and Air Conditioning Engineers.
 11. ASHRAE: American Society for Heating, Refrigeration and Air Conditioning Engineers.
 12. ASME: American Society for Mechanical Engineers.
 13. ASTM: American Society for Testing and materials.
 14. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.
 15. NFPA: National Fire Protection Association.
 16. SMACNA: Sheet Metal and Air Conditioning Contractor's National Association.
 17. UL: Underwriters Laboratories, Inc.

1.8 COORDINATION

- A. Carefully examine specifications and drawings to be thoroughly familiar with items which require HVAC connections and coordination.
- B. Coordinate with other Divisions to leave proper chases and openings, place outlets, anchors, sleeves, and supports prior to pouring concrete of installation of masonry work.

1.9 SUBMITTALS

- A. Submittals are only required for specific items of equipment or material listed in individual sections of these specifications.
- B. Within 15 days after award of contract for this work, submit a list of proposed manufacturers (of equipment or material to be used) for approval. Submit this list before submittal of shop drawings and product data, and obtain approval before submitting required items.
- C. Shop Drawings (not required for Owner furnished equipment).

1.10 DELIVERY AND STORAGE

- A. Insofar as possible, deliver items in manufacturer's original unopened packaging. Where that is not practical, cover items with protective materials to keep them from being damaged. Use care in loading, transport, unloading, and storage to keep items from being damaged.

1.11 FIRE RATINGS

- A. Materials used anywhere in the work must have NFPA ratings as following:
 1. flame spread - not over 25
 2. smoke developed - not over 50
 3. fuel contributed - not over 25
- B. Materials shall be "self Extinguishing".

1.12 PERMITS AND FEES

- A. Obtain, pay for, and deliver permits, certification of inspection, and other such items required by the authorities having jurisdiction. Deliver certification to the Construction Manager prior to Final Acceptance of the work. An inspection certificate for each class of work requiring inspection must be submitted prior to or with the final payment invoice. The responsible Trade Contractor must make application for the inspection, coordinate same and pay the required inspection fee.

1.13 EXTENDED WARRANTIES

- A. Work furnished under the Contract shall be warranted against defects in workmanship and (Contractor furnished) materials for a period of not less than one (1) year, or as otherwise specified, from the date of final acceptance of the installation. Defects of workmanship developing during this period shall be remedied, and defective material replaced, without additional cost. When defects in a Trade Contractor's work causes damage to the work of the other Trade Contractors, such damage shall be repaired by the Trade Contractor causing damage and work restored to its original condition, at the expense of the Trade Contractor that caused the damage.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Within the Contract Documents relating to mechanical work, manufacturer's names, catalog numbers, and other proprietary references to materials and equipment are made. Such references are made to establish the standards of quality and type required, and not to limit competition. Acceptable manufacturer's of competitive products are listed in applicable sections as "approved equals". Reasonable requests for substitution or additions to "approved equals" will be considered, but the Mechanical Engineer will be the sole judge of acceptability of items proposed as substitutes.
- B. materials and equipment used in carrying out these specifications shall bear UL or other recognized testing laboratory label when such labels are available.

PART 3 - EXECUTION

3.1 LOCATIONS

- A. Mechanical layouts indicated on drawings are diagrammatic. Exact locations of duct, and equipment may vary because of conflicts with work of other trades. Work out conflicts where relocation's will not affect operation or appearance of systems.
- B. Locate equipment requiring periodic servicing so that it is readily accessible. Do not back up service sides to walls, nor place it too close to other equipment to make service impractical. Equipment service clearance shall meet minimum acceptable distance as recommended by equipment manufacturer.

