

**ANSI/AHRI Standard 250-2013
with Addendum 1**

**2013 Standard for
Performance and
Calibration of Reference
Sound Sources**



Approved by ANSI on April 16, 2014



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ANSI/AHRI STANDARD 250-2013 WITH ADDENDUM 1

Performance and Calibration of Reference Sound Sources

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Addendum 1 (dated September 2015) of ANSI/AHRI Standard 250-2013, “Changes to ANSI/AHRI Standard 250-2013” is provided as follows. The following changes have been incorporated (deletions are shown by **strikethroughs**, additions are shown by **shading**) into the already published 2013 version of ANSI/AHRI Standard 250 to avoid confusion:

Note: This addendum is not ANSI approved and is currently going through the process to do so.

The changes include:

1. Addition of a sentence to Section 5.10.

5.10 *Use of Windscreens.* **The use of a windscreen is optional.** If a windscreen is used it shall not affect the microphone response by more than ± 1 dB from 50 to 4,000 Hz or ± 1.5 dB for frequencies above 4,000 Hz. Windscreen corrections shall be determined per Appendix D of this standard. These corrections shall be added to the measurements made in Section 5.6 or Appendix C of this standard.

2. Addition of a sentence to Section 7.3.

7.3 *Background Levels.* Background ambient sound levels shall be at least 12 dB below the measured data for each One-third Octave Band. **If the background ambient sound levels are less than 12 dB below the measured data, corrections per ANSI/ASA Standard S12.55 shall be applied.**

3. Edits to Section C2.

C2 *Procedure.* The RSS calibration procedures found in Section 5 shall be carried out over the 50 to 10,000 Hz one-third octave band frequency range using sound pressure level measurements. These requirements are then duplicated in the 50 through 315 Hz One-third Octave Bands using sound intensity level measurements. Sound intensity level measurements shall be made in accordance with ISO 9614-1 using a spacer recommended by the probe manufacturer with a minimum length of 50 mm ~~a 50 mm spacer~~. The measurement positions and the measurement path of the intensity probe shall be per Clauses 5.4 and 5.5, and as shown in Figure 1 of this standard. If using a windscreen, it shall not affect the microphone response by more than ± 1.5 dB from 50 to 315 Hz. Windscreen corrections shall be determined per Appendix D of this standard. For all measurements, the Sound Intensity Level shall be measured in the outward radial direction. The Sound Power Levels determined from the sound pressure level and sound intensity level measurements shall be compared. If these Sound Power Levels differ by no more than the tolerance of Table C1, then the Sound Power Levels determined from the sound intensity measurements shall be deemed valid and shall be the calibrated levels reported for the 50, 63 and 80 Hz One-third Octave Bands.

IMPORTANT

SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

This standard supersedes ANSI/AHRI Standard 250-2008.

Foreword

This standard differs from the 2008 version in that it references ISO 6926 for atmospheric and barometric corrections and ANSI/ASA Standard S12.55 for room qualification methods.

TABLE OF CONTENTS

SECTION		PAGE
Section 1.	Purpose	1
Section 2.	Scope	1
Section 3.	Definitions	1
Section 4.	Performance Requirements	2
Section 5.	Primary RSS Calibration Procedure	3
Section 6.	Secondary RSS Transfer Calibration Procedure	4
Section 7.	Test Requirements	5
Section 8.	Test Data To Be Recorded	5
Section 9.	Information To Be Recorded.....	6
Section 10.	Minimum Data Requirements for Published Information	6
Section 11.	Frequency of Calibration	6
Section 12.	Conformance Conditions	7

TABLES

Table 1.	RSS Sound Power Level Output Standard Deviations	2
Table 2.	Minimum Reverberation Room Volume for Secondary RSS Transfer Calibration	4
Table 3.	RSS Tolerance Levels	7

FIGURES

Figure 1.	Microphone Path	3
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APPENDICES

Appendix A.	References – Normative	8
Appendix B.	References – Informative	8

Appendix C.	Alternative Primary RSS Calibration Procedure – Normative	9
Appendix D.	Procedures for Determining Windscreen Corrections – Normative	10
Appendix E.	Example for the Determination of the Directivity Index and Resultant RSS Calibration – Informative	11

