KORFUND DYNAMICS COMPANY
VIBRATION MOUNTING AND CONTROLS, INC.

SUGGESTED SPECIFICATION

MECHANICAL VIBRATION CONTROL

AND SEISMIC RESTRAINT

Specification No. 15241-1

113 Main Street, Box 37, Bloomingdale, NJ 07403 • Telephone (201) 838-1780
• Fax (201) 492-8430 • www.vmc-kdc.com

VIBRATION MOUNTINGS AND CONTROLS
VIBRATION ISOLATION AND SEISMIC RESTRAINT SPECIFICATION
FOR HVAC, FIRE PROTECTION, ELECTRICAL AND PLUMBING

PART 1 - GENERAL

1.01 SCOPE

Unless otherwise noted on equipment schedules or specification, all equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted structure-borne noise to the building structure. The scope of this dual purpose specification encompasses the necessary design and product specifications for the vibration isolation and seismic restraint of mechanical equipment, piping, and ductwork, and is part of the general conditions for the HVAC, plumbing, fire protection and electrical contracts.

1.02 REQUIREMENTS

All vibration mountings shall be manufactured in the United States.

1.03 INTENT

It is the intent of the seismic restraint portion of this specification to provide restraint of non-structural building components. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component center of gravity. The work in this section includes the following:

- Vibration isolation elements for equipment
- Equipment isolation bases
- Piping flexible connectors
- Seismic restraints for isolated equipment
- Seismic restraints for non-isolated equipment
- Certification of seismic restraint designs and installation supervision
- Certification of seismic attachment of housekeeping pads

1.04 DEFINITIONS

The term EQUIPMENT will be used throughout this specification. It includes all non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on grade within five feet of the foundation wall. Equipment buried underground are excluded but entry of services through the foundation wall are included. The term "equipment" shall refer (but not be limited to) the following:

AC units	Cabinet Heaters	Conduit	Light Fixtures	Transformers
Air Handling Units	Cable Trays	Cooling Towers	Mtr. Cntrl. Ctrs.	Unit Heaters
Air separators	Chillers	Ductwork	Piping	Unit Substations
Battery Chargers	Compressors	Electrical Panels	Pumps (all types)	Unit Ventilators
Battery Racks	Comp. Rm. Units	Fans (all types)	Rooftop Units	Var. Freq. Drives
Boilers	Condensers	Generators	Switching Gear	Water Heaters
Bus Ducts	Condensing Units	Heat Exchangers	Tanks (all types)	

Life Safety systems shall be defined as:

- All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, and smoke exhaust systems
- All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all circuits to fire protection, and smoke evacuation.
- All medical and life support systems.
- Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, etc.

Positive attachment shall be defined as a support location with a cast-in or wedge type expansion anchor, a double-sided beam clamp, a welded or through bolted connection to the structure.

Transverse Bracing - Restraint(s) applied to limit motion perpendicular or angular to the centerline of the pipe, duct, or conduit.

Longitudinal Bracing - Restraint(s) applied to limit motion along the centerline of the pipe, duct, or conduit.

1.05 RESPONSIBILITIES

The manufacturer of vibration isolation and seismic restraint shall determine the sizes and locations of isolators and seismic restraints, provide equipment isolation and seismic restraints as specified, guarantee specified isolation system deflections, provide installation instructions, proper drawings, and shall certify correctness of installation upon completion.

The Contractor shall cause all vibration isolation systems, including the isolators, seismic restraints/snubbers and flexible connectors between the isolated equipment and associated piping, ducting and/or electrical work, to be designed by a Manufacturer experienced in this type of work. This provision, however, shall not be construed as relieving the Contractor of his overall responsibility for the work. The Contractor shall provide to the manufacturer of vibration isolation products a listing of all mechanical equipment to be isolated including RPM, total weight, center of gravity, and mounting attachment points. The structural integrity of the supported equipment shall be the responsibility of the equipment manufacturer.

1.06 DESIGN - VIBRATION ISOLATION SYSTEMS

Vibration isolators shall be selected based on known or estimated operating weight distributions of the isolated equipment, with the quantity and location as shown on the component drawing. Isolator type shall be tabulated for each isolated piece of equipment. Isolators shall have either known non-deflected heights of spring element or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified to determine if the load is within the proper range of the isolator and if the correct degree of vibration isolation is being provided. Isolators shall function in the linear portion of the load versus deflection curve. Theoretical vertical natural frequency shall not differ from the design objectives by more than 10%.

Substitution of internally or externally isolated and restrained equipment supplied by the equipment vendor, in lieu of the isolation and restraints specified in this section, is acceptable provided all conditions of this section are met. The Equipment manufacturer shall provide a letter of guarantee from their Engineering Department stamped and certified per the section on Seismic

Restraint Design (paragraph 1.07) stating that the seismic restraints are in full compliance with these specifications.

Letters from field offices or representatives are unacceptable. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment vendor in the event of non-compliance with the preceding. Internal isolation is not acceptable for:

- Rooftop equipment over or adjacent to:
  - Patient or operating areas
  - Theater space
  - Critical office location such as executive and conference areas.
  - Assembly areas

Unless the equipment incorporates unit construction using an integral unit frame or is specified otherwise, each item of mechanical equipment, along with its drive unit, shall be mounted on a rigid steel or steel and concrete base. The equipment, including the base, shall be mounted on, or suspended from, vibration isolators to prevent the transmission of vibration and mechanically transmitted structureborne sound to the supporting structure.

