SECTION 15050 - VIBRATION ISOLATION

City of San Diego, CWP Guidelines

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing vibration isolation systems for mechanical equipment. Additional vibration isolation system requirements may be included in individual equipment sections.

B. The WORK also includes coordination of design, assembly, testing and installation.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 11000 Equipment, General

1.3 CODES

A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

1. Uniform Mechanical Code

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ANSI A58.1	Minimum Design Loads for Buildings and Other Structures
2.	ASHRAE CH 52	1987 Handbook, HVAC Systems and Applications, Sound and Vibration Control

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300:

1. Static and dynamic deflections, weights, isolator locations, and flexible connector design information.

2. Information on spring deflections and diameters, compressed spring heights and solid spring heights.

3. Curb mounted base seal and wind resistance details.

4. Scale drawing of Type D mounting hanger showing the 30 degree arc capability.

5. Seismic restraint load deflection curves.

6. Qualifications of the engineer who will perform the vibration isolation design.

1.6 OWNER'S MANUAL

A. The following shall be submitted in compliance with Section 01300:

1. Certified seismic restraint dynamic analysis report.
2. Manufacturer's final inspection report and certification.

PART 2 - PRODUCTS

2.1 GENERAL

A. **Mounting Requirements**: Unless the equipment incorporates unit construction using an integral rigid frame or is indicated otherwise, each item of mechanical equipment, along with its drive unit, shall be mounted on a rigid steel and concrete base. Cast iron bases are not permitted when equipment is furnished with a vibration isolation system. Where indicated, the equipment, including the base, shall be mounted on or suspended from vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the supporting structure. Vibration isolation available internally in the equipment will not be considered equivalent and shall not be provided in lieu of the vibration isolation indicated. Normally provided internal vibration isolators shall be replaced with rigid supports in such cases. Vibration isolators shall be selected in accordance with unit weight distribution to produce reasonably uniform deflections at each support. Unless otherwise indicated, bases, isolators, and deflections shall be as indicated in Table 27, ASHRAE CH 52.

B. **Design Requirements**: The CONTRACTOR shall cause all vibration isolation systems, including the isolators, seismic restraints, and flexible connectors between the isolated equipment and associated piping, ducting and/or electrical work, to be designed by an engineer qualified in this type of work and having no less than 3 years' experience in it. This provision, however, shall not be construed as relieving the CONTRACTOR of his overall responsibility for the work. The CONTRACTOR shall submit the engineer's qualifications prior to starting the vibration isolation design. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of the vibration isolation system engineer.

C. **Seismic Restraints**:

1. General: Restraint devices shall resist the forces indicated and shall be designed in accordance with UBC for seismic zone 4. Design lateral forces shall be distributed in proportion to the mass distribution of the equipment.

2. Floor Mounted Equipment: Equipment and appurtenances floor mounted on spring or pad type vibration isolators, except for curb mounted equipment, shall be provided with seismic snubbers. Equipment shall receive four all-directional restraint snubbers. The capacity of snubbers, at 3/8-inch deflection, shall be 3 to 4 times the load at the adjacent equipment mount.

Restraint assembly for floor mounted equipment shall consist of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a resilient elastomer, 3/4 inches thick. Restraints shall be field adjustable and be positioned for 1/4-inch clearance both vertically and horizontally or clearance as required to prevent interference during normal operation, stopping, or starting. Restraint assembly shall have a minimum rating of [ ] g based on independent test data.

3. Curb Mounted Equipment: Seismic restraints for equipment mounted on vibration isolation curbs shall consist of slack stainless steel cables designed to provide [ ] g restraint in the four primary horizontal directions based on independent test data.

4. Suspended Equipment: Restraint assembly for suspended equipment, piping, or ductwork shall consist of plow steel cable attached to steel thimbles with neoprene sleeve all specifically designed for cable service and securely fastened to the equipment or the equipment base and the building structure. Cables shall be sized for a force of [ ] g with a minimum safety factor of 2 based upon independent test data. Cables shall be installed to prevent excessive seismic motion but not engage during normal operation, starting or stopping.

5. Testing: Seismic restraint dynamic tests shall be conducted in an independent laboratory or under the 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 elastomeric nor the snubber body sustained any obvious deformation after release of load.

