Designation: E 1574 – 98

Standard Test Method for Measurement of Sound in Residential Spaces[1]

This standard is issued under the fixed designation E 1574; 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 provides guidance to the methodology used in the measurement of building interior sound levels.

1.2 This test method describes procedures for measuring sound in enclosed residential spaces produced by built-in utilities and major appliances such as plumbing, heating, ventilating, air-conditioning systems, refrigerators, and dish washers. The measured values may then be used to assess compliance, design, or habitation suitability.

1.3 This test method does not promulgate or recommend acoustical criteria.

1.4 This test method is not intended for obtaining data to evaluate indoor environments for:

1.4.1 Commercial activities such as studios, communication centers, hospitals, and auditoria, and

1.4.2 Effects from exterior sources such as aircraft, railroad operations, motor vehicles, mining operation, weapons fire, etc.

1.5 This test method is not intended for evaluating sound transmission loss, sound absorption coefficient, or any other acoustical aspects of the space or structure.

1.6 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 634 Terminology Relating to Environmental Acoustics[2]

2.2 *ANSI Standards:*[3]

S1.4 Specification for Sound Level Meters

S1.11 Specification for Octave-Band and Fractional-Octave Analog and Digital Filters

S1.40 Specification for Acoustical Calibrators

3. Terminology

3.1 Definitions—For definitions of acoustical terms used in this standard see Terminology C 634.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *background noise*—to include sound propagating to the measurement space from sources which are not under control of the proprietor or occupant of the measurement space. See Terminology C 634.

3.2.1.1 *Discussion*—Examples include external utilities, traffic, and activity in adjacent residences.

3.2.2 *highest transient sound*—a sound characterized by a brief excursion of pressure level which exceeds the ambient or steady sound.

3.2.2.1 *Discussion*—The transient sound may be accompanied by steady sound; for example, flushing of toilets or furnace start-up. The highest transient sound is the maximum excursion of the sound product by the source of interest during the source on-off cycle.

3.2.3 *measurement space*—residential spaces with a defined boundary, usually a room or hallway, in which acoustical data are to be acquired. Although the space may have a defined boundary, it does not have to be an enclosing boundary.

3.2.3.1 *Discussion*—For example; an L-shaped living room/dining room would be considered two spaces—living room and dining room.

3.2.4 *source of interest*—a source which is part of the residence and which propagates sound into the measurement space.

3.2.4.1 *Discussion*—Typical sources of interest are built-in utilities such as plumbing, heating, ventilating, air-conditioning systems, and major appliances.

3.2.5 *source sound*—the sound pressure level at a point produced solely by the source of interest.

3.2.6 *steady sound*—a sound whose pressure level remains substantially constant during the period of observation when measured with the *slow* setting on the sound level meter.

3.2.6.1 *Discussion*—Examples are a forced air blower and a water pump.

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[1] This test method is under the jurisdiction of ASTM Committee E-33 on Environmental Acoustics and is the direct responsibility of Subcommittee E33.08 on Mechanical and Electrical System Noise.

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[2] *Annual Book of ASTM Standards*, Vol 04.06.

[3] Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

4. Summary of Test Method

4.1 This test method is a procedure for quantifying the sound from sources identified as the cause or potential cause of noise complaints in residential spaces.

4.2 The sound generated by the source of interest may be steady, transient, or a mixture of the two. For each source of interest the steady sound and the highest transient sound are measured.

4.2.1 *Steady Sound*— The measurement space is surveyed and the point at which the highest utilities-generated A-weighted, slow response sound level occurs is located (see 9.1). The octave band and A-weighted sound levels at this point are measured and reported.

4.2.2 *Highest Transient Sound*—The highest utilities-generated A-weighted, fast response sound level is measured at the center of each measurement space and reported.

4.2.3 These procedures are repeated in all measurement spaces and for all sources, or combination of sources, of interest.

5. Significance and Use

5.1 This is an in situ method, that is, the measurements are made at the actual installation. The sound levels measured according to this test method should be representative for that installation and for the quantity of acoustical absorption actually, permanently present.

5.2 The test method has the following limitations:

5.2.1 The test method produces sound data which may be compared with applicable criteria or limits only if they are in terms of the quantities measured in this test method.

5.2.2 The test method does not quantify certain subjective aspects of the sound environment that may be objectionable. These include pure tones, spectral content, and temporal distribution.

6. Measurement Space

6.1 The measurement space shall be any space, individual room, or enclosed portions of the residential space that are intended to be occupied by people.

