PART 1   GENERAL

1.1  WORK INCLUDED
A. Isolation of mechanical equipment as indicated on the Drawings and specified herein.
B. Seismic restraint of equipment, piping and ductwork.

1.2  RELATED WORK SPECIFIED ELSEWHERE
A. Section 15050 Basic Mechanical Materials and Methods
B. Section 15140 Supports and Anchors.
C. Section 15891 Low Pressure Ductwork.
D. Section 15892 Medium Pressure Ductwork.

1.3  QUALITY ASSURANCE
A. A single manufacturer shall select and furnish all isolation required, except packaged equipment with integral isolators shall be provided thereunder.
B. Isolation performance requirements are indicated on the Drawings. All deflections indicated are minimum actual static deflections for specific equipment supported.
C. Isolator Stability:
   1. Size springs of sufficient diameter to maintain stability of the equipment being supported with minimum horizontal to vertical stiffness ratio not less than 0.9 or greater than 1.5.
   2. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
D. Seismic Restraints:
   1. Restraint of equipment, piping and ductwork to be in accordance with the current state and local Building Code.
   2. All calculations shall be in accordance with the project design seismic zone with a minimum restraint capability of 1.0G.

1.4  SUBMITTALS
A. Submit the following in accordance with Section 15050:
   1. Submit Shop Drawings showing complete details of construction for steel and concrete bases including:
      a. Equipment mounting holes.
      b. Dimensions.
      c. Isolation selected for each support point.
      d. Details of mounting brackets for isolator.
      e. Weight distribution for each isolator.
      f. Code number assigned to each isolator.
   2. Submit product data and calculation sheets for isolators, showing:
      a. Size, type, load and deflection of each required isolator.
      b. Percent of vibration transmitted based on the lowest disturbing frequency of the equipment.
B. Installation report as specified in Part 3 of this section.
C. Operation and maintenance data.
1.5 EQUIPMENT VIBRATION ISOLATION
   A. The installing contractor to furnish a balanced set of vibration isolators for each piece of equipment listed in the Equipment Schedule.
   B. Isolation work to include, but not necessarily be limited to, the following:
      1. Isolation support of motor-driven equipment.
      2. Inertia base frames in conjunction with isolation.
      3. Isolation support of air-handling housings.
      4. Isolation support of piping, piping risers, and ductwork.
      5. Penetration isolation of pipework, ductwork, and conduits through walls, floors or ceilings.
      6. Flexible connections of ductwork and piping to equipment.
   C. Each piece of rotating equipment must meet a reasonable criterion for maximum vibration levels at each bearing, while in operation. The criteria for varying operating speeds are given as follows:
      1. Rotating equipment operating peak vibration velocities must not exceed 0.08 in./sec.
      2. If it is discovered that the operating vibration velocities exceed this criteria, the equipment shall be repaired or replaced at no expense to the owner until approval of the equipment is given by the engineer.
   D. Any components or materials not specially mentioned herein, but necessary to the proper vibration isolation of the equipment, shall be provided.

1.6 ACCEPTABLE MANUFACTURERS
   A. Amber Booth.
   B. Mason Industries, Inc.
   C. Kinetics Corporation.
   D. Vibrex.
   E. Approved equal, meeting all of the conditions and requirements specified herein.

1.7 CONTRACTOR RESPONSIBILITY
   A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or suppliers.
   B. Adequately restrain all equipment, piping, and ductwork to resist seismic forces. Design and select restraint devices to meet seismic requirements as defined in the latest issue of the International Building Code under Earthquake Design and applicable state and local codes in accordance with project area Seismic Zone with a minimum restraint capability of 1.0 g.
   C. In addition, the contractor shall have the following responsibilities:
      1. Selection, installation, adjustment and performance of vibration isolators which will meet the requirements given on the plans or in the specifications.
      2. Provide Engineering drawings, details, supervision, and instruction to assure proper installation and performance.
      3. Provide whatever assistance necessary to ensure correct installation and adjustment of the isolators.

PART 2 PRODUCTS
2.1 TYPE 1 - NEOPRENE WAFFLE PAD
   A. 1/4-inch thick neoprene waffle pads with pattern repeating on 1/2-inch centers.
   B. Select Duro rating for maximum deflection at average load rating.
   C. Acceptable Manufacturer: Mason Type “W”; Similar Amber-Booth, Kinetics Corporation.
2.2  TYPE 2 - DOUBLE DEFLECTION NEOPRENE
A. Double deflection neoprene mountings with minimum actual static deflection for equipment supported of 0.35 inches.
B. Friction pad both top and bottom.
C. Steel rails used above those mountings of equipment with overhang.
D. Manufacturer: Mason type ND or rail type DNR, similar Amber-Booth type RVD, Kinetics Corporation, Vibrex.

