



Designation: E3091 – 17

Standard Specification for Systems to Measure Sound Levels¹

This standard is issued under the fixed designation E3091; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This specification is for measurement systems used in making sound pressure level measurements in buildings in accordance with ASTM standards and guides. Systems for making sound pressure level measurements in other environments are not addressed in this specification. A future expansion of this specification may include these environments. The systems addressed include one or more microphones and associated components to process the output of the microphone measurement system conforms to a sound level meter specification it is sufficient to specify the category of precision and accuracy required by the measurement system and that direction is given in the user manual for proper use. Where the system is composed of components, specifications are given for microphone type and orientation, filters and windscreens.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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 and health practices and determine the applicability of regulatory limitations prior to use.*

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

C423 Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

¹ This specification is under the jurisdiction of ASTM Committee E33 on Building and Environmental Acoustics and is the direct responsibility of Subcommittee E33.05 on Research.

Current edition approved July 1, 2017. Published July 2017. DOI: 10.1520/E3091-17.

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.

C634 Terminology Relating to Building and Environmental Acoustics

E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

E492 Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine

E1111 Test Method for Measuring the Interzone Attenuation of Open Office Components

E1130 Test Method for Objective Measurement of Speech Privacy in Open Plan Spaces Using Articulation Index

E2964 Test Method for Measurement of the Normalized Insertion Loss of Doors

2.2 Other Standards:^{3,4}

ANSI S1.4-2014/Part 1/IEC 61672-1: 2013 Electroacoustics - Sound level meters – Part 1: Specifications

ANSI S1.4-2014/Part 3/IEC 61672-3: 2013 Electroacoustics - Sound level meters – Part 3: Periodic tests

IEC 61094-4: 1995 Electroacoustics - Measurement Microphones – Specifications for working standard microphones

ANSI/ASA S1.11-2014/Part 1/IEC 61260-1: 2014 Electroacoustics - Octave-band and fractional-octave-band filters – Part 1: Specifications

ANSI S1.40-2006 Specifications and Procedures for Sound Calibrators

IEC 60942:2003 Electroacoustics –Sound calibrators

ANSI S1.17/Part 1-2004 Microphone Windscreens – Part 1: Measurements and Specifications of Insertion Loss in Still Air or Slightly Moving Air

NOTE 1—ANSI S1.4-2014/Part 1 and Part 3 are nationally adopted standards mirroring IEC 61672-1: 2013 and IEC 61672-3: 2013. Therefore only the IEC 61672 standards will be referenced in the rest of this standard. ANSI/ASA S1.11-2014/Part 1 is a nationally adopted standard mirroring IEC 61260-1:2014. Therefore only the IEC 61260-1 will be referenced in the rest of this standard.

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

⁴ Available from International Electrotechnical Commission (IEC), 3, rue de Varembe, 1st Floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, <http://www.iec.ch>.

3. Terminology

3.1 For definitions of terms used in this specification see Terminology **C634**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *diffuse field microphone, n*—a microphone which provides its most uniform frequency response for sound equally incident from all angles, IEC 61094-4 Type D.

3.2.2 *free-field microphone, n*—a microphone which provides its most uniform frequency response when oriented with the plane of its diaphragm perpendicular to the direction of the sound, IEC 61094-4 Type F.

NOTE 2—The complete designation of a working standard microphone according to IEC 61094-4 includes “WS” and a number specifying the diameter for a half inch free-field response microphone be “WS2F”.

3.2.3 *frequency response (of microphones), n*—the ratio of the electrical output of the measurement system to the sound pressure microphone dependent on the angle of incidence.

3.2.4 *pressure microphone, n*—a microphone which provides its most uniform frequency response when oriented with the plane of its diaphragm parallel to the direction of the sound, IEC 61094-4 Type P.

3.2.5 *windscreen, n*—a device fitted on to a microphone to reduce the spurious sound pressures generated by turbulent air flowing around the microphone cartridge.

4. Significance and Use

4.1 Microphones and associated measurement systems are used in standard test methods to measure sound pressure levels.

4.1.1 Often the measurement system is obtained from the manufacturer as a complete system including subsystems comprising one or more microphones, signal processing circuitry, a signal analysis system and display. All of these subsystems are designed to conform to a normative sound level meter specification. In such a measurement system:

4.1.1.1 The instruction manual shall contain sufficient information for a user to obtain reproducible sound pressure level measurements in various sound fields and,

4.1.1.2 The performance of the system or sub systems is straight forward to test.

4.1.2 There are other measurement systems that use sophisticated multi-channel analyzers, filters and display systems; however these may not be supplied with a specific microphone so they cannot conform to a normative sound level meter specification. Such a system may be more useful for acoustical testing than a simpler instrument that is fully compliant to a normative sound level meter specification.

4.1.2.1 Even systems that are fully compliant with a normative sound level meter performance specification may have non-compliant modes of operation such as reverberation time measurements.

4.1.2.2 For these systems or non-compliant modes of operation, it is necessary to specify both the filter class and the frequency response characteristics of the microphone orientation of the microphone with respect to the sound source.

4.1.2.3 The performance of a non-compliant system may be more complex to verify because:

(1) There may not be a user manual that encompasses the entire system (see **Note 3**).

(2) Microphones may selected by the user rather than the manufacturer.

(3) It may not be practical to perform normative periodic performance tests on certain features or functions.

NOTE 3—IEC 61672-3 requires the user manual to be available to a calibration laboratory so that it can perform periodic performance testing.

4.2 This specification addresses:

4.2.1 Reverberation time measurements in diffuse fields as in Test Method **C423**.

4.2.2 Level differences in diffuse sound fields as in Test Methods **E90** and **E2964**.

4.2.3 Level differences in free-field conditions above a reflecting plane as in Test Method **E1111**.

4.2.4 Absolute levels in diffuse fields as in Test Method **E492**.

4.2.5 Absolute levels as in Test Method **E1130**.

4.3 This specification does not address all situations where sound pressure levels are measured. These include outdoor noise measurement, intensity measurement and measurement along surfaces.

5. Measurement Systems

5.1 The measurement system includes all the components necessary to indicate measured sound pressure levels. The components may include microphones, preamplifiers, cables, processing units, filters, computers, display units, and other peripheral devices. There are two categories of measurement systems:

NOTE 4—IEC 61672-1 defines a system for measuring sound pressure levels as a “sound level meters”.

5.1.1 A measurement system that conforms a normative sound level meter performance standard shall meet the class 1 specifications of IEC 61672-1 and have its performance verified using a normative standard for periodic testing, that is, IEC 61672-3.

5.1.2 The performance of a measurement system that has not been designed to conform to the specifications of normative standards shall be tested periodically for class 1 performance criteria in **5.1.3** and **5.1.4** if frequency weighting is to be used. Strict compliance with the procedures in IEC 61672-3 may not be possible since the system may not meet all of the specifications in IEC 61672-1. Periodic testing of performance to a subset of IEC 61672-3 is permissible providing all criteria listed in **5.1.3** are included and if frequency weighting is to be used then the criteria in **5.1.4** are also included.

5.1.3 Performance criteria required for measurement of sound pressure levels in building acoustics are:

5.1.3.1 Indication at the calibration frequency according to IEC 61672-3, Section 10.

5.1.3.2 Self-generated noise according to IEC 61672-3, Section 11.

5.1.3.3 Electrical signal tests of frequency weightings according to IEC 61672-3, Section 13.

5.1.3.4 Frequency and time weightings at 1kHz according to IEC 61672-3, Section 14.