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Jerry G. Lilly, P.E.
Consulting Acoustical Engineer

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SOUND SOLUTIONS

ROOFTOP UNITS

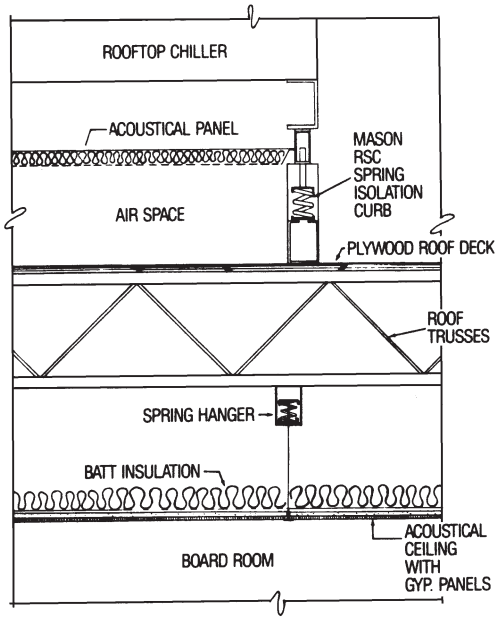
No. 5

One of the most difficult problems which confronts HVAC mechanical engineers is the problem of controlling noise and vibration from rooftop units. Rooftop units are usually prepackaged, self-contained, air conditioning or refrigeration units which are mounted on top of the roof (air conditioning units are usually mounted on a factory built or site built curb). Rooftop units are common in warehouse, low-rise office, and retail structures, but they can also be found in hospitals, schools, and other commercial buildings.

There are two acoustical problems which are commonly found with rooftop units. One is noise radiated from the fans and compressors in the unit, and the second is excessive vibration of the building. Both of these conditions are affected by the roof structure, which in recent years has generally trended toward lighter and more compliant systems to reduce costs. The following paragraphs provide general recommendations for solving these problems. Specific details (such as roof construction, isolator design and deflection, isolator placement, unit location, and duct configuration) must be individually generated for each project.

The first and most important step to controlling both noise and vibration is the installation of vibration isolators between the unit and the roof structure. Deleting the vibration isolators will almost certainly cause excessive noise in the occupied space below (even with a heavy concrete roof deck) due to structure-borne sound transmission. For most systems some type of steel spring mount or spring isolation curb is adequate. Rubber mounts are usually inadequate. For very critical installations (such as above a hospital operating room) high efficiency air springs may be required. In order to make a proper isolator selection several factors must be known including fan speed (rpm), unit weight at each support point, and the vertical and horizontal stiffness of the supporting structure at the support points.

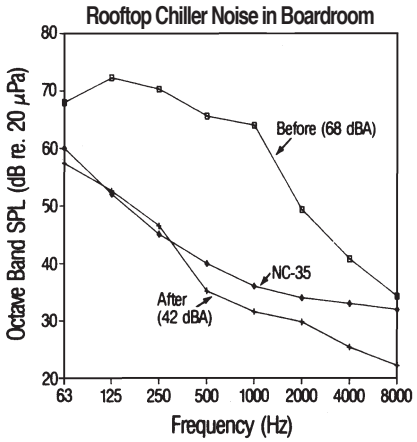
A properly selected and installed vibration isolation system will usually solve the structure-borne sound and roof vibration problems, but it will have no effect on the air-borne noise from the unit's fans and compressors. Air-borne noise generally follows three paths: 1) through the supply ductwork, 2) along the return air path, and 3) via direct radiation through the roof and suspended ceiling. All three of these potential sound paths must be checked in order to ensure a satisfactory installation.



The specific requirements for controlling air-borne noise from rooftop units varies from project to project. Certain units are noisier than others, and selecting the quietest unit and locating it over non-critical space (i.e. a storage room or restroom) is usually the most effective and least expensive means of noise control. Prefabricated sound traps are sometimes required in the supply and return air ductwork, depending upon the duct layout and other details. The return air system is usually more critical than the supply air system because it is often unducted and exposed directly to the ceiling plenum of the occupied space.