TABLES FOR APPENDICES

Table C1.	Tolerance for Sound Power Level Difference	9
Table E1.	Example for the Determination of the Directivity Index and Resultant RSS Calibration	11
Table E2.	RSS Maximum Sound Pressure Levels in One-third Octave Bands, L_{pi}	12
Table E3.	RSS One-third Octave Bands Directivity Index, dB	13
Table E4	Resultant RSS Calibration	13

PERFORMANCE AND CALIBRATION OF REFERENCE SOUND SOURCES

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish the performance characteristics of a Reference Sound Source, define the acoustical calibration procedures, and define the method for transfer of calibration from a Primary to a Secondary Reference Sound Source.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This standard applies to all Reference Sound Sources used in conjunction with AHRI sound rating standards and covers the one-third octave band frequency range from 50 to 10,000 Hz. This standard also includes calibration over a limited frequency range. Multiple Reference Sound Sources may be used to cover the entire frequency range from 50 to 10,000 Hz.

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the ASHRAE Terminology website (<https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology>) unless otherwise defined in this section.

3.1 *Directivity Index (D_i).* An indicator, expressed in decibels (dB), of the non-uniform spatial sound radiation of the Reference Sound Source being calibrated.

3.2 *Hertz (Hz).* A unit of frequency equal to one cycle per second.

3.3 *Octave Band.* A band of sound covering a range of frequencies such that the highest is twice the lowest. The Octave Bands used in this standard are those defined in ANSI Standard S1.11.

3.4 *One-third Octave Band.* A band of sound covering a range of frequencies such that the highest frequency is the cube root of two times the lowest frequency. The One-third Octave Bands used in this standard are those defined in ANSI/ASA Standard S1.11.

3.5 *Reference Sound Source (RSS).* A portable, aerodynamic sound source that produces a known stable broad band sound power output. The device shall meet the performance requirements as defined in Section 4.

3.5.1 *Primary Reference Sound Source.* A laboratory RSS whose Sound Power Levels are determined by using the procedures as defined in Section 5.

3.5.2 *Secondary Reference Sound Source.* A laboratory RSS whose Sound Power Levels are determined by using the transfer calibration procedure as defined in Section 6.

3.6 *Sound Intensity Level, L_i .* Ten times the logarithm to the base ten of the ratio of the magnitude of the intensity to the reference intensity of 1 picowatt per square meter (pW/m²).

3.7 *Sound Power Level, L_w .* Ten times the logarithm to the base ten of the ratio of the sound power radiated by the source to a reference sound power, expressed in decibels (dB). The reference sound power used in this standard is 1 picowatt (pW).

3.8 *Sound Pressure Level, L_p .* Twenty times the logarithm to the base ten of the ratio of a given sound pressure to a reference sound pressure of 20 μ Pa, expressed in decibels (dB).

3.9 *“Shall” or “Should”.* “Shall” or “should” shall be interpreted as follows:

3.9.1 *Shall.* Where “shall” or “shall not” is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.9.2 *Should.* “Should” is used to indicate provisions which are not mandatory but which are desirable as good practice.

Section 4. Performance Requirements

4.1 *Type of Sound Source.* A portable, aerodynamic sound source that produces a known stable broad band sound power output. The sound source shall have no pure tones within the frequency range of interest. The presence of a tone is indicated by variation in adjacent One-third Octave Bands of more than 3 decibels.

4.2 *Reference Sound Source Spectral Characteristics.* The spectrum of the Reference Sound Source shall be broad band and the spread of one-third octave band Sound Power Levels of the RSS when calibrated over the frequency range of 50 – 10,000 Hz shall not exceed 16 dB. When the Reference Sound Source is only calibrated over the frequency range of 100 to 10,000 Hz the spread of one-third octave band Sound Power Levels of the RSS shall not exceed 12 dB. Regardless of the frequency range of calibration adjacent bands shall not deviate by more than 3 dB to avoid the presence of tones when tested in accordance with this standard.

4.3 *Reference Sound Source Size.* The largest dimension of the source shall not exceed 0.5 m.

4.4 *Vibration Isolation.* The RSS shall be equipped with integral vibration isolation so that it will provide a minimum of 95% isolation at its rotational speed.

4.5 *Temporal Steadiness and Repeatability of the Sound Power Output.* The Reference Sound Source shall be designed and constructed so that the Sound Power Level in each One-third Octave Band is constant in time within the limits defined in Table 1 for the required measurement period. The values in Table 1 represent the expected repeatability of the measurements. Temperature and barometric pressure corrections shall be performed per Clause 8.4 of ISO 6926.