Isolation hangers shall be used for all piping in equipment rooms or for 50 ft. from vibrating equipment, whichever is greater. To avoid reducing the effectiveness of equipment isolators, at least three of the first hangers from the equipment should provide the same deflection as the equipment isolators, with a maximum limitation of 2 inch deflection. The remaining hangers shall be spring or combination spring and rubber with a minimum of 0.75 inch deflection. To prevent load transfer to the equipment flanges when the piping system is filled, the first three hangers adjacent to the equipment shall be the positioning type (specification type 5). Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use restrained vibration isolators. They should be selected according to the guidelines for hangers.

1.07 DESIGN - SEISMIC RESTRAINTS/SNUBBERS

Internally isolated equipment in lieu of specified isolation and restraint systems must include certification by the equipment manufacturer that the internal isolation system meets the specified isolation and system restraint criteria. A seismic design Errors and Omissions insurance certificate MUST accompany the equipment manufacturer's certification. Product liability insurance certificates are not acceptable. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure. Curb or roof rail mounted equipment must not only have seismic attachment to the structure but must additionally have seismic attachment of the equipment to the roof curb or rails. This attachment and certification thereof shall be by this section. Unless otherwise specified, all isolated equipment and all piping and duct work shall be seismically restrained in accordance with requirements contained herein. All unisolated mechanical equipment shall be adequately secured to the structure.

Each piece of isolated equipment shall receive a minimum of four all-directional restraint/snubbers, located as close to the equipment corners as practical. These shall consist of either restrained isolators or free standing isolators with separate snubbers. All snubbers must have an impact surface consisting of a high quality elastomer. The elastomer shall be easy to inspect for damage and shall be replaceable. All seismic restraint devices shall maintain the equipment in a captive position and not short circuit isolation devices during normal operating conditions.

Calculations by the Manufacturer's qualified licensed Engineer substantiating the mounting system, seismic restraints and recommended anchor bolts shall be submitted for approval along with the shop drawings. Minimum spacing and embedment of anchor bolts, as well as location from edges of structure or concrete, shall be identified.

Unless otherwise specified, all equipment, piping and ductwork shall be restrained to resist seismic forces. Restraints shall maintain mechanical equipment, piping or duct work in a captive position. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest issue of:

- Uniform Building Code,
- BOCA,
- Southern Building Code;
- applicable state and local codes (engineer to specify)

Exclusions for seismic restraint of piping and duct shall be according to the applicable codes. This site is classified as Seismic Zone (engineer to specify zone 1 thru 4). However, the minimum horizontal restraint capability shall be 0.5g horizontal and .33 vertical. Life safety equipment such as fire pumps, emergency generators, sprinkler piping, etc. shall be designed to survive a minimum 1.0g horizontal load and .67g vertical load.

1.08 SUBMITTALS

A seismic design Errors and Omissions insurance certificate must accompany submittals from the seismic engineer. Manufacturers product liability insurance certificates are not acceptable.

The manufacturer of vibration isolation products shall submit an itemized list of all isolated and non-isolated equipment with detailed schedules showing isolators and seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers. The schedule shall include the weight, center of gravity, and RPM of each piece of equipment. When equipment center of gravity is not available, assumed locations for center of gravity shall be identified in submittals.

Submittals for hangers and mountings shall indicate specific model numbers with complete dimensional and deflection data and color code. Base drawings for equipment shall include dimensions, structural member sizes, support point locations.

Seismic calculations, signed by a qualified licensed Professional Engineer, shall be submitted showing adequacy of bolt sizing and type. Calculations shall be furnished for anchors on restraint devices, cable, isolators and rigidly mounted equipment. Calculations shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. All performance of products (such as strut, cable, anchors, clips, etc.) associated with restraints must be supported with manufacturer's data sheets or certified calculations. Seismic analysis must indicate calculated dead loads, derived loads, and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or weld length.

1.08.1 RELATED WORK

Housekeeping pad design shall be by the project structural engineer. Attachment shall be designed and certified according to this section by the seismic/isolation supplier. Material and

labor required for attachment and construction shall be by the concrete section contractor. Housekeeping pads shall be sized to accommodate a minimum of six (6) inches of clearance all around the equipment and its mounting package. Structural support and connections for all equipment, including roof mounted equipment, specified in other sections shall comply with the seismic requirements of this section.

PART 2 - PRODUCTS

2.01 DESCRIPTION

All vibration isolation and seismic devices described in this section shall be the product of a single manufacturer. **Vibration Mountings and Controls, Inc.** is the base manufacturer of these specifications. Products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Base Manufacturer.

Design of hardware and devices such as beam clamps, anchor bolts, cable and cast-in-place plates must be by this section's supplier to ensure seismic compliance and certification. The contractor has the option to utilize alternate fastening devices (anchor bolts) so long as the sizing and dimensions on seismic submittals are followed.

