

APPENDIX C SAMPLE S&V SPECIFICATION – SHORT FORM

SECTION 15xxx (23xxx) – SOUND AND VIBRATION TESTING

PART 1 – GENERAL

1.1 SUMMARY

This Section includes measurement and reporting of sound and vibration levels.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION

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3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with the Project requirements and to discover conditions in the system design that may preclude proper S&V testing of systems and equipment.
 - 1. Inspect Contract Documents defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that sound and vibration isolating devices are required by the Contract Documents. Verify that the quantities and locations of these isolating devices are accessible and appropriate for testing.
- B. Examine approved submittal data of final installed HVAC systems and equipment, provided by the mechanical/general contractor, or building owner's representative.
- C. Examine appropriate system and equipment test reports, for systems and equipment requiring factory start-up.
- D. Verify that all system and equipment installations are complete and that testing, adjusting, and balancing specified in the contract documents have been performed.
- E. All vibration isolated machinery must be inspected to examination installation conditions before startup. The following items should be checked:
 - 1. Verify that all isolators are installed in accordance with manufacturer's recommendations.
 - 2. Verify that piping, duct, and conduit penetrations through mechanical equipment room envelope are sealed, and if required, rigid contact with building structure does not exist.

3. Steel isolation bases must be inspected for cracked welds, excessive bending or twisting of steel members.
4. Concrete isolation bases must be examined for cracked concrete. Isolator retainer brackets must be checked for looseness. The concrete base must be flat and true in plane.
5. Elastomer isolators must be examined for cracks in the rubber and for loose bonds between the rubber and steel plates or other steel components. Adequate clearance must be provided between bolts and the side of the bolt holes to prevent short circuiting.
6. Steel spring isolators must be examined for loose or missing bolts, nuts or lock washers. Check for spring overloading or underloading, completely collapsed spring coils, and cocked springs. Note if rubber or glass fiber pad between the bottom plate of the steel spring and the concrete slab or supporting structure is present.
7. Housed steel springs must be examined for proper centering of the springs, clearance between the cast housing and rubber snubber, and the steel spring for tilted or cocked springs.
8. When the specifications require that the isolators be bolted to the concrete slab or other supporting structure, the bolts may be isolated by means of rubber bushings and rubber washers.
9. Inspect isolators with restraint devices to make sure that all shims have been removed and supportive nuts have been properly adjusted to allow for free floating of the isolated system.
10. Seismic restraints shall not prevent the proper functioning of vibration isolation system.
11. Pneumatic isolators must be inspected for overload or underload by checking the air pressure gauge against manufacturer's submittals or catalog. The pneumatic isolator system should include the isolator, strainer, oil separator, height regulator, and air pressure gauge. Inspect the vicinity of the isolator. Note if the isolator is exposed to damage from vehicle or other traffic.
12. Carefully inspect the space under all isolated bases to assure that these spaces are clean and free of debris to prevent short-circuiting.
13. Check to ensure that all shipping bolts associated with spring isolators have been removed.
14. Inspect all flexible piping, hoses, and expansion joints as to type, length and location as called for by the specifications. Examine flexible hose for excessive elongation.
15. Inspect all electrical and control connections to ensure that they do not restrain the movement of the vibration isolated equipment.
16. Inspect all fabric connections between fans and ductwork to ensure that a fabric "bellows" exists when the fans are operating.
17. Each piece of vibration isolated machinery must be free of any structural tie or rigid connection that may "short circuit" the isolation system. All limit stops, shipping bolts, and leveling bolts on all isolators must be inspected to ensure that they are not "short circuiting" the isolation system.
18. Hanger isolators should be free of misalignment and over / underloading. Under no circumstances the isolator rod should be allowed to make rigid contact with the hanger housing.

Report deficiencies as discovered to the appropriate parties.

3.2 PROCEDURES FOR VIBRATION MEASUREMENTS

- A. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 1. Turn off equipment in the building that might interfere with testing.
 2. Restrict people from occupying areas where human activity may affect accuracy of measurements.