Table 1. RSS Sound Power Level Output Standard Deviations	
Frequency Range, Hz	Sound Power Level Output Standard Deviation, dB
50 - 80	0.8
100 - 160	0.4
200 – 10,000	0.2

4.5.1 *Sound Power Level Variation from Electrical Variation.* The RSS Sound Power Level in any One-third Octave Band shall not vary by more than ± 0.3 dB within the range of the source electrical power. The manufacturer of the RSS shall provide the tolerances of electrical input power to assure no more than a ± 0.3 dB deviation.

4.5.2 *Sound Power Level Variation from Atmospheric Conditions.* The Sound Power Level of the Reference Sound Source may depend on the atmospheric pressure and temperatures along with the altitude. The manufacturer of the RSS shall provide correction values for these variables.

4.6 *Directivity Index.* The Directivity Index of the Reference Sound Source in any One-third Octave Band from 50 to 10,000 Hz at any microphone height shall not exceed + 6 dB. See Section 5.8 for procedure to determine Directivity Index.

Section 5. Primary Reference Sound Source Calibration Procedure

5.1 General. The RSS calibration procedure shall be carried out in accordance with the provisions of Section 5 for sound pressure measurements in a hemi-anechoic room or as provided in Appendix C for using the sound intensity method. Calibration of the laboratory instrumentation system used for this procedure shall be verified at intervals in a calibration laboratory demonstrating traceability to appropriate standards.

5.2 Test Environment. The test environment shall be a hemi-anechoic space meeting or exceeding the qualification requirements of ANSI/ASA Standard S12.55. The hard surface shall extend at least 1 m beyond the projection of the measurement surface in all directions. In addition, the volume of the test room shall be greater than 280 m³.

5.3 Microphone. A calibrated 12 mm free field microphone mounted with its axis 0° towards the Reference Sound Source shall be used. The microphone frequency response shall be corrected to give a flat frequency response within 0.1 dB over the frequency range of interest.

5.4 Microphone Positions. The measurement surface shall be a hemisphere with a radius of 2 m. The center of this hemisphere shall be located on the floor directly below the center of the RSS fan wheel.

5.5 Microphone Path. The path to be used is defined as twenty coaxial, horizontal circular traverses on the surface of the 2 m radius hemisphere and around a vertical axis passing through the center of the RSS fan wheel. The traverse speed shall not exceed 1 rpm. The twenty coaxial, horizontal circular traverses shall start at a height of 0.025r (r = radius) starting from the floor and increase in 0.05r increments to 0.975r in Figure 1.

