QRA-1107 - Standard Test Method For In Situ Measurement of the Noise Reduction Potential of Computer Rack Enclosures

Scope

This test method covers the measurement of the noise reduction of sound isolating rack enclosures by simulating the operating conditions in a typical office environment. The Noise Isolation Class (NIC) may be determined from the Insertion Loss measured in accordance with this test method

Reference Documents

ASTM E596-96(2009) -Standard Test Method for the Laboratory Measurement of Noise Reduction of Sound Isolating Enclosures

ISO 7779 - Measurement of Airborne Noise Emitted by Information Technology and Telecommunications Equipment

ASTM E 413-04 - Classification for Rating Sound Insulation

Rationale

While ISO 7779 measures the noise emitted by computers themselves it is not suitable for measuring the performance of a computer rack enclosure containing a typical selection of server units. This test method is a simple reproducible test method that can be carried out in any reasonably quiet room of sufficient size.

Summary of Test Method

The enclosure to be tested is placed in a typical office room with the back of the enclosure at a normal distance from an unobstructed wall. The background noise levels inside the enclosure and in the office room are measured in one-third octave bands. A special calibrated 2U rack box with rear facing miniature speakers is installed in the middle of the rack with the remaining spaces covered with blanking plates. Sound pressure Levels and the articulation index are then calculated for the installed test noise with all cooling fans running. The average noise in each one-third octave band is then calculated with (A) weighting for the measurement made at the front of the enclosure. The source signal is then changed to white noise and the level recorded with the source inside the enclosure compared to the level of the source in the same physical location but without the test enclosure and the resultant level difference is the Insertion Loss of the rack enclosure. The Insertion Loss is then used with ASTM E 413-04 to calculate the NIC.

Test Room Requirements

The test room should be a typical office space with as low background noise level as possible (The background level should be at least 10 dB(A) below the simulated enclosure level). The space for testing should be in front of a large flat wall with a minimum unobstructed length of 5 m. There should be no obstructions within 3 m from the front and sides of the enclosure when placed in front of the wall.

Measuring Instrumentation

Minimum instrumentation required for this test method is a microphone and amplifier that satisfy the requirements for a type 1 sound level meter. The recording and/or analysis should be capable of one-third octave filter measurements. The frequency range shall include be all preferred one-third octave bands from 125 Hz to 4000 Hz and may be extended if desired.

Three microphones positions/measurement locations will be 1.6 m above the floor and at 1 m away from the sides and front of the rack enclosure. (See diagram 1)

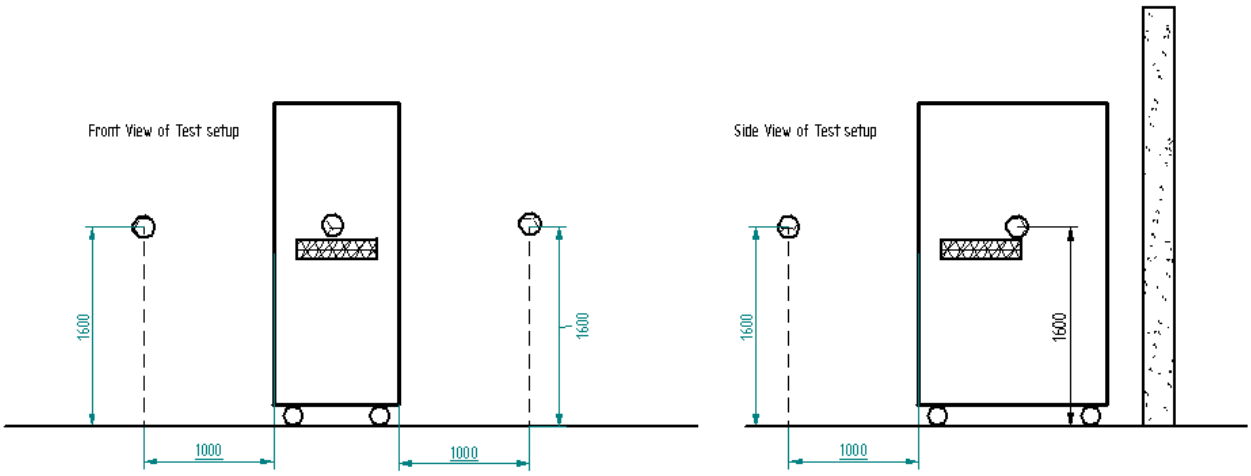

Diagram 1 - General layout for microphone positions

Test Signal

The test signal will be a randomized signal with a profile similar to the sound made by a server. A standard data file is available for use. The amplified signal level should be capable of more than 10 dB(A) above the measured background noise when the source is fitted in the enclosure

Procedure

Before any measurements are made, the special 2U rack box (See appendix) should be supported at mid-rack height and the sound pressure levels measured at all four microphone positions with a sound source set at the calibration level of 74 dB(A) at the Front Microphone Position. The test rack should then be placed against the office wall with the normal clearance and 2U rack box fitted to the middle of the rack enclosure with all the empty slots filled with blanking plates.

The following measurement should then be taken with a sound source set to the 74 dB(A) calibration level.

1. With the sound source turned off to measured background noise.
2. With the Cooling fans turned on full (i.e. override any thermostatic controls to achieve maximum fan speed).
3. With the sound source turned on and the cooling fans turned on full.
4. With the sound source turned on and the cooling fans turned off.
5. With the sound source emitting white noise and the cooling fans turned off.

Calculate the simulation performance of the enclosure by averaging the sound pressure level at each of the external microphones, but adding the value measured from the front into the average twice. Calculate the articulation index using the open procedure and the overall simulated level weighted in the same manner.

With the cooling fans turned off, set the sound source to white noise and measure the sound pressure level at all three microphone positions. (L_2)

Remove the cabinet and mount the source at mid-rack height and measure the same level at the three microphone positions. (L_1)

Calculate the Insertion Loss in each one third-octave band as follows:

$$IL = \bar{L}_1 - \bar{L}_2$$

Where:

IL = Insertion Loss

L1 = weighted average sound pressure level measured outside the enclosure space with the enclosure removed

L2 = weighted average sound pressure level measured outside the enclosure space with the enclosure.

Report

A statement, if true in every respect, that the test was conducted in accordance with this test method.

Description of the enclosure tested. The description should be sufficient to identify that this is a unique enclosure being tested. It should include all construction details and materials used in construction particularly any details of the openings, lining materials and cooling fans.

Single number ratings based on the A weighted sound pressure level and the articulation index measured with the calibrated sound source and the cooling fans operating. The single number rating NIC (Noise Isolation Class) by using classification ASTM E413 except that the measured insertion loss values are used instead of the transmission loss values.

A graph showing the variation of insertion loss with frequency and the variation of A Weighted Sound Pressure Level with frequency can also be supplied.

The statement that the following information is available on request if it is not included in the test report.

1. Detailed description of the test procedure
2. Description of the test environment
3. The measuring instruments used and when they were last calibrated.

Appendix

Figure 2 Front of Sound Source - Three apertures covered with vinyl tape to prevent fans pressure back loading the transducers

Figure 3 Rear of sound source showing microphone holder and 12 broad frequency miniature speakers

Figure 4 Microphone Layout for setting the sound source levels

Figure 5 Sound source fitted to a cabinet with blanking plates fitted