Unless otherwise specified, all isolator hardware shall be zinc plated. Springs with a deflection of up to 2 inches shall be coated with a polyester epoxy powder. Springs and rubber isolators shall be color coded for proper identification of rated load capacity. Zinc plating shall conform at ASTM B633, Class 2 SC2, minimum. All other metal parts used outdoors shall be hot spray or hot dipped galvanized.

2.02 VIBRATION ISOLATION AND SEISMIC RESTRAINT TYPES

TYPE 1 - DOUBLE DEFLECTION NEOPRENE

Double deflection neoprene mountings shall have a minimum rated static deflection of 0.40 inches. Steel top plate and base plate shall be completely bonded and embedded in oil-resistant elastomer. Mountings shall be molded in color for ease of identification of load capacity, and shall have ribbed neoprene surfaces on top and bottom to provide friction pads for those applications which do not need to be bolted to the floor or to equipment. Bolt holes shall be provided on the bottom plate, and a tapped hole on the top, for applications requiring positive tie down.

Neoprene mountings shall be type RD as manufactured by Vibration Mountings and Controls, Inc.

TYPE 2 - FLOOR MOUNTED SPRING ISOLATORS

Spring-type isolators shall consist of a telescoping housing containing one or more steel springs as the isolation medium, shall have built-in leveling bolt, resilient inserts to act as upper and lower housing guides, and neoprene acoustical non-skid pad bonded to the bottom. Springs shall be color coded for proper identification of rated load capacity.

Spring-Flex Mounting shall be Series B or C as manufactured by Vibration Mountings and Controls, Inc.

Korfund Dynamics Company

Or

Free standing spring-type isolators, shall be laterally stable without housing, snubbers, or guides, and shall include a steel reinforced, ribbed neoprene cup (¼ inch minimum thickness) between the baseplate and the support. Mountings shall have leveling bolts on the top, consisting of an adjusting bolt, cap screw and washer. Mountings shall include a bolt hole in the bottom cup or a two hole rectangular steel baseplate for bolting to the structure.

Springs shall not be welded to the baseplate or cup. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection.

Free standing Spring-Flex Mounting shall be Series AC/ACB as manufactured by Vibration Mountings and Controls, Inc.

TYPE 3 - HOUSED SPRINGS WITH LIMIT STOPS

Free standing, laterally stable spring type isolators. Isolator is the same as described in Specification TYPE 2, except that it includes a housing to provide vertical limit stops to prevent spring extension during weight changes, or when equipment is exposed to uplift loads such as wind loading. The housing serves as blocking during erection, and shall be located between the equipment and supporting structure. There shall be a minimum clearance of ¼" between the restraining bolts and the housing and spring to prevent interference with spring performance. Limit stops shall be out of contact during normal operation. Mountings shall have an adjusting bolt on the top of the spring compression plate. For non-seismic applications, neoprene acoustical non skid pads (¼ inch minimum thickness) shall be attached to the bottom plate. When used in seismic applications, neoprene bushings shall be incorporated in the limit stop plate. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection. Springs shall not be welded to the cups or housings.

Spring-Flex Mountings shall be Series AWR or AWRS as manufactured by Vibration Mountings and Controls, Inc.

TYPE 4 - COMBINATION SPRING/RUBBER ISOLATION HANGERS

Spring-Flex hangers shall consist of a steel spring in series with a .2 inch (minimum) deflection neoprene element. Springs shall be color coded, and elastomer element molded in specific colors for proper identification of rated load capacity. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Pipe isolators shall have spring diameters and hanger box lower hole sizes of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box. Hangers which are to be used with flat iron duct straps will be provided with eye bolts on both ends.

Spring-Flex hangers shall be series RSH/RSH-30A as manufactured by Vibration Mountings and Controls, Inc. Hangers with eyebolts to be type RSHSC/RSHSC-30A as manufactured by Vibration Mountings and Controls, Inc.

TYPE 5 - SPRING/RUBBER PRE-POSITIONING HANGERS

Spring-Flex hangers shall consist of color-coded steel spring in series with a neoprene element molded in specific colors for proper identification of rated load capacity. Hanger design shall incorporate a means for supporting the suspended equipment or piping at a fixed elevation during installation regardless of load changes as well as a means for transferring the load to the spring.

Korfund Dynamics Company

Spring-Flex hangers shall be series RSHP or SHP (spring only) positioning hangers as manufactured by Vibration Mountings and Controls, Inc.

TYPE 6 - ISOLATED PIPE HANGER SYSTEM

Spring-Flex pipe hanger system shall consist of a precompressed spring and elastomer isolation hanger combined with pipe support into one assembly. Replaces standard clevis, single or double rod roller, or double rod fixed support. The system shall have a spring element with a steel lower spring retainer and an upper elastomer retainer cup with an integral bushing to insulate the support rod from the isolation hanger. The neoprene element under the lower steel spring retainer shall have an integral bushing to insulate the support rod from the steel spring retainer.

The hanger shall be hinged to allow for a minimum of 30° misalignment between the rod attachment to structure and the connection to the isolation hanger. Hangers shall be designed and constructed to support loads over three times the rated load without failure. The system shall be precompressed to allow for rod insertion and standard leveling.

Spring-Flex Isolated Pipe Hanger System to be type CIH, CIR, TIH, TIR, and PIH as manufactured by Vibration Mountings and Controls, Inc.