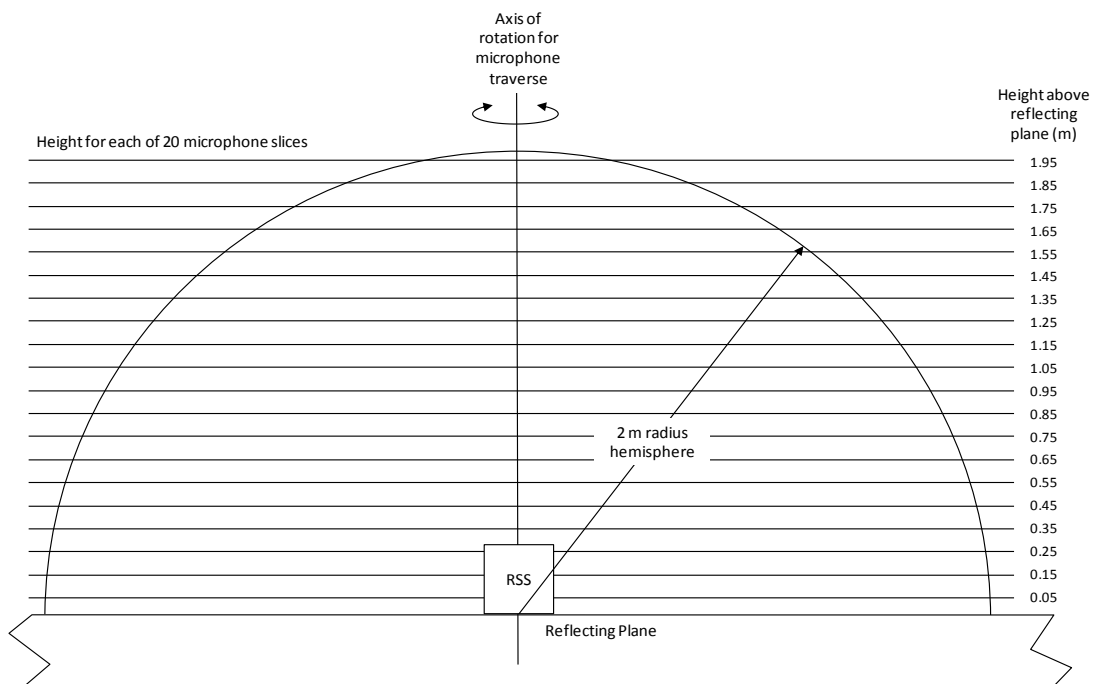


Figure 1. Microphone Path

The circular path may be achieved by uniformly rotating either the microphone or RSS through 360°. If the RSS is to be rotated, the top surface of the turntable shall be flush with the floor (rotational speed not to exceed 1 rpm).

5.6 Measurements. Measure the one-third octave band Sound Pressure Level in accordance with ANSI/ASA Standard S12.55 with an integration time equal to one complete revolution of the microphones or source. The analyzer shall be capable of making measurements to 0.1 dB.

5.7 Calculations. The one-third octave band Sound Power Levels shall be computed per ANSI/ASA Standard S12.55 using the surface Sound Pressure Levels calculated in accordance with ANSI/ASA Standard S12.55 and they shall be rounded to the nearest 0.1 decibels.

5.8 Directivity Index Calculation. The maximum measured Sound Pressure Level or maximum measured Sound Intensity Level for each One-third Octave Band at each microphone height shall be used to compute the Directivity Index.

The Directivity Index shall not be computed for the 0.025r microphone height. The maximum calculated Directivity Index for each One-third Octave Band shall be published per Section 10.2 item 1 and calculated per Equation 1.

$$D_i = L_{pi} \text{ or } L_{ii} - L_p \tag{1}$$

Where:

- D_i = Directivity Index for a given One-third Octave Band
- L_{pi} = Maximum measured Sound Pressure Level for a given One-third Octave Band at a given microphone height
- or
- L_{ii} = Maximum measured Sound Intensity Level for a given One-third Octave Band at a given microphone height
- L_p = Average Sound Pressure Level for a given One-third Octave Band over the surface of the measurement hemisphere

Refer to Appendix E for an example.

5.9 Instrumentation and Equipment. The instrumentation and equipment shall meet or exceed the requirements of ANSI/ASA Standard S12.55.

5.10 Use of Windscreens. The use of a windscreen is optional. If a windscreen is used it shall not affect the microphone response by more than ± 1 dB from 50 to 4,000 Hz or ± 1.5 dB for frequencies above 4,000 Hz. Windscreen corrections shall be determined per Appendix D of this standard. These corrections shall be added to the measurements made in Section 5.6 or Appendix C of this standard.

5.11 Calibration Over a Limited Range. This standard allows the RSS to be calibrated over a limited range of frequencies. If the RSS is calibrated over a limited range then the range of calibration shall be reported.

Note: A limited range may not be acceptable for all AHRI standards.

Section 6. Secondary Reference Sound Source Transfer Calibration Procedure

6.1 Test Environment. The test environment shall be a reverberation room meeting or exceeding the qualification requirements of ANSI/AHRI Standard 220 over the frequency range of interest.

6.2 Reverberation Room Volumes. Minimum reverberation room volumes shall be as listed in Table 2.

Table 2. Minimum Reverberation Room Volume for Secondary RSS Transfer Calibration	
Lowest One-third Octave Band of Interest, Hz	Minimum Reverberation Room Volume, m ³
50	280
100	200
200	70

6.3 Microphone(s) Location. Microphone(s) location shall be as per specified in ANSI/AHRI Standard 220.

6.4 RSS Locations. The Reference Sound Sources shall be placed in a minimum of four locations within the reverberation room for testing. The locations and the orientations shall be the same for each source and these locations shall be positions that were used in qualifying the reverberation room per ANSI/AHRI Standard 220.