3.2 UTILITIES EXCAVATING AND BACKFILLING

- A. Perform trenching, excavating, backfilling for mechanical work in accordance with the appropriate sections and as set forth below
 1. perform work necessary for installation of mechanical utilities.
 2. Depth of excavation to provide a minimum of 3' above top of pipe. Excavation to be carried to a depth of at least 6" below bottom of pipe elevation. Fill below pipe (6"), around pipe, and a minimum of 12" above pipe with sand or class 12" crushed stone tamped firm and even. Separate topsoil during excavation. Final layer or dirt (12" minimum) to be topsoil. Trenches to be at least 18" wider than pipe with batter boards placed every 25'. Backfilling shall be done to exclude use of rock or stone above sand or crushed stone.

3.3 CUTTING AND PATCHING

- A. Repair or replace routine damage caused by cutting in performance of contract.
- B. Correct unnecessary damage caused due to installation of mechanical work.
- C. Perform repairs with materials which match existing and install in accordance with the appropriate section of these specifications or the best standards of the industry.

3.4 CONNECTION TO EQUIPMENT

- A. Connect or install equipment shown on mechanical drawings that require mechanical hookups.

3.5 SERVICE OF SYSTEM

- A. If equipment is placed in service prior to acceptance of the project, operate equipment strictly in accordance with manufacturer's instructions. Install new filters in equipment prior to owner occupying building.
- B. Provide competent, qualified personnel in operation of the equipment.
- C. Provide for proper operation and cleanliness.
- D. Open up equipment for inspection as directed by the Superintendent.
- E. Lubricate equipment and perform such other maintenance as required to place it in first class operating condition.

END OF SECTION

SECTION 3
HEATING, VENTILATION AND AIR CONDITIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Refer to drawings and Contract for materials furnished by Owner, installed by Contractor or furnished and installed by Owner.

1.2 SCOPE OF WORK

- A. Furnish all labor, supervision, and equipment (unless equipment is specifically noted as "Owner furnished") for the complete installation of heating, ventilation, and air conditioning system together with all necessary auxiliaries and appurtenances.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications - install packaged units, as indicated in the Drawings, in accordance with manufacturer's instructions and requirements. Provide related products and accessories from one manufacturer. Store materials in accordance with manufacturer's recommendation protecting from dirt, moisture, contaminants, and weather.
- B. Codes and standards - Perform all installation in accordance with the latest standards as recognized by ASHRAE, SMACNA and all applicable state and local codes and ordinances.
- C. Workmanship - Experienced, well - trained workers, competent to complete the work as specified, shall perform Labor in conformance with generally accepted trade standards. Install all equipment square and plumb allowing access for proper operation, adjustment and service.

1.4 STRUCTURAL AND SPACE CONDITIONS

- A. All work shall avoid obstructions and interference with other trades, preserve headroom and keep openings and passageways clear and free.

1.6 VIBRATION AND NOISE

- A. Install each of the various pieces of equipment to operate without objectionable vibration or noise.

1.7 CUTTING AND PATCHING

- A. Cutting or patching necessary to permit the installation of any work under this contract shall be the responsibility of this trade. Cutting and patching shall be coordinated with other trades so as not to impact other work

1.8 BALANCING AND TESTING

- A. Test and Balance shall be performed by a nationally qualified Test and Balance Company. Balance company shall be an NEBB company.
- B. Contractor shall coordinate testing with the Testing and Balance Company. All systems shall be fully operational prior to commencement of testing. Correct all deficiencies noted in the Test and Balance Report within three days or prior to acceptance of the project.
- C. Assume responsibility for correcting all items determined to be the result of improper or incomplete installation. Extra testing required due to such deficiencies will be at contractor's expense.
- D. Contractor shall be responsible for providing test reports to the local Building and Health Departments as required for Certificate of Occupancy.

PART 2 - PRODUCTS

2.1 AIR CONDITIONING UNITS, FANS AND AIR DEVICES

- A. Shall be as indicated on the Drawings.

