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Standard Test Method for Measuring Insertion Loss of Pneumatic Exhaust Silencers[1]

This standard is issued under the fixed designation E1265; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the laboratory measurement of both the acoustical and mechanical performance of pneumatic exhaust silencers designed for quieting compressed gas (usually air) exhausts from orifices connected to pipe sizes up to ¾ in. NPT. This test method is not applicable for exhausts performing useful work, such as part conveying, ejection, or cleaning. This test method evaluates acoustical performance using A-weighted sound level measurements.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Section 8.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C634 Terminology Relating to Building and Environmental Acoustics

2.2 *ANSI Standards:*[3]

S1.4 Specification for Sound Level Meters

S1.13 Method for the Measurement of Sound Pressure Levels

S1.31 Precision Method for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms

S1.33 Engineering Methods for the Determination of Sound Power Levels of Noise Sources in a Special Reverberation Room

B2.1 Taper Pipe Thread (NPT)—Standard Designation for Tapered Pipe Threads

2.3 *Federal Standard:*

Rules and Regulations—Hand and Portable Power Tools and Equipment[4]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, see Terminology C634. Particular terms of interest are: *sound level* and *average sound pressure level.*

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *flow ratio*—the ratio of gas flow with the pneumatic exhaust silencer installed relative to flow of the unrestricted pipe.

3.2.2 *flow resistance*—the reduction of fluid flow caused by various restrictions, surface roughness, devious paths, obstacles, etc. This term is sometimes referred to as "back pressure."

3.2.3 *Discussion*—For this test method back pressure is a qualitative term, therefore, there is no need to measure.

3.2.4 *insertion loss of a pneumatic exhaust silencer (at a specific supply pressure)*—the difference in average A-weighted sound levels measured with and without the pneumatic exhaust silencer installed on an unrestricted or "open" pipe.

3.2.5 *Discussion* —Insertion loss, as defined in this test method, differs from the definition in Terminology C634. As stated in 1.1, this test method uses A-weighting rather than discrete frequency bands. It compares a set of sound pressure data measured in a reverberation room rather than determining

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] This United States Occupational Safety and Health Administration Regulation, *Federal Register*, Vol 36, Number 105, Part II, p. 10653, May 1971, is available from Superintendent of Documents, Government Printing Office, Washington, DC 20402–9371.

absolute sound power levels. This test method is intended to assess the difference in sound regenerated at the pipe orifice and does not evaluate sound propagating along the pipe interior.

3.2.6 *pneumatic exhaust silencer*—a device attached to a pipe fitting or orifice. The silencer reduces the sound produced when the released pressurized exhaust gases (usually air), merge with ambient (static) air in the region surrounding the orifice. Such silencers are not usually intended to perform useful work such as part conveying, ejection, or cleaning. The port sizes of the pneumatic exhaust silencers addressed by this test method are: ⅛, ¼, ⅜, ½, ⅝, and ¾ in. NPT (based on the American National Standard Taper Pipe Thread designation, (B.2.1), specified in fractions of an inch).

4. Summary of Test Method

4.1 A special air reservoir system terminates in a reverberation room where acoustical measurements are made to assess the sound produced by both an open pipe and the pipe terminated with a silencer. Both flow volume and A-weighted sound level measurements are made as the air supply valve is opened between the reservoir and the piping system. The test procedure is repeated for three air reservoir pressures both with and without silencer. The flow ratios are calculated from the flow volumes with an unrestricted pipe and with the silencer. The insertion loss is determined by the difference in A-weighted sound levels. This is done for each of the three air reservoir pressures. The overall pneumatic exhaust silencer performance is then reported as insertion loss versus flow ratio.

5. Significance and Use

5.1 This test method permits the evaluation of both the acoustical and mechanical performance of pneumatic exhaust silencers designed for quieting compressed gas exhausts (usually air). The data can be used by manufacturers to assess or improve their products, or by users to select or specify a silencer. The data acquired using this measurement method allow for performance comparisons of competitive products and aid in the selection of an appropriate device.

5.2 Flow rate is an important parameter to consider when the application involves machinery or equipment that requires compressed air or other gases to be exhausted rapidly. For example, in an automatic pneumatic press, compressed air must be exhausted rapidly to avoid a premature second cycle. For this reason, flow ratio is reported in addition to acoustical performance.

6. Assumptions

6.1 Studies have shown that the sound level (in decibels) produced by quieted pneumatic exhausts generally is linear with supply pressure for the range of pressures covered in this test method. It is assumed that the air supply pressures called for in this test method include those typical of most applications. Sound levels may be extrapolated for silencers operating at pressures slightly beyond the test range. A linear relationship can be assumed between discrete test supply pressures.

6.2 Generally, the sound power produced by pneumatic exhausts is dominant in the frequency range from 500 to 10 000 Hz. This frequency range allows testing in a relatively small reveberation room. ANSI Standard S 1.33 (Appendix A), provides guidelines for the design of an appropriate test room.

NOTE 1—Reverberation rooms as small as 17 m^3 are sufficient for making A-weighted measurements of noise generated by pneumatic exhaust silencers. The minimum volume of 70 m^3 recommended in ANSI S1.33 can be ignored.

6.3 The performance of pneumatic exhaust silencers tends to deteriorate over time, due to clogging and other factors. The primary purpose of this test method is to evaluate the optimum performance of pneumatic exhaust silencers, therefore only new or unused silencers should be tested. This test method may also be used to measure the performance of a silencer during its actual or simulated service life.

7. Apparatus

7.1 *Reverberation Room:*

7.1.1 The reverberation room shall conform to the requirements in ANSI S1.33, except for the minimum volume. (See Note 1.)

7.1.2 The reverberation room shall be equipped with a duct-type muffler or silencer to control static air pressure while simultaneously reducing extraneous sound entering the test room from adjacent areas.

7.1.2.1 This duct-type muffler shall have an adequate“ free” cross-sectional area to allow the air introduced by the test process to be vented rapidly, relieving the pressure within the test room. The static pressure in the reverberation room shall be measured initially while testing the largest open pipe to determine if the free cross-sectional area is adequate to allow air to escape. If the gage pressure[5] rises to more than 4 kPa, then the cross-sectional area of the duct or the room volume must be increased.

7.1.2.2 The construction of the duct-type muffler and the reverberation room shall be adequate to ensure that the background sound level within the test room is at least 10dB below the lowest sound level measured during the evaluation. The muffler shall also be so selected as to avoid “self-generated” sound.

7.2 *Piping System:*

7.2.1 The test apparatus shall consist of a system similar to that shown in Fig. 1. The critical elements are the compressor-tank capacity, size of supply pipes and method of assembly, lengths of certain pipe sections, and design of devices in the air stream (that is, valves, regulators, flow meters, temperature, and pressure sensors).

7.2.1.1 *Reservoir Capacity*—The minimum air reservoir size is determined by the maximum unrestricted pipe diameter planned for the test. Use a reservoir whose size is adequate to permit obtaining three contiguous 1 s average sound levels within 2 dB of each other (see 9.3.3.2).

NOTE 2—Based on experience, the minimum storage tank capacity for testing ⅛ in. NPT devices is approximately 2.8 ft^3 (0.08 m^3). The

[5] The Magnehelic gage, available from F.W. Dwyer Co., P. O. Box 3029, 1123 Mearns Rd., Ivyland, PA 18974, or equivalent, has been found satisfactory for this measurement.