PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and the following Specification sections apply to all Work herein:
1. Section 22 00 10 - General Requirements
2. Section 22 00 20 - Plumbing Scope of Work
3. Section 22 05 07 - Design Conditions
4. Section 22 05 93 - Testing, Balancing and Adjusting
5. Section 22 07 00 - Thermal Insulation
6. Section 22 10 00 - Domestic Water Systems
7. Section 22 21 23 - Pumps
8. Section 22 30 00 - Plumbing Equipment
9. Section 22 63 13 - Natural Gas Systems
10. Section 23 10 00 - Facility Fuel System

1.2 SUMMARY

A. Furnish and install foundation vibration isolation, and associated equipment for piping, rotating equipment, etc., as specified herein.

B. The Division 22 Subcontractor shall assume complete responsibility for the anchoring of the equipment, piping systems, etc., specified hereinafter to the concrete foundation pads, to the concrete inertia bases and to the supporting structural steel and concrete beams.

C. Coordinate piping supports for use in the parking garage structure.

D. The Division 22 Subcontractor shall provide all miscellaneous steel for support of equipment, piping systems and ductwork systems.

1.3 REFERENCE STANDARDS

A. All vibration isolation devices and components shall be designed, manufactured and tested in accordance with the latest applicable standards including the following:
1. ANSI R211

B. All equipment and material to be furnished and installed on this Project shall be in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and Section 22 00 10 and shall include, but not be limited to:
1. Vibration Isolation* including calculations, Drawings, etc. Submittal data shall include size, type, load and deflection of each isolator selected and shall clearly outline procedures for setting and adjusting all isolation devices.
2. Pipe Risers* including pipe riser diagrams and loads imposed upon the structure at support points.
3. Complete installation instructions including details and sizing of anchor devices or plates required shall be furnished by the manufacturer.
4. The Plumbing Subcontractor shall submit isolation Shop Drawings for all horizontal and vertical piping, equipment inertia bases, and plumbing equipment to the Structural Engineer, Architect and Engineer prior to fabrication and installation of any of the isolation and restraint equipment or systems. Submittal data shall include certification by the vibration isolation manufacturer that all water and steam piping systems (horizontal and vertical) have been examined for excessive stresses and that none will exist in the design proposed. See Section 22 00 10 for certification requirements. Piping Shop Drawings shall indicate the anticipated thermal expansion and contraction at each support point, creep and/or compression of the building structural frame, initial and final loads on the building structure, spring deflection changes, construction loading, normal operating condition loading and the structural loading

which will occur during normal operation of each piping system expansion and contraction. All calculations shall be included with the Shop Drawings and shall be of a similar format to facilitate review. Each device shall have a permanently attached identification tag, which is cross referenced to the diagrams by location and service (not just model numbers or serial numbers).

5. Piping Shop Drawing Stress Analysis* shall indicate the anticipated thermal expansion and contraction at each support point, creep and/or compression of the building structural frame, initial and final loads on the building structure, spring deflection changes, construction loading, normal operating condition loading and the structural loading which will occur during normal operation of each piping system expansion and contraction. All calculations shall be included with the Shop Drawings and shall be of a similar format to facilitate review.
6. Each isolator shall have a permanently attached identification tag, which is cross referenced to the Shop Drawings by location and service (not just model numbers or serial numbers).
7. Shop Drawings shall be submitted to the Project Structural Engineer for review of loads exceeding [500 lb.] imposed on the building structure. The Shop Drawing shall be submitted to the Engineer for review after review by the Project Structural Engineer.
8. Shop Drawings shall also be submitted to the Project Acoustical Consultant for review.
9. Factory Test Reports
10. Proposed test procedures, recording forms, test equipment, and list of personnel and qualifications for all tests proposed. Refer to Section 22 05 93 titled “Testing, Balancing, and Adjusting” for additional requirements.
11. Field Test Reports
12. Manufacturer’s factory trained technician written certification that all vibration isolation has been installed properly in accordance with the manufacturer’s recommendations.
13. Seismic restraint calculations stamped by a California State licensed structural or civil engineer, confirming compliance with ASCE 7-05.
14. Provide calculations to demonstrate compliance with the requirements of regulatory agencies.
15. Note compliance with seismic code regulations and the project specification on the submittals.
16. Number and location of seismic restraints and anchors for each piece of equipment including but not limited to bolted or welded connections between cooling tower and support beams, vertical pipe risers, bolt sizing and embedment depth, and seismic cable strength and diameters.
17. Specific details of restraints including anchor bolts for mounting and maximum loading at each location.
18.