2.3  TYPE 3 - SPRINGS
A. Free standing springs without housings.
B. 1/4-inch neoprene acoustical friction pads between base plate and support.
C. All mounting shall have leveling bolts with height saving brackets.
D. Springs mounted outboard of channels.
E. Attach baseplate screws using neoprene bushings and washers.
F. Spring diameters not less than 0.8 of the compressed height of the spring at rated load.
G. Manufacturer: Mason type SLF, Amber-Booth type SW, Kinetics Corporation, Vibrex, units requiring limit stops similar to Mason type SLR.

2.4  TYPE 4 - SPRINGS WITH RESTRAINTS
A. Same as springs except seismic restraints to be added.
B. Seismic restraint on integral part of isolator.
C. Seismic restraint selected for 2G ultimate seismic capacity.
D. Manufacturer: Mason type SSLR with seismic restraints; similar Amber-Booth, Kinetics Corporation Model FYS, Vibrex.

2.5  TYPE 5 - BASE WITH SPRINGS
A. Integral structural steel base; rectangular or tee shaped as required.
B. All perimeter members shall be WF beams with minimum depth equal to 8% of longest dimensions of base.
C. Fan Bases: Mason WFSL with external height saving brackets.
D. Pump Bases: Mason KSL with external height saving brackets.
E. Closed Circuit Cooler Base: Mason WF with external height saving brackets and 2-1/2-inch deflection springs with restraints.
F. Manufacturer: Mason as indicated, similar Amber-Booth, Kinetics Corporation, Vibrex.

2.6  TYPE 6 - ISOLATING HANGERS
A. Combination rubber-in shear and steel spring isolators installed on the hanger rods.
B. Isolators shall have the proper deflection to allow the piping to deflect as a unit with the pump isolators.
C. Hangers designed for 30 degree angular movement.
D. Minimum deflection shall be one inch.
E. Manufacturer: Mason 30N, similar Amber-Booth, Consolidated Kinetics, Vibrex.
2.7 ISOLATING SLEEVES
   A. Provided for all piping through walls and floors of penthouses and chiller room. Size for piping as required.
   B. Manufacturers: Potter-Roemer PR isolators or Grinnell Semco Trisolators.

2.8 SEISMIC RESTRAINTS
   A. General Requirements:
      1. Seismic restraints shall be provided for all equipment, both supported and suspended, piping and ductwork.
      2. Bracing of piping and ductwork shall be in accordance with the provisions set forth in the SMACNA seismic restraint manual.
      3. The structural requirements for the restraints, including their attachment to the building structure, shall be reviewed and approved by the structural engineer.
      4. Attachments to supported or suspended equipment must be coordinated with the equipment manufacturer.
   B. Supported Equipment:
      1. The seismic restraints shall consist of interlocking steel members restrained by shock absorbent neoprene materials compounded to bridge bearing specifications as previously noted in paragraph 1.3. The elastomeric materials shall be replaceable and be a minimum 3/4-inch thick. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8-inch, nor more than 1/4-inch.
      2. Each snubber shall be capable of restraint in all three mutually orthogonal directions.
      3. Submittals shall include load versus deflection curves up to 1/2-inch on the x, y and z planes. Tests shall be conducted in an independent laboratory or under the signed supervision of an independent registered engineer. The snubber assemblies shall be bolted to the test machine as the snubber is normally installed. Test reports shall certify that neither the neoprene elements nor the snubber body has sustained any obvious deformation after release of the load.
      4. Acceptable Manufacturer: Mason Model Z-1011, or similar Amber-Booth, Kinetics Corporation.
   C. Bracing of Pipes:
      1. Provide seismic bracing of all piping as detailed below.
      Exception: Piping suspended by individual hangers 12 inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced.
      a. Brace all fuel oil piping, gas piping, such as fuel gas, medical gas piping, and compressed air piping that is 1-inch nominal diameter or larger.
      b. Brace all piping located in boiler rooms, mechanical equipment rooms, and refrigeration mechanical rooms that is 1-1/4-inch nominal diameter and larger.
      c. Brace all pipes 2-1/2 inches nominal diameter and larger.
      2. Seismic braces for pipes on trapeze hangers may be used.
      3. Provide flexibility in joints where pipes pass through building seismic joints or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators. For threaded piping, the flexibility may be provided by the installation of swing joints.
      4. Cast iron pipe of all types, glass pipe, and any other pipe jointed with a shield and clamp assembly, where the top of the pipe is 12 inches or more from the supporting structure, shall be braced on each side of a change in direction of 90 degrees or more. Riser joints shall be braced or stabilized between floors.
      5. Vertical risers shall be laterally supported with a riser clamp at each floor. For buildings greater than six stories high, all risers shall be engineered individually.
D. Bracing of Ductwork:
   1. Brace rectangular ducts with cross sectional areas of 6 square feet and larger. Brace flat oval ducts in the same manner as rectangular ducts. Brace round ducts with diameters of 28 inches and larger. Brace flat oval ducts the same as rectangular ducts of the same nominal size. Exception: No bracing is required if the duct is suspended by hangers 12 inches or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached.
   2. Transverse bracing shall occur at the interval specified in the SMACNA tables or at both ends if the duct run is less than the specified interval. Transverse bracing shall be installed at each duct turn and at each end of a duct run, with a minimum of one brace at each end.
   3. Longitudinal bracing shall occur at the interval specified in the SMACNA tables with at least one brace per duct run. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it if the bracing is installed within four feet of the intersection of the ducts and if the bracing is sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.