TYPE 7 - PRE-COMPRESSED HANGERS

Spring-Flex hangers shall consist of a color coded steel spring in series with a neoprene element molded in specific colors for proper identification of rated load capacity. Springs shall be pre-compressed to the rated deflection so as to support the suspended equipment or piping at a fixed elevation during installation regardless of load changes. For 30° misalignment capability, spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box.

Spring-Flex hangers shall be Series RSHPR or RSHPR-30A as manufactured by Vibration Mountings and Controls, Inc.

TYPE 8 - SPRING HANGERS

Spring-Flex hangers shall consist of a color coded steel spring with a neoprene and steel washer which will properly distribute the load on the spring. For 30° misalignment capability, spring diameters and hanger box lower hole sizes shall be of sufficient size to permit the hanger rod to swing approximately 30° before contacting the box. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers which are to be used with flat iron duct straps will be provided with eye bolts on both ends.

Spring-Flex hangers shall be Series SH, SH-30A, SHSC, SHSC-30A as manufactured by Vibration Mountings and Controls, Inc.

TYPE 9 - SELF-ALIGNING SPRING HANGER

Spring-Flex hangers shall consist of a color coded steel spring seated in a neoprene spring cup with integral bushing to insulate the lower support rod from the hanger box. The steel hanger box shall be hinged to allow for a minimum of 30° misalignment between the rod attachment to structure and the connection to the supported equipment. Hanger boxes shall withstand three times the rated load without failure.

Spring-Flex Self Aligning hangers shall be series SA as manufactured by Vibration Mountings and Controls, Inc.

Korfund Dynamics Company

TYPE 10 - HORIZONTAL THRUST RESTRAINTS

Horizontal thrust restraints shall be provided to prevent excessive movement of air handling equipment having air thrust which exceeds 10% of the unit weight. The Horizontal thrust restraint shall consist of a steel housing containing a steel spring in series with a neoprene pad. The restraint assembly shall be designed to be pre-adjusted by the manufacturer and permit further adjustment in the field to limit horizontal movement to a maximum of ¼ inch. Assembly shall be furnished with back up plates and hardware for attachment to both the equipment and duct work or structure. Horizontal restraints shall be attached on the centerline of thrust on each side of the unit.

Horizontal thrust restraints shall be Series HTR as manufactured by Vibration Mountings and Controls, Inc.

TYPE 11 - FLOOR, WALL, AND CEILING SLEEVES

Where piping passes through walls, floors, or ceilings, a vibration control sleeve shall be provided to reduce the transmission of vibration. The sleeve shall consist of two pipe halves with neoprene sponge material bonded to the inside and a bolting arrangement for secure fit around piping. Where temperature exceeds 240°F, an appropriate density fiberglass shall be used in place of neoprene material.

Sleeve shall be type VCS as manufactured by Vibration Mountings and Controls, Inc.

TYPE 12 - RESILIENT PIPE GUIDES

Where vertical piping runs between support points, a resilient pipe guide shall be provided. The guide shall consist of an angle frame and four double deflection neoprene mountings molded in specific colors for proper identification of rated load capacity.

Resilient pipe guide shall by type RPG as manufactured by Vibration Mountings and Controls, Inc.

TYPE 13 - PIPE ANCHORS

Multi-directional pipe anchor shall consist of suitable steel sections in series with heavy duty duck and neoprene material assembled in a telescopic housing to provide the necessary restraint in both the vertical and horizontal directions. Pipe anchor shall be sized to limit load on neoprene and duck material to 500 psi.

Multi-directional pipe anchor shall by type MDPA as manufactured by Vibration Mountings and Controls, Inc.

TYPE 14 - FLEXIBLE CONNECTORS

Quiet-Sphere flexible connectors shall be molded in spherical design of multiple layers of neoprene and synthetic fiber with integral corrosion resistant plate steel flanges. The connectors shall be suitable for pressures up to 214 psi and temperatures up to 240°F. Where piping is not anchored, control rods must be installed at each connector to limit movement within their specified limits.

Korfund Dynamics Company

Flexible connectors shall be Quiet-Sphere type VMS, VMT, or VMU as manufactured by Vibration Mountings and Controls, Inc.

TYPE 15 - SEISMIC SPRING MOUNTINGS

Steel spring isolator incorporating elastomeric snubbing in all directions. The snubber shall be adjustable in the vertical direction and allow a maximum of ¼" travel in all directions before contacting the elastomer cushion. Spring diameters shall be no less than 0.8 times the compressed height of the spring at rated load. Springs shall also have a minimum additional travel to solid equal to 50% of the rated deflection. Housing shall have provision to adjust the rebound plate and to inspect the spring. Housing shall be of cast ductile iron, malleable cast iron or of welded steel construction. Gray iron castings are not permitted. Springs shall be color coded for proper identification of rated load capacity. Springs shall be coated with a polyester epoxy powder. Hardware shall be stainless steel, or zinc plated.

Spring-Flex seismic mountings shall be Series AEQM, AWRS, ASCM or AWMR as manufactured by Vibration Mountings and Controls, Inc.