B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification “MCA” as set forth in Section 22 00 10. See Section 22 00 10 for certification requirements.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 22 00 10.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. If it complies with these Specifications, one of the following vibration isolation manufacturers will be acceptable:
1. Amber/Booth Company (The VMC Group)
2. Grinnell Corporation
3. Korfund Dynamics Corporation (The VMC Group)
4. Mason Industries, Inc.
5. Peabody Kinetics
6. Vibration Eliminator Company
7. Vibration Mounting and Controls, Inc. (The VMC Group)
8. Vibrex Vibration Control Systems (Sausse)
9. Vibro-Acoustics
10. Victaulic Corporation

B. Unless otherwise noted, the vibration isolation devices described herein are products of the Amber/Booth Company.

2.2 GENERAL

A. All vibration isolators shall be furnished with zinc electroplated hardware to prevent corrosion and bolt freeze up and to maintain attractive appearance. To prevent corrosion, steel or cast iron housing shall be treated by phosphating and painting while aluminum housing shall be etched in Chromi Coat solution and painted. Isolators exposed to weather shall have the spring cadmium plated or PVC coated. Housings shall be of cast aluminum, hot dipped galvanized steel or steel cadmium plated after fabrication.

B. Isolators for equipment subject to wind loading shall be provided with uplift restraints.

C. The isolation devices for all piping systems and channel frames shall be products of a single vibration isolation manufacturer. The isolation manufacturer's local representative shall maintain an adequate stock of springs and isolators of the type used so that any changes required during construction and checking can be accomplished promptly. Complete installation instructions including details and sizing of anchor devices or plates required shall be furnished by the manufacturer.

D. The Subcontractor shall coordinate the vibration isolation supports with the manufacturers of the equipment to be isolated. See the Paragraph titled "Coordination Drawings" in Section 22 00 10 for additional requirements.

E. Seismic restraints and anchorage shall be designed for the lateral and vertical forces required by the Building Code for the specific project type and site. Confirm lateral and vertical forces and site-specific design criteria with the project Structural Engineer.

2.3 VIBRATION ISOLATION FOR DOMESTIC WATER PUMPS

A. Pumps for the service listed below shall be installed on concrete inertia pads with minimum thickness as specified below and designed for support of the pump and pump elbows and shall be formed of concrete poured with a structural steel frame with reinforcing as required as listed hereinbefore. Isolation shall consist of Type PSW-2 spring isolators embedded in the inertia pad with ribbed neoprene pads and removable coverplate. The spring shall be sized for 2" deflection and shall be cast in the concrete inertia block. Prior to startup, clean out all foreign material between the inertia block and the concrete base.

B. Minimum Thickness of Concrete Pad or Inertia Base shall be:

Total Motor HP	Minimum Thickness (Inches)
5-15	6
20-50	8
60-75	10
100-250	12
300-400	14

2.4 VIBRATION ISOLATION FOR PIPING

A. All piping for the systems listed below shall be isolated by means of spring type vibration isolation hangers as may be required to create the effect of a completely floating system. It shall be the responsibility of the vibration isolation manufacturer to coordinate the selection of piping supports with equipment supports to provide for a carefully engineered system designed to accommodate expansion and contraction without creating excessive stresses in any portion of the piping system or stress at any equipment connections in excess of that allowed by the equipment manufacturers. Consideration shall be given to the movement of piping through sleeves with fire safing. Refer to Section 22 00 10 for additional requirements. Piping for the following systems shall be isolated:
   1. All piping 4" in diameter and larger for pumped domestic water, except vertical zone risers downstream of PRV stations.
   2. All piping where exposed on the roof.
   3. All piping 2-1/2" and over located in all mechanical equipment rooms, and for a minimum of 50' or 100 pipe diameters, whichever is greater, from connection to vibrating or rotating plumbing equipment.

B. Isolation hangers for horizontal piping shall be installed at regular intervals as per the hanger schedule specified in Section 22 10 00 titled “Domestic Water Systems”.

C. Pipe risers shall be supported at the intervals listed below for each piping system.
   1. Isolator supports for pipe risers shall have deflection capability at least four (4) times the anticipated thermal expansion to minimize the transfer of piping weight from floor to floor as pipe risers expand and contract during normal operation.
   2. Isolator supports for pipe risers shall have deflection capacity to account for structural creep in concrete frame buildings and structural compression in steel frame buildings that will occur during the first four years after construction, in addition to the anticipated thermal expansion and contraction. Refer to structural drawings and specifications to determine anticipated creep and compression values.
   3. Stagger the support points as necessary so the load points do not occur on the same level. The isolation device manufacturer shall provide written detailed instructions for loading the isolators and putting system in service. Isolator supports for piping risers shall be located at the following intervals:
      a. Domestic water: Every third floor, not to exceed 35’.

D. Temporary anchors, where required, shall be installed to permit preadjustment procedure to control direction of pipe movement. Final operating deflection of the springs shall be detailed in the submittal data.