3. Exterior vibration sources; i.e. trains, roadway traffic, adjacent construction activities, etc.
- B. Attach and secure the vibration transducer in accordance with the latest edition of the *NEBB S&V Procedural Standards for Measurement of Sound and Vibration*.
- C. Measure and record, on all pumps and fans over 3 hp, and all chillers and compressors over 5 hp, at discrete frequencies or in 1/3 octave bands as follows:
 1. Discrete vibration levels from 1 to 200 Hz in 1 Hz increments, or
 2. In each 1/3 octave band from 12.5 Hz to 100 Hz.
- D. Measure and record equipment vibration, bearing vibration, equipment base vibration, and on building structure adjacent to equipment. Record velocity and displacement readings in the radial vertical, radial horizontal and axial planes, where measurements can be performed safely.
 1. Pumps:
 - a. Pump Bearing: Drive end and opposite end.
 - b. Motor bearing: Drive and opposite end.
 - c. Pump Base: Top and side, within 6" of each isolator.
 - d. Building: Floor adjacent to pump/motor, within 6" of each isolator.
 2. Fans and HVAC Equipment with Fans:
 - a. Fan Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive and opposite end.
 - c. Equipment Base: Top and side, within 6" of each isolator.
 - d. Building: Floor adjacent to fan/motor, within 6" of each isolator.
 3. Chillers and HVAC Equipment with Compressors:
 - a. Compressor Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Base: Top and side, within 6" of each isolator.
 - d. Building: Floor adjacent to equipment, within 6" of each isolator.
- E. Vibration Measurement Reports:
 1. Date and time of test
 2. Equipment designation, location, equipment speed, motor speed and motor horsepower.
 3. Measured acceleration (in units of g's, inches/sec², meters/sec², or units requested by the engineer of record), and/or, measured velocity (in units of inches/sec, meters/sec or units requested by the engineer of record) and/or, measured displacement (in units of inches, mils, millimeters, or units requested by the engineer of record).

3.3 PROCEDURES FOR SOUND LEVEL MEASUREMENTS

- A. Close windows and doors to the space.

- B. Perform measurements when the space is not occupied, or when the occupant noise levels from other spaces in the building and outside are at a minimum, or do not affect sound readings.
- C. Clear the space of temporary sound sources so unrelated disturbances will not be measured. Turn off all sound sources (personal computers, printers, fax machines, etc) in the space that may affect sound readings.
- D. Position testing personnel during measurements to achieve a direct line-of-sight between the sound source and the sound-level meter.
- E. Take sound measurements at a height approximately 48 inches above the floor and at least 36 inches from a wall, column, or any other large surface capable of altering the measurements.
- F. Take sound measurements in dB (linear or flat), with the slow time constant, in the octave bands from 31.5 to 8000 Hz.
- G. Take sound measurements with the HVAC systems off to establish the background levels and take sound measurements with the HVAC systems operating. Calculate the difference between measurements. Apply a correction factor depending on the difference and adjust measurements.
- H. Perform sound testing in all occupied space horizontally and vertically adjacent to all mechanical equipment rooms and all mechanical chases.
- I. Perform sound testing at 10% of locations on the project for each type of the following spaces. For each space type tested, select a measurement location that has the greatest anticipated sound level. If testing multiple locations for each space type, select at least one location that is near and at least one location that is remote from the predominant sound source.
 - 1. Private office.
 - 2. Open office area.
 - 3. Conference room.
 - 4. Auditorium/large meeting room/lecture hall.
 - 5. Classroom/training room.
 - 6. Patient room/exam room.
 - 7. Sound or vibration sensitive laboratory.
 - 8. Hotel room/apartment.
 - 9. Library open space.
 - 10. Public areas (such as, lobbies, hallways, break rooms).
 - 11. Perform sound testing in all spaces with a design criterion of NC or RC 25 or less.
- J. Sound Measurement Reports: Record sound measurements on appropriate test forms, indicating the decibel levels measured in for both “background” and “HVAC system operating” readings. Record each tested location on a separate NC or RC chart. Record the following on the forms.
 - 1. Date and time of test.
 - 2. Equipment operational parameters – speed / frequency at time of measurements.
 - 3. Indoor measurements - space location within building including floor level and room / space number.

4. Outdoor measurements – location identifier such as location relative to equipment, building, or property line.
5. Indicate where measurements meet or exceed design criteria

3.4 FINAL REPORT

- A. The final report shall be in accordance with the requirements of the current edition of the NEBB *Procedural Standards for Measurement of Sound and Vibration*.

End of Appendix C

APPENDIX D SAMPLE S&V REPORT FORMS

	FORM TITLE
	Report Title
	Certification Form

NEBB S&V PROCEDURAL STANDARDS
APPENDIX C

	Vibration Isolation Installation
	Vibration Isolation Bases
	Vibration Isolation Freedom
	Vibration Isolation Inspection Flexible Piping
	Vibration Analysis
	System Schematic
	Noise Criterion Form
	Room Criterion Form
	Noise Exposure Data Sheet
	Mechanical Equipment Room Operating Conditions
	Exterior Noise Measurement Description Operating Conditions