TYPE 16 - SEISMIC SNUBBERS/RESTRAINTS

All-directional seismic snubbers shall include all directional elastomer elements, having a minimum elastomer thickness of ¾" in all directions. Elastomers shall be easy to inspect and shall consist of replaceable elastomer inserts. Elastomer shall be neoprene or a high quality rubber including anti-ozone and anti-oxidant materials and conform to ASTM D2000 Grade 2BC or Bridge Bearing Neoprene. Snubbers shall be manufactured with an air gap between steel and elastomer of 1/8 inch to ¼ inch. Snubbers shall be installed with factory set clearances. Snubber must have at least two anchor bolt holes and shall have an ultimate load capacity of at least four times the rated static load capacity.

Seismic restraints shall be Series SR as manufactured by Vibration Mountings and Controls, Inc.

TYPE 17 - CABLE RESTRAINTS

Steel aircraft cable restraints are designed and installed to limit motion on suspended isolated equipment, piping or ducting. Cable are installed with enough slack to engage only when ¼ inch movement occurs. On suspended equipment, cables are installed in sets of four, located at 45° angles to all three axes. Where required at pipe hangers, cables are placed two at each location, alternating orientation at successive locations. Cable shall be 7x19 galvanized or stainless steel aircraft cable conforming to FED-STD-RR-W-410D.

Seismic cable restraint shall be Series SCR as manufactured by Vibration Mountings and Controls, Inc.

TYPE 18 - CAPTIVE ELASTOMER MOUNTINGS

Consist of a captive elastomeric mount molded from neoprene or EPDM compound conforming to the requirements of ASTM D2000. Load bearing elastomer element shall be housed in a cast ductile iron housing. Mount shall incorporate a fail-safe captive design, and shall provide a vertical natural frequency of approximately 8 Hz at rated static load. Mount shall be capable of providing dynamic deflections of up to .5 inches.

Korfund Dynamics Company

Captive elastomer mountings shall be type RSM as manufactured by Vibration Mountings and Controls, Inc.

TYPE A - STRUCTURAL BASES

Integral structural steel bases shall be rectangular in shape. All structural members shall be of wide flange, angle or channel steel with depth equal to a minimum of 1/10 of the longest span of equipment, but not less than 6 inches. Built-in adjustable motor slide rails and height saving brackets shall be supplied as in integral part of the base.

Structural bases to be type WFB as manufactured by Vibration Mountings and Controls, Inc.

TYPE B - STRUCTURAL RAILS

Rails for indoor applications or outdoor applications where isolation systems are mounted on equipment supports shall be:

Structural steel rails shall be of wide flange, angle or channel steel with depth equal to a minimum of 1/10 of the longest span of equipment, but not less than 6 inches. Height saving brackets shall be supplied as an integral part of the rails. For seismic applications rails must be structurally attached to one another Vibration Mountings and Controls type WFR

Rails for outdoor applications where weatherproofed isolated equipment supports are required, shall be a continous structural support rail that combines equipment support and isolation mounting into one unitized assembly. Rails shall incorporate roof enclosed springs which are adjustable, removable and interchangeable after equipment has been installed. The system shall maintain the same installed and operating height with or without the equipment load and shall be capable of being utilized as a blocking device. The entire assembly shall be an integral part of the roof's membrane waterproofing and shall be dry galvanized. Unit to be supplied with continuous upper and lower galvanized flashing. Rails shall be cross braced at support and equipment attachment points when used in seismic zones. Rails shall be bolted or welded to the building steel or anchored to the concrete deck to attain specified acceleration criteria.

Rails shall be type R-7000 as manufactured by Vibration Mountings and Controls, Inc.

TYPE C - CONCRETE INERTIA BASE

Concrete inertia base forms shall be of formed steel members or removable concrete forms with a depth not less than 1/12 of the longest base dimension, but not less than 6 inches. Height saving isolator mounting brackets shall be bolted or welded to the members. Pouring forms shall include minimum 3/8 inch concrete reinforcing steel (rebar) on 8 inch centers running the length and width of the base. Pouring forms for split case pumps shall be wide enough to support suction and discharge elbows. Anchor bolt templates shall be provided to accept mounting hole location of the supported equipment.

Bases shall be type MPF or WPF as manufactured by Vibration Mountings and Controls, Inc.

TYPE D - SPRING ISOLATION CURB

Rooftop curb mounted equipment shall be isolated from the building structure by means of a factory assembled unitized vibration control base consisting of extruded aluminum upper and lower members incorporating zinc plated steel springs selected for 1 inch static deflection, sized and positioned to insure uniform deflection for the entire system. Unitized construction minimizes

on site assembly. Field assembled curb kits not acceptable. A continuous flexible "hydro gard" seal shall be provided between the upper and lower members of the vibration control base. A closed cell sponge rubber gasket to be bonded to the top and bottom members.

The unitized vibration control system shall be iso-curb type AXR as manufactured by Vibration Mountings and Controls, Inc.