Air-borne noise radiation through the roof can be a problem for lightweight roofing systems such as metal deck with rigid insulation and built-up roofing. Providing a concrete slab in the vicinity of the unit is usually required for larger air conditioning units. Radiated noise can also be reduced by installing a sound barrier of gypsum board or steel between the roof deck and the unit. The following example provides specific details from a recently completed project involving an existing rooftop refrigeration unit.

A large food distribution company in the Seattle area was expanding their offices inside a large warehouse, and they had already started construction on their own corporate boardroom when they discovered that the noise from three rooftop chillers (located on the roof directly above the boardroom) was intolerable. Inspection of the units revealed no vibration isolators, and the roof system was simply plywood decking with built-up roofing.



The noise and vibration measurements indicated that the structure-borne noise was about 15 dB greater than the air-borne noise, but both were well above the desired NC-35 level. A detail illustrating the recommended solution to the problem is shown at left. The rooftop units were remounted on top of a spring isolation curb manufactured by **Mason Industries** which was mounted directly to the existing roof deck. To control air-borne compressor noise, a 2" thick acoustical panel (attached to the spring isolation curb) was inserted under the compressors. A spring isolated suspended acoustical ceiling backed with gypsum panels and batt insulation completed the installation in the boardroom.

The measured results of this work are shown in the figure above. The original noise level in the boardroom (without a suspended ceiling) was NC-64 or 68 dBA. After completion of the specified work the noise level was reduced to NC-36 or 42 dBA with all three compressors running. Understandably, the owner is extremely pleased with the performance of the system.

MASON INDUSTRIES, Inc.
Manufacturers of Vibration Control Products
350 Rabro Drive, Hauppauge, NY 11788
631/348-0282 FAX 631/348-0279
2101 W. Crescent Ave., Suite D, Anaheim, CA 92801
714/535-2727 FAX 714/535-5738
Info@Mason-Ind.com • www.Mason-Ind.com

DAMPING COMPOUND

TYPE MDC-10

DATA SHEET DS-801

MDC-10

Sheet metal surfaces transmit noise by vibrating at sound frequencies. Taking the "ring" out of these surfaces by applying MDC-10 Damping Compound substantially reduces noise transmission. Treatment is particularly effective on ductwork and roofdecks under roof mounted equipment.

Optimum results are obtained by applying a coating equal to the metal thickness. MDC-10 can be applied by spraying, troweling or brushing. The effective temperature range is 32°F to 175°F with maximum and minimum of –45°F to 375°F. MDC-10 is shipped in 55 gallon drums or 5 gallon pails. The label below is used on all shipping containers.

MASON INDUSTRIES, Inc.

DAMPING COMPOUND MDC-10

Decay Rate 45 db/sec @ 75°F
Non-Burning per ASTM-D-635-56T
Passes MVSS-302
Smoke Density Factor 0-ASTM-E84

APPLICATION PROCEDURES

1. MDC-10 is shipped at the proper spraying consistency. If necessary use only water for thinning. Use no solvents.
2. All surfaces must be completely clean. Use a primer on steel if it is not "bonderized".
3. Apply MDC-10 by spraying or trowelling. Spraying is faster. Use a 4:1 ratio pump type unit dropped into a 5 gallon or 55 gallon drum. Feed line is 3/4" I.D. Use a Binks Spray Gun No. 18 equipped with a 1/8" - 1/4" round nozzle or equivalent equipment. Pressure on pump is 50 psi. Atomizing pressure is 40 - 50 psi. Keep gun in water when not in use. Clean equipment with water after each shift and before material dries.

MDC-10 thickness should be equal to metal thickness

Gallons Required per 100 Square Feet of Surface

Metal Gauge	22	20	18	16	14	12	11	1/4" plate
Gallons	3	4	5	7	9	12	14	28

- IMPORTANT -
THE SOUND DAMPING PROPERTIES OF MDC-10 ARE NOT APPARENT UNTIL THE MATERIAL IS DRY.
MDC-10 CURE TIME IS 48 HOURS

KEEP FROM FREEZING ■ NON-TOXIC ■ NON-CORROSIVE

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