2.2 DUCTWORK

- A. Rectangular Duct Fabrication, General - Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA - HVAC Duct Construction Standards, Tables 1 - 3 through 1 - 19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

2.3 DUCT ACCESS PANELS AND DOORS

- A. In sheet metal work, hollow core double construction of same or heavier gage material as duct in which installed, products by CESCO, Vent Products, Air Balance, or equivalent.
1. Provide Ventlok or approved hinges and latches on all doors; 100 series hinges and latches on low pressure system doors up to 18" maximum dimension, 200 series on larger low pressure system doors and 333 series on high pressure systems.
2. Construct doors up to 18" maximum dimension with one inch overlap fit and gasket with 3/4" by 1/8" sponge rubber, fit larger doors again 1-1/2" by 1/8" flat stock of angle frame and gasket with 3/4" by 1/8" sponge rubber or felt.
3. Door swing to be opposite of airflow.

2.4 DUCTWORK SPECIALTIES

- A. Volume and Splitter Dampers
 1. Galvanized sheet metal blade and frame with Ventfabrice inc. Ventlok operating hardware.
 2. For accessible dampers, provide #641 self - locking duct regulators and #644 self - locking dial regulators for insulated ductwork, #637 square end bearing, and #639 spring end bearing, as applicable
 3. For inaccessible dampers, provide #666 or #667 concealed locking damper regulator with bearing as above. For static pressures above 3" W.G., provide #640 HVel dial regulator and #609 HVel end bearing for accessible dampers.
- B. Multi - Louver Volume Dampers
 1. 16 - gauge galvanized steel frame. Opposed, 6" wide, 16 - gauge galvanized steel blades. Concealed linkage frame
 2. Titus #AG - 35 - B, Ruskin #CD35/ OBD or equal
- C. Flexible Connections
 1. Provide flexible connectors at the discharge and inlet of fans, air handlers, rotating mechanical equipment, and where shown on the Drawings for proper vibration isolation.
 2. Neoprene impregnated glass cloth with 24 - gauge galvanized metal frame. Minimum dimensions - 3" metal, 3" fabric, 3" metal.
 3. Duro Dyne #MFN4, Vent fabrics #Ventglas, Q Industries, consolidated Kinetics, Elgen, or equal.
- D. Backdraft Dampers
 1. Provide counterweight type complete with frame, end bearing, counterbalance assembly, blades, and linkage.
 2. Install at outside air intake, exhaust outlets, and where shown on Drawings.
 3. Pacific Air Products #PRD - 100AL, Ruskin #CBS - 7 or equal by American Warning, or Vent Products.
- E. Turning Vanes
 1. Provide turning vanes at all 90° and 45° square elbows. Turning vanes shall be double wall air foil type constructed and installed as per SMACNA.

2.5 DUCT INSULATION

- A. Acceptable Manufacturers: Provide products of the following manufactures, complying with specified requirements. Equivalent products of other manufacturers will be considered.
 1. Owens - Corning Fiberglas Corp.
 2. Manville Products Corp.
 3. Certainteed Corp.
- B. All insulation material shall comply with applicable energy conservation regulation for Project location.
- C. Provide composite mechanical insulation (insulation, jacket, coverings, sealers, mastics, and adhesives) with flame - speed index of 25 or less, and smoke - developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- D. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- E. Provide cements, adhesives, coatings, sealers, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.

2.6 REFRIGERANT PIPING

- A. Refrigerant piping to be copper seamless, vacuum packed tubing.
- B. All suction lines to slope back towards condensing unit.
- C. All suction lines heading up towards condensing unit shall have a "P" trap.
- D. Provide sight glass and filter drier on liquid lines at condensing units.
- E. All re-frigerant piping underground to be contained in a PVC sleeve.
- F. Re-frigerant piping to be sized and installed as per equipment manufacturer's recommendations.

2.7 HVAC CONTROLS

- A. Shall be as indicated on the Drawings.
- B. Electric and Electronic HVAC Controls - Components and operating features as indicated on the Drawings.

PART 3 - EXECUTION

3.1 HVAC SYSTEM INSTALLATION, GENERAL

- Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements
 1. Coordinate mechanical systems, equipment, and materials with