TYPE E - ROOF ISOLATION CURB

The structural steel spring isolation curbs shall bear directly on the roof support structure and be flashed and waterproofed into the roof's membrane waterproofing system. Equipment manufacturer's or field fabricated curbs shall not be used. The curb shall consist of a rigid steel lower section containing properly spaced pockets with fully adjustable spring isolators. All springs shall be color coded for proper identification and spring pocket shall allow for easy removal or replacement of any spring without disturbance of the supported equipment. Pockets shall have removable waterproof covers to allow for spring adjustment. Spring pockets shall contain combination vertical and horizontal restraint in conjunction with a ¼ inch thick neoprene rubber bushing which will resist wind and seismic forces. All springs shall be installed in series with a ¼ inch thick neoprene acoustical cup or pad. The curb shall be the sound attenuating type utilizing standard 2 inch roof insulation supplied and installed by the roofing contractor to act thermally outside and acoustically inside. Curbs supplied without this feature shall be factory acoustically lined with 2 inch duct liner. An air tight neoprene seal shall be incorporated into the curb design to prevent air leakage or infiltration. Air seal must not be exposed so that it could be damaged or that in the event of the air seal failure, water could leak into the curb's interior. Wood nailer and flashing shall be provided and curbs shall be manufactured to NRCA standards. Curbs shall include a means of incorporating a sound barrier package, consisting of two layers of waterproof gypsum board furnished and installed by the General Contractor. Individual pier supported curbs are not acceptable.

Roof isolation curb to be type RIC or P as manufactured by Vibration Mountings and Controls, Inc.

PART 3 - EXECUTION

3.01 EQUIPMENT ISOLATION

Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all submittal data. Locations of all vibration isolation products shall be selected for ease of inspection and adjustment, as well as for proper operation. Electrical and plumbing connections to vibration isolated equipment shall be flexible. Equipment shall be isolated and restrained as indicated in the vibration isolation schedules.

The minimum operating clearance under bases shall be 1". All bases shall be placed in position and supported temporarily by blocks or shims prior to the installation of the equipment, isolators and restraints. Spring isolators shall be installed after all equipment is installed without changing equipment elevations. After the entire installation is complete and under full operational load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators. Remove all debris from beneath the equipment and verify that there are no short circuits of the isolators or the isolation system.

3.02 PIPING AND DUCTWORK ISOLATION

Vibration isolation hangers shall be positioned as close as possible to the structure without coming in contact with any object (including the structure). Hanger rods shall not contact any object which would short circuit the isolator. Parallel running pipes may be hung together on a trapeze which is isolated from the building. Do not mix vibration isolated and non-isolated pipes on the same trapeze. Attention must be paid to movements of piping caused be expansion and contraction.

Type 6 hangers may be substituted for all other hangers listed below. Pre-compressed hangers shall only be used if installed along with piping.

Isolation hangers shall be installed for all piping in equipment rooms or for 50 ft. from vibrating equipment, whichever is greater. To avoid reducing the effectiveness of equipment isolators, at least three of the first hangers from the equipment should provide the same deflection as the equipment isolators, with a maximum limitation of 2 inch deflection. The remaining hangers shall be spring or combination spring and rubber with a minimum of 0.75 inch deflection. To prevent load transfer to the equipment flanges when the piping system is filled, the first three hangers adjacent to the equipment shall be the positioning type (specification type 5). Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use restrained vibration isolators. They should be selected according to the guidelines for hangers. Vertical riser supports for pipe 4" diameter and larger shall be isolated from the structure using type 11 and type 12 anchors and guides.

All ductwork over four square feet face area located in the mechanical equipment room(s) shall be isolated with type 8 hangers with a minimum of 0.75 inch deflection. Emergency generator exhaust shall be isolated with type 8 hangers with a minimum of 0.75 inch deflection.

Install type 14 flexible connectors at all connections of pipe to pumps and chillers, and to other isolated equipment only as shown on drawings. Where they are not installed on isolated equipment, insert spool pieces on the equipment side of shutoff valves.

3.03 SEISMIC RESTRAINT

All equipment shall be seismically restrained and isolated per the vibration isolation schedule. All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to the structure to resist the specified acceleration. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers do not preclude the need for snubbers. All equipment must be positively attached to the structure.

All suspended isolated equipment shall be restrained with type 17 seismic cable restraints. Non isolated equipment may be rigidly braced. Support rod compressive stress resulting from seismic accelerations shall be included in the calculations and addressed accordingly. VAV boxes attached directly to ductwork on the main supply side shall be considered as ductwork for seismic design purposes. Rod bracing shall be installed as per approved submittal and shop drawings.

All isolated, horizontally suspended pipe, duct, cable trays, bus duct and conduit shall use restraint type 17. Non-isolated shall utilize rigid restraint methods. Support rod compressive stress resulting from seismic accelerations shall be included in the calculations and addressed accordingly. For seismic accelerations of .48g or less, spacing of seismic bracing shall be per the latest edition of the SMACNA seismic restraint manual for piping and ductwork. For all trapeze supported piping and conduit, the individual pipes and conduits must be transversely and vertically restrained to the trapeze support at the designated restraint locations.

Korfund Dynamics Company

Seismic bracing for:
-No hub, spigot, bell, cast iron piping:
shall be at a maximum of 10 ft on center transverse and 20 ft on center longintudinally and at changes of direction of 4 ft or more.

-Threaded, welded, soldered, grooved piping: (schedules 10, 20, 40)
shall be at a maximum of 40 ft on center transverse and 80 ft on center longintudinally and a change in direction of 15 diameters. Actual spacing will be determined by the seismic calculations and analysis as outlined in the specifications.