NOTE 1—Examples of spaces expected to be measured are bedrooms, living rooms, kitchens, and finished basements. Examples of spaces that are not expected to be measured are utility closets, closets, and carports. Examples of spaces that may or may not be measured are garages, unfinished basements, and hallways.

6.2 For new construction, the measurements shall be made with the space configured in the completed, but unfurnished, state.

6.3 For currently inhabited spaces, the measurements shall be made as furnished.

6.4 Absorptive material shall not be added to the space solely for the purpose of influencing the measurements.

7. Measurement Location

7.1 The microphone height shall be between 1.1 and 1.3 m above the floor, the approximate average of the sleeping, standing, and seated ear heights of an individual.

7.2 The microphone shall be located no closer than 1 m to any wall or other extended surface, except in spaces narrower than 2 m where the measurement shall be at a location equidistant from the closest opposing walls. If the source of interest (built-in utility or appliance) protrudes from the extended surface, the measurement shall not be made closer than 1 m from the source.

7.3 The reported measurement shall be made at the location within each measurement space that meets the above requirement and produces the highest sound level during the survey.

7.4 The measurements shall be made with the minimum number of people in the measurement space. Personnel shall not occupy the direct line of sight between the source of interest and the sound level meter.

8. Instrumentation

8.1 The sound measurement system shall meet the requirements of ANSI S1.4 for Type 1 sound level meters.

8.2 Octave band or fractional band filters shall meet the requirement of ANSI S1.11, Type 2, Order 3, or higher. If 16 000 Hz measurements are to be made, a Type 1 filter must be used.

8.3 Acoustic calibrators shall meet the requirements of ANSI S1.40.

8.4 If measurements are to be made in a stream of moving air such as generated by a forced air heating system or air conditioner, place a windscreen over the microphone. The motion of air over the microphone of the sound level meter can cause local air turbulence noise at the microphone. The meter will respond to this turbulence noise and produce an erroneous reading. Placing a windscreen over the microphone will reduce this local turbulence.

NOTE 2—A windscreen having a diameter of at least 7 cm is recommended.

9. Measurement Procedures

9.1 *Determining the Location of Sound Level Maximum*—Survey each measurement space of interest to find the location of the maximum A-weighted, slow response sound level produced by each sound source or combination of sources of interest. Walk slowly and quietly, first at 1 m from the inside boundary of the space, then at concentric paths about 1 m apart, while observing the sound levels. Note the location and sound level in the space where the level is the highest.

NOTE 3—An alternate method is to measure and record at fixed intervals such as 1 m, then note the highest level.

9.2 *Measurement Procedure for Steady Sound*—In each measurement space, repeat the following procedure for each source or combination of sources of interest:

9.2.1 Place the microphone in the measurement space at the location of the sound level maximum as determined in 9.1.

9.2.2 Measure the combined source sound and background noise. With the source of interest operating and all other controllable sound sources off, measure the octave band sound pressure level in each band from 31.5 Hz to 8000 Hz inclusive, using the slow response on the sound level meter or average sound level for periods depending on the octave band as follows: 40 s for the 31.5 Hz band, 20 s for the 63 Hz band, 9 s for the 125 Hz band and 5 s for bands above 125 Hz.

NOTE 4—The measurement may be made in 1/3-octave bands and the

data may be used to calculate the 1/1-octave bands levels.

NOTE 5—High frequency sound from television sets, computer monitors and intrusion sensors may be observed in the 16 000 Hz octave band. These should be reported as indicated in 10.1.8, especially if they are audible to an occupant or if they contribute to the A-weighted background noise as indicated in 3.2.1.

9.2.3 *Measure the Background Noise*—Shut off the source of interest and repeat the measurement of 9.2.2 using slow response or average band level consistent with 9.2.2.

9.2.4 If, in each octave band, the background noise level (measured in 9.2.3) is 10 dB lower than the corresponding octave band level of the combined source sound and background noise (measured in 9.2.2) then report the 9.2.2 measurements as the octave band levels of the sound generated in the measurement space by the source of interest.

9.2.5 If, in any octave band, background noise level is not 5 dB lower than the corresponding measured octave band level for the combined background noise and source sound, then indicate in the report that these octave band data are contaminated by background noise.

9.2.6 If in any octave band the background noise level (measured in 9.2.3) is between 5 and 10 dB lower than the corresponding octave band level of the combined source sound and background noise, adjust the 9.2.2 measurements in accordance with Table 1 and report the adjusted level as the octave band level of the sound generated in the measurement space by the source of interest.

9.3 *Measure Procedure for Highest Transient Noise*—For each measurement space of interest, repeat the following procedure for each source of interest:

NOTE 6—Transient background noise could affect background as well as source noise measurements.