E. Suspended Equipment and Piping and Ductwork:
   1. Cable Method: The seismic restraints shall consist of a combination of stranded steel aircraft cable and the specified vibration isolation hanger with an added nut and neoprene and steel washer. The cable resists lateral and downward motion. The modified vibration hanger resists upward motion.
   2. Cable attachment details, cable size, and the neoprene and steel washers shall be sized by the manufacturer and are to be indicated in the Shop Drawings.
   3. Provide detailed Shop Drawings for approval in sufficient time to allow structural attachment work to be incorporated into the normal work sequence.
   4. Acceptable Manufacturers: Mason Model SSB.

PART 3 EXECUTION

3.1 GENERAL
   A. Do not install any equipment or pipe which makes rigid contact with the building. "Building" includes slabs, beams, studs, walls, etc.
   B. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
   C. Correct, at no additional cost, all installations which are defective in workmanship or materials.

3.2 PREPARATION
   A. Treat all isolators, including springs, brackets and housing, with a rustproof metal primer.
   B. Coat items exposed to weather with cadmium plating, galvanizing, or plastic coating.

3.3 INSTALLATION
   A. General:
      1. Install isolation where indicated on the Drawings by type and location and where indicated below.
      2. The assigned code number shall be marked on the isolators and bases to assure placement in the proper location.
      3. Anchor baseplate to floor. Rubber grommets and washers shall be provided to isolate the bolt from the base plate. Under no circumstances shall the isolation efficiency be destroyed when bolting the isolators to the floor.
MECHANICAL NOISE, VIBRATION AND SEISMIC CONTROL

B. Isolating Pipe Hangers:
   1. Install on heating and chilled water piping in mechanical room connected to rotating equipment. Provide isolating hanger supports for each piece of isolated equipment outside of mechanical room and where indicated.
   2. Isolated equipment items in general include air supply units with integral heating or cooling coils, base mounted pumps, line mounted pumps. Air supply units in which fans are internally isolated do not require isolating pipe hangers.

C. Pump Bases:
   1. Fill with concrete to provide base weight equal to 2 times combined pump, motor, pipe, and water weight.
   2. Support heels of suction and discharge elbows from base.
   3. Secure pump and heel supports with inserts and grout.

3.4 SEISMIC RESTRAINTS

A. General:
   1. Install and adjust seismic restraints so that the equipment, piping, and ductwork supports is not degraded by the restraints.
   2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Supported Equipment:
   1. Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities.
   2. Care must be taken so that a minimum 1/8-inch air gap in the seismic restraint snubber is preserved on all sides in order that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment be completed after the vibration isolators are properly installed and the installation approved.

C. Bracing of Pipes:
   1. Branch lines may not be used to brace main lines.
   2. Transverse bracing shall be at 40 feet maximum except where a lesser spacing is indicated in the SMACNA tables for bracing of pipes.
   3. Longitudinal bracing shall be at 80 feet maximum except where a lesser spacing is indicated in the tables. In pipes where thermal expansion is a consideration, an anchor point may be used as the specified longitudinal brace provided that it has a capacity equal to or greater than a longitudinal brace. The longitudinal braces and connections must be capable of resisting the additional force induced by expansion and contraction.
   4. A rigid piping system shall not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
   5. Transverse bracing for one pipe section may also act as longitudinal bracing for a pipe section of the same size connected perpendicular to it if the bracing is installed within 24 inches of the elbow or tee.

D. Bracing of Ductwork:
   1. Hangers must be positively attached to the duct within 2 inches of the top of the duct with a minimum of two #10 sheetmetal screws.
   2. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
   3. Walls, including gypsum board nonbearing partitions, which have ducts running through them may replace a typical transverse brace. Provide solid blocking around duct penetrations at stud wall construction.
   4. Unbraced ducts shall be installed with a 6-inch minimum clearance to vertical ceiling hanger wires.
E. Suspended Equipment, Piping, and Ductwork Cable Method:
   1. The cables shall be adjusted to a degree of slackness approved by the Structural Engineer.
   2. The uplift and downward restraint nuts and washers for the Type HST hangers shall be adjusted so that there is a minimum 1/4-inch clearance.

3.5 FIELD QUALITY CONTROL

A. Installation Report: Isolation manufacturer’s representative shall confirm that all isolation is installed correctly and submit report stating that isolators are installed as shown on Shop Drawings, isolators are free to work properly, and that installed deflections are as scheduled and as specified.

END OF SECTION