-All conduit and cable trays:
shall be at a maximum of 40 ft on center transverse and 80 ft on center longintudinally and a change in direction of 15 diameters. Actual spacing will be determined by the seismic calculations and analysis as outlined in the specifications.

-Bus Duct:
shall be at a maximum of 20 ft on center transverse and 40 ft on center longintudinally and a change in direction of 4 ft or more. Actual spacing will be determined by the seismic calculations and analysis as outlined in the specifications.

-Ductwork:
shall be at a maximum of 30 ft on center transverse and 60 ft on center longintudinally and a change in direction of 15 ft or more. Actual spacing will be determined by the seismic calculations and analysis as outlined in the specifications.

For overhead supported equipment, over stress of the building structure must not occur. Bracing may occur from flanges or structural beams, upper truss chords in bar joists, or cast in place inserts or drilled and shielded inserts in concrete structures.

In pipe risers which pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D., including insulation. Cored holes must be packed with resilient material or fire stop as specified in other sections of this specification and/or state and local codes. No additional horizontal seismic bracing is required at these locations. Non-isolated, constant temperature pipe risers through cored holes require a riser clamp at each floor level on top of the slab attached in a seismically approved manner for vertical restraint. Non-isolated, constant temperature pipe risers in pipe shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the structural steel. The riser clamp and structural steel must be capable of withstanding all thermal, static and seismic loads.

Isolated and/or variable temperature risers through cored holes require type 12 and type 13 guides and anchors installed to meet both thermal expansion and seismic acceleration criteria. Each floor level must have either a riser clamp that does not interfere with the thermal expansion/contraction of the pipe or a riser clamp/cable assembly capable of supporting the weight of the pipe between floors in the event of pipe joint failure. Riser guides and anchors must also be selected to serve as seismic restraints.

Isolated and/or variable temperature risers in pipe shafts require type 12 and type 13 guides and anchors installed on structural steel to meet both thermal expansion and seismic acceleration criteria. Each floor level must have a riser clamp/cable assembly that does not interfere with the thermal expansion/contraction of the pipe capable of supporting the weight of the pipe between floors in the event of pipe joint failure. Riser guides and achors must also be selected to serve as seismic restraints.

Chimneys, stacks and boiler breeching passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.

Lay-in ceilings in compliance with seismic zone requirements may use earthquake clips or other approved means of positive attachment to secure fixtures such as panel light and diffusers to T-bar structure.

3.031 SEISMIC EXCLUSIONS

Exclusions for equipment in states governed by BOCA:

-Curb mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded unless specifically detailed in the schudules or drawings.

DUCT:
Rectangular, square, and oval air handling ducts less than six square feet in cross sectional area.
Round air handling duct less than 28 inches in diameter.
Duct supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork with positive support to the structure.

PIPING
All piping less than 2 1/2" diameter
All clevis or trapeze supported piping suspended by hanger rods less than 12 inches in length (6 inches or less for fire sprinkler piping) with positive attachment to structure.
PVC or Feberglass suspended waste or vent pipe 6 inch diameter or smaller.

ELECTRICAL
All conduit less than 2 1/2" diameter suspended by individual hanger rods.
All clevis or trapeze supported conduit suspended by hanger rods less than 12 inches in length from the bottom of the support to the top of the conduit with positive attachment to structure.
Trapeze supported cable trays and bus ducts suspended by hanger rods less than 12 inches in length with positive attachment to structure.

Exclusions for equipment in states governed by UBC:

-Floor mounted equipment weighing less than 400 Lb. and not resiliently mounted.

Exclusions which **DO NOT** apply for life safety equipment regardless of governing code:

ELECTRICAL
Critical, standby or emergency power conduit (1" nominal diameter and larger), cable tray or bus duct.

PIPING
Fuel oil, gasoline, natural gas, medical gas, compressed air or any piping containing hazardous or corrosive materials that is 1" nominal diameter and larger.
Fire protection standpipe, risers, mains and branches 2" and larger

DUCT
Smoke evacuation duct or fresh air make up connected to emergency system

Korfund Dynamics Company

3.04 INSPECTION

Upon completion of installation of all vibration isolation and seismic restraint devices, a certification report prepared by the manufacturer or the qualified representative shall be submitted in writing to the contractor indicating that all systems are installed properly and in compliance with the specifications. The report must identify those areas that require corrective measures or certify that none exists. Any field coordination type changes to the originally submitted seismic restraint designs must be clearly defined and detailed in the report.