9.3.1 Place the microphone at the center of the space of interest within the limits of Section 7. For nonrectangular spaces such as *L-shaped* rooms, break up the space into rectangles and measure at the center of each rectangle.

9.3.2 Set the sound level meter to A-weighting, fast response.

9.3.3 Measure the background noise. With the source of interest and all other controllable sound sources shut off, note the maximum A-weighted, fast response level for a 15-s interval.

9.3.4 Measure the combined source sound and background noise. Activate the source of interest and note the highest value of the A-weighted, fast response level indicated by the meter.

9.3.5 If the A-weighted, fast response level of the background noise is 10 dB lower than the highest A-weighted, fast response level of the combined source sound and background noise, then report the 9.3.4 measurements as highest transient sound level generated in the space by the source of interest.

TABLE 1 Corrections for Background Noise Level (dB)

Difference between the level measured with source of interest operating and the measured background noise alone	6	7	8	9
Correction to be subtracted from level measured with the source of interest operating to obtain the adjusted level (due to the source of interest alone)	1.3	1.0	0.8	0.6

9.3.6 If the A-weighted, fast response level of the background noise is not 5 dB lower than the level of the combined source sound and background noise, indicate in the report that the data are contaminated by background noise.

9.3.7 If the A-weighted, fast response level of the background noise is between 5 and 10 dB lower than the highest A-weighted, fast response level of the combined source sound and background noise, then adjust the 9.3.4 measurements in accordance with Table 1 and report the adjusted 9.3.4 measurements as highest transient sound level generated in the space by the source of interest.

10. Report

10.1 Report the following information:

10.1.1 A tabulation of sound levels for each measurement set with identification of the measurement space, measurement location within the space, source of interest or combination of sources of interest, and time the data were obtained. See Fig. 1 for a suggested data sheet.

10.1.2 The frequency weighting (A-), band center frequency, and time weighting (*fast* or *slow*, etc.) used for each measurement.

10.1.3 The time of calibration checks and whether a windscreen was installed. If applicable, battery checks should also be noted.

10.1.4 A diagram of each measurement space showing measurement locations (maximum A- sound pressure levels, slow and fast response).

Project reference											Date		Page
Location address											Room		
Instrumentation	Manufacturer		Type		Serial number			Date calibrated			Room was furnished		
Sound level meter											Yes		No
Microphone													
Calibrator											Windscreen was used		
Calibration check	Pre dB, time				Post dB, time						Yes		No
		Octave band center frequency, Hz										A-weighted	
Time	Source and condition	31.5	63	125	250	500	1000	2000	4000	8000	16000	fast	slow
Diagram													
Comments													
Measured by											Telephone number		

FIG. 1 Suggested Data Sheet

10.1.5 A diagram of the measurement space showing sources of interest.

10.1.6 Instrument data, including manufacturer, model, and serial number, and dates of the last factory (or laboratory) calibration of the sound level meter and acoustic calibrator.

10.1.7 Times, dates, and durations of measurements, and the names and telephone numbers of persons making measurements.

10.1.8 A description of the measured sounds (steady, tonal, transient), the identified sound sources, and the steady repetition of any transient components.

10.1.9 A statement, to the extent true, that this test method was followed. Any exceptions should be noted.

NOTE 7—It is recommended that all raw data sheets be retained, regardless of whether they are included in the report.

10.1.10 If applicable (see 9.2.5 and 9.3.5), indicate that the identified octave band data are contaminated with background noise.

10.1.11 If applicable (see 9.2.6 and 9.3.7), indicate that the identified data have been adjusted for background noise per Table 1.

11. Precision and Bias

11.1 *Precision*—The information given below is based on a test involving experienced acousticians. The details are in ASTM Research Report No. E33-1008.[4]

11.1.1 Each participant measured the same 2 noise sources in a room using the same instruments.

11.1.2 The repeatability standard deviation between acousticians for the maximum A-weighted, slow level for a steady source was 0.71 dB. The repeatability standard deviation for the maximum A-weighted, fast level for a transient source was 0.80 dB. The repeatability standard deviation for individual octave bands not contaminated by background noise varied from 0.66 to 1.5 dB depending on the band.

11.1.3 The respective 95 % reproducibility limits between participants can be obtained by multiplying the above numbers by 2.8.

11.1.4 The term repeatability standard deviation and reproducibility limit are used as specified in Practice E 177.

11.2 *Bias*—The test method has no bias because levels are defined only in terms of this test method and the particular environment evaluated.

12. Keywords

12.1 noise; residential noise; residential space; sound

[4] Supporting data have been filed at ASTM Headquarters and may be obtained by requesting RR: E33-1008.