2.2 BASES

A. **Curb Mounted Bases**: Curb mounted equipment where vibration isolation is required, principally roof top heating, ventilating, and air conditioning equipment, shall be mounted on vibration isolation bases that fit over the curb and under the isolated equipment. The extruded aluminum top and bottom members shall contain cadmium-plated springs having a 1-inch minimum deflection with 50 percent additional travel to solid. Spring diameters shall be no less than 0.8 times the spring height at rated load. Wind resistance shall be provided by means of resilient snubbers in the corners with a minimum clearance of 1/4 inch so as not to interfere with spring action except in high winds. The weather seal shall consist of continuous closed cell sponge materials both above and below the base and a waterproof flexible neoprene connection duct joining the outside perimeter of the aluminum members. Foam or other contact seals are unacceptable at the spring cavity closure. Caulking shall be kept to a minimum.

B. **Type I Bases**: Type I bases shall be structural steel bases. The bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases, which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10 of the longest dimension of the base. Beam depth need not exceed 14 inches provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1 inch.

C. **Type II Bases**: Type II bases shall be steel members used to cradle machines having legs or bases that do not require a complete supplementary base. All members shall be sufficiently rigid to prevent strains in the equipment. Height saving brackets shall be employed in all mounting locations to provide a clearance of 1 inch below the base.

D. **Type III Bases**: Type III bases shall be rectangular foundations consisting of concrete filled structural steel beam or channel forms. Bases for split case pumps shall be of sufficient size to provide support for suction and discharge base ells. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer or required for mass or rigidity. In general, base depth shall be a minimum of 1/12 of the longest dimension of the base but not less than 6 inches. Forms shall include, as a minimum, concrete reinforcement consisting of 1/2-inch bars or angles welded in place or additional steel as required by structural conditions. Forms shall be provided with drilled steel members with sleeves welded below the holes to receive equipment anchor bolts where the anchor bolts fail in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1-inch clearance below the base.

2.3 VIBRATION ISOLATION MOUNTINGS

A. **Type A Mountings**: Type A mountings shall be double deflection neoprene mountings having a minimum static deflection of 0.35 inches. All metal surfaces shall be neoprene covered to avoid corrosion and shall have friction pads both top and bottom so that they need not be bolted to the floor. Bolt holes and anchor bolts shall be provided where required to resist lateral migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases. On equipment such as small vent sets, steel rails shall be used above the mountings to compensate for the overhang.

B. **Type B Mountings**: Type B mountings shall be free-standing spring type isolators laterally stable without any housing and complete with 1/4-inch neoprene acoustical friction pads between the base and the support. Mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. Mountings shall be hot-dip galvanized steel.

C. **Type C Mountings**: Type C mountings shall be Type B mountings with a housing having vertical limit stops to prevent spring extension when weight is removed. Type C mountings shall be provided for equipment with operating weight different from the installed weight, such as chillers and boilers, and equipment exposed to the wind, such as cooling towers. The housing shall serve as blocking during erection and shall be located between the supporting steel and roof or the grillage and dunnage as indicated. The installed and operating heights shall be the same. A minimum clearance of 1/2 inch shall be maintained around restraining bolts and between the housing and the spring to prevent interference with the spring action. Limit stops shall be out of contact during normal operations. Mountings shall be hot-dip galvanized steel.

D. **Type D Mountings**: Type D mountings shall be steel hangers which contain a steel spring and a 0.3-inch deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing which passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing through a 30 degree arc before contacting the hole. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.

E. **Type E Mountings**: Type E mountings shall be double deflection cork and rubber sandwich pads consisting of a high-density cork layer permanently bonded to top and bottom layers of corrugated oil-resistant synthetic rubber. The corrugated design shall allow deflection to increase with load and shall form a nonskid surface to resist lateral migration of the equipment. Bolt holes and anchor bolts shall be provided where required to resist migration. Resilient washers and bushings shall be provided to prevent contact between the bolts and the equipment support bases.

2.4 MANUFACTURERS

A. Products of the type indicated shall be manufactured by one of the following (or equal):

1. Consolidated Kinetics Corporation
2. Korfund Dynamics
3. Mason Industries, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **General**: Vibration isolators and equipment shall be installed in accordance with the manufacturer's written instructions.

B. Flexible connectors shall be provided by the manufacturer of the mechanical equipment item in accordance with the recommendations of the vibration isolation system engineer.

3.2 FIELD INSPECTION

A. The vibration isolation manufacturer, or his qualified representative, shall provide such supervision as is necessary to assure correct installation and adjustment of the isolators and seismic restraints. Upon completion of the installation and after the system is put into operation, the manufacturer or his representative shall make a final inspection and submit his report in writing certifying the correctness of installation and compliance with shop drawings.

** END OF SECTION **