Isolation Schedule

Equipment Location

Basement Below Grade		Grade and 20' Floor Span		25' Floor Span		30' Floor Span		40' Floor Span		50' Floor Span	
Type	Defl	Type	Defl.	Type	Defl.	Type	Defl.	Type	Defl.	Type	Defl.
AIR COOLED CONDENSING UNITS											
15-B	0.75	15-B	1	15-B	1	15-B	1.75	15-B	1.75	15-B	1.75
BOILER FEED PUMPS											
18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25
BOILERS AND STEAM GENERATORS											
18	0.5	18	0.5	18	0.5	18	0.5	18	0.5	18	0.5
CENTRIFUGAL FANS (Floor mounted) 24 inch diameter and up Up to 40 HP Up to 300 RPM											
15-A	2	15-A	2	15-A	2.5	15-A	2.5	15-A	2.5	15-A	3
CENTRIFUGAL FANS (Floor mounted) 24 inch diameter and up Up to 40 HP 300 to 500 RPM											
15-A	2	15-A	2	15-A	2.5	15-A	2.5	15-A	2.5	15-A	3
CENTRIFUGAL FANS (Floor mounted) 24 inch diameter and up Up to 40 HP 500 RPM and up											
15-A	0.75	15-A	0.75	15-A	0.75	15-A	1	15-A	1.5	15-A	2
CENTRIFUGAL FANS (Suspended)											
4-17	1	4-17	1.25	4-17	1.25	4-17	1.5	4-17	1.5	4-17	1.5
CHILLERS (Absorption/Centrifugal)											
15	0.75	15	1	15	1.75	15	1.75	15	1.75	15	2
CONDENSATE PUMPS											
18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25	18-B	0.25
COOLING TOWERS Up to 300 RPM											

15	3	15	3.5	15	3.5	15	3.5	15	5	15	5

COOLING TOWERS
301 to 500 RPM

15	2	15	2	15	2	15	2.5	15	2.5	15	3

COOLING TOWERS
500 RPM and up

15	1	15	1	15	1	15	1	15	1.5	15	1.75

ENGINE DRIVEN GENERATORS

15	0.75	15	0.75	15	0.75	15	1	15	1.5	15	1.5

FAN COIL UNITS

4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75

PACKAGED AIR HANDLING UNITS (Point mounted)
Up to 5 HP

15	0.75	15	0.75	15	0.75	15	0.75	15	0.75	15	0.75

PACKAGED AIR HANDLING UNITS (Point mounted)
7 1/2 HP and larger
Up to 575 RPM

15	0.75	15	1.5	15	1.5	15	2	15	2.5	15	2.5

PACKAGED AIR HANDLING UNITS (Point mounted)
7 1/2 HP and larger
576 RPM and up

15	0.75	15	1.25	15	2	15	2	15	2.25	15	2.25

PACKAGED AIR HANDLING UNITS (Curb mounted rooftop)
Up to 5 HP

E	0.75	E	0.75	E	0.75	E	0.75	E	0.75	E	0.75

PACKAGED AIR HANDLING UNITS (Curb mounted rooftop)
7 1/2 HP and larger
Up to 575 RPM

E	1	E	1	E	1	E	1	E	1	E	1

PACKAGED AIR HANDLING UNITS (Curb mounted rooftop)
7 1/2 HP and larger
576 RPM and up

E	1	E	1	E	1	E	1	E	1	E	1

PACKAGED AIR HANDLING UNITS (Suspended)
Up to 5 HP

4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75

PACKAGED AIR HANDLING UNITS (Suspended)
7 1/2 HP and larger
Up to 575 RPM

4-17	0.75	4-17	1.5	4-17	1.5	4-17	2	4-17	2.5	4-17	2.5

PACKAGED AIR HANDLING UNITS (Suspended)
7 1/2 HP and larger
576 RPM and up

4-17	0.75	4-17	1.25	4-17	2	4-17	2	4-17	2.25	4-17	2.25

PUMPS (Close Coupled) Up to 7.5 HP

15-C	0.75	15-C	0.75	15-C	0.75	15-C	0.75	15-C	1	15-C	1.5

PUMPS (Close coupled) 10 HP and up

15-C	0.75	15-C	0.75	15-C	1	15-C	1	15-C	1.5	15-C	1.75

PUMPS (End Suction and Split Case) Up to 40 HP

15-C	0.75	15-C	0.75	15-C	1	15-C	1.5	15-C	2	15-C	2

PUMPS (End Suction and Split Case) 50 HP and larger

15-C	0.75	15-C	1	15-C	1.5	15-C	2	15-C	2.5	15-C	2.5

PUMPS (Large Inline Floor Mounted) 5 HP to 25 HP

15	0.75	15	0.75	15	1.75	15	1.75	15	1.75	15	1.75

PUMPS (Large Inline Floor Mounted) 30 HP and larger

15	1.75	15	1.75	15	1.75	15	1.75	15	2	15	2.5

PUMPS (Large Inline Suspended) 5 HP to 25 HP

4-17	0.75	4-17	0.75	4-17	1.75	4-17	1.75	4-17	1.75	4-17	1.75

PUMPS (Large Inline Suspended) 30 HP and larger

4-17	1.75	4-17	1.75	4-17	1.75	4-17	1.75	4-17	2	4-17	2.5

RECIPROCATING COMPRESSORS

15-C	0.75	15-C	0.75	15-C	1	15-C	1.25	15-C	1.5	15-C	2

TRANSFORMERS

18	0.25	18	0.25	18	0.25	18	0.25	18	0.5	18	0.5

UNIT HEATERS

4-17	0.5	4-17	0.5	4-17	0.5	4-17	0.5	4-17	0.5	4-17	0.5

UNIT VENTILATORS

4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75

VAV BOXES (Fan powered)

4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75	4-17	0.75

PIPING

4-17	1	4-17	1	4-17	1	4-17	1	4-17	1	4-17	1

DUCTWORK

8-17	1	8-17	1	8-17	1	8-17	1	8-17	1	8-17	1

Note: Static Deflection is measured in inches.