6.5 *Measurements.* The one-third octave band Sound Pressure Levels shall be measured in accordance with ANSI/AHRI Standard 220 for the RSS. The analyzer integration time shall be the same for all measurements and a minimum of 64 seconds. When using a traversing microphone, the analyzer integration time shall be equal to a whole number of microphone traverses. The analyzer used shall have a measurement resolution of at least 0.1 dB.

6.6 *Calculations.* One-third octave band Sound Power Levels for the RSS shall be calculated by using the average of the measured Sound Pressure Levels (rounded to the nearest 0.1 decibel) of the RSS. The RSS Sound Power Levels, L_{wSEC} , shall be computed and reported to the nearest 0.1 decibel, as follows for each One-third Octave Band of interest in Equation 2.

$$L_{wSEC} = (L_{wPRI} - L_{pPRI}) + L_{pSEC} \quad 2$$

Where:

L_{wPRI} = Sound Power Level of the Primary RSS, dB

L_{pPRI} = Averaged Sound Pressure Level of the Primary RSS, dB

L_{pSEC} = Averaged Sound Pressure Level of the Secondary or Working RSS, dB

6.7 *Instrumentation and Equipment.* Instrumentation and equipment shall meet or exceed the requirements of ANSI/AHRI Standard 220.

6.8 *Requirements.* A transfer calibration shall be done only from the Primary RSS. Transfer calibration shall only be done between like sources (i.e., vertical shafted fan to vertical shafted fan and horizontal shafted fan to horizontal shafted fan).

6.9 *Transfer Calibration Over a Limited Range.* This standard allows the RSS to be calibrated over a limited range of frequencies. If the RSS is calibrated over a limited range then the range of calibration shall be reported.

Note: A limited range may not be acceptable for all AHRI standards.

Section 7. Test Requirements

7.1 *Operating Voltage.* Operating voltage shall be held to ± 1 V during testing.

7.2 *Environmental.* The temperature shall be between 10°C and 30°C and during testing it shall not vary more than ± 3 °C. The relative humidity shall be between 30% and 80% and during testing it shall not vary more than ± 5 %.

7.3 *Background Levels.* Background ambient sound levels shall be at least 12 dB below the measured data for each One-third Octave Band. If the background ambient sound levels are less than 12 dB below the measured data, corrections per ANSI/ASA Standard S12.55 shall be applied.

Section 8. Test Data to be Recorded

8.1 *Test Data to be Recorded.* The following data shall be recorded:

8.1.1 Temperature, °C

8.1.2 Relative humidity, %

8.1.3 Barometric pressure, kPa

8.1.4 Line voltage, V

8.1.5 Frequency, Hz

8.1.6 Rotational speed, rev/s

8.1.7 Location and orientation in room

8.1.8 Time and date

8.1.9 Measured one-third octave band Sound Pressure Levels for the frequency range of interest, dB

Section 9. Information to be Recorded

9.1 *Information to be Recorded.* The following information shall be recorded:

- 9.1.1 Model, serial number and manufacturer of RSS(s)
- 9.1.2 Test methods used
- 9.1.3 Test personnel identification
- 9.1.4 Laboratory identification
- 9.1.5 Model and serial number of all instruments used in testing and their calibration
- 9.1.6 Laboratory where testing was done for each RSS
- 9.1.7 Type of space (e.g. anechoic) used for testing
- 9.1.8 Physical dimensions of test space, (length, width, height), m
- 9.1.9 Altitude of test site above sea level, m
- 9.1.10 Type of microphone traverse and speed, m/s

Section 10. Minimum Data Requirements for Published Information

10.1 *Minimum Data Requirements for Published Information.* As a minimum, published information shall include all items as listed in Section 10.2. All claims to ratings within the scope of this standard shall include the statement "Determined in accordance with ANSI/AHRI Standard 250."

10.2 *Information to be Published.* The following information shall be published:

- 10.2.1 Model, serial number and manufacturer of RSS(s)
- 10.2.2 Measured one-third octave band Sound Pressure Levels, and if applicable, Sound Intensity Levels for the frequency range of interest, dB
- 10.2.3 Calculated one-third octave band Sound Power Levels for the frequency range of interest, dB
- 10.2.4 Octave band and overall "A" and linear Sound Power Levels calculated from the calculated one-third octave band Sound Power Levels for the frequency range of interest, dB
- 10.2.5 Voltage, V
- 10.2.6 Frequency, Hz
- 10.2.7 Rotational speed during testing, rev/s