E. Vibration isolators for the piping systems shall be of the following types:
   1. The first two (2) hangers for suspended horizontal piping at equipment and at the riser connection of horizontal piping shall be Type PBS positioning type spring hangers with load transfer plate to hold piping at a fixed elevation during installation and to permit transferal of the load to the spring after installation. The remaining hangers for suspended horizontal piping shall be Type BS. Hangers in main mechanical equipment room shall be Type BSRA, combination spring and rubber angularity hangers.
   2. Hangers for horizontal piping at riser connections shall be sized to accommodate anticipated vertical riser movement due to thermal expansion and contraction, plus anticipated structural creep or compression described herein above.
   3. The first two (2) isolators for floor supported piping and isolators for floor mounted equipment shall be Type XL or CT. The remaining floor supports shall be Type SW.
   4. Riser supports shall be Type SWP precompressed spring supports, preset by the vibration isolation manufacturer to the proper initial load as determined by the computer printout of riser support/expansion analysis. Individual spring designation shall be identified on the Shop Drawings and securely attached to the spring isolator. Riser supports shall be floor mounted and the pipe clamp or support shall mount directly on the isolator. Refer to the detail on the Drawings for riser supports. No extensions will be allowed to connect to the pipe clamp.

2.5 SEISMIC RESTRAINTS

A. Provide restrains capable of safety accepting forces specified and/or as required by the authorities having jurisdiction without failure, to maintain equipment, piping in a captive position. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise. If required by the authorities having jurisdiction, submit calculations by Structural Engineer licensed and registered in the State of the project to verify seismic restraint and sway cable capacities. Provide products with certification numbers or provide calculations demonstrating compliance with regulatory requirements.
   1. Spring Seismic Restraint, Type 1: Comply with general characteristics of Spring Isolators. Incorporate snubbing restraint in all directions. Restraint shall be capable of supporting equipment at a fixed elevation during equipment erection.
      a. Type CT-LR.
   2. Seismic Restraint, Type II: Each corner or side seismic restraint shall incorporate minimum 5/8 inch thick pad limit stops. Restraints shall be made of plate, structural members or square metal tubing in a welded assembly incorporating resilient pads.
      a. Type ER.
   3. Seismic Restraint, Type III: Cable type with approved end fastening devices (minimum of two per end) to equipment and structure. Cable to comply with Federal Specifications MIL-W-83420 military grade 7x19 galvanized steel.
      a. Type SSB – Mason Industries, Inc.

B. Provide diagonal thrust restraint consisting of hangers with the same deflection as specified for the spring mountings. Design the spring element so it can be preset for thrust and adjusted to allow for a maximum of 1/4 inch Type WB – Mason Industries, Inc.

PART 3 EXECUTION

3.1 INSTALLATION

A. The complete vibration isolation installation shall be in accordance with the manufacturer's recommendations and as indicated on the Drawings.

3.2 SEISMIC RESTRAINTS

A. General:

1. Cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment or piping. Cable restraints shall be installed taut on non-isolated systems. Seismic solid brace restraints may be used in lieu of cables on non-isolated rigidly attached systems only.
2. Where cable or solid brace restraints are located, the equipment, or piping support rods shall be angle braced for compression loads.
3. At all locations where cable or solid brace restraints are attached to pipe clevises, the clevis cross bolt shall be reinforced with cross braces or a pipe spacer placed over the clevis bolt.
4. Provide drill-in concrete anchors for ceiling and wall installation and female wedge type for floor-mounted equipment.

B. Seismic Restraint of Piping:

1. Transverse piping restraints shall be at 40-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
2. Longitudinal restraints shall be at 80-foot maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads.
3. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.
4. Cast iron piping transverse restraints must be at 20-foot maximum and longitudinal restraints at 40-foot maximum spacing.
5. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within a specified distance (based on engineered data) of the elbow or tee or combined stresses are within allowable limits at longer distances.
6. Hold-down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.
7. Branch lines may not be used to restrain main lines.

C. Seismic Restraint of Equipment:

1. All mechanical equipment shall be vibration isolated and seismically restrained as scheduled using either inherently restrained vibration isolators or separate all-directional seismic snubbers as specified. Suspended equipment shall be restrained by cable restraints.

D. Seismic Restraint Exclusions (Flexible connectors are required between pipe and equipment):

1. Piping:

a. For I_p = 1.5 projects or systems, all piping 1-inch nominal diameter and smaller, except cast iron piping, regardless of size.

b. For I_p = 1.0 projects, all steel and copper piping 3-inch diameter and smaller, except cast iron piping, regardless of size.

c. All piping suspended by individual hangers 12 inches or less as measured from the top of the pipe to the bottom of the support where the hanger is attached provided the hanger rod connection to the structure will not develop a moment. However, if the 12-inch limit is exceeded by any hanger in the run, seismic bracing is required for the run.

d. The 12-inch exemption applies for trapeze supported systems if the top of each item supported by the trapeze qualifies.

E.

3.3 FACTORY TESTING

A. All vibration isolation devices and components shall be tested in accordance with the latest applicable industry standards.

3.4 FIELD TESTING

A. After installation and prior to “Final Review”, the isolation manufacturer’s factory trained technician shall check all the various isolators and certify in writing to the Subcontractor and Owner that they have been installed properly and are in accordance with the manufacturer’s recommendations.

B. Refer to Section 22 05 93 for additional testing requirements for equipment installed with vibration isolation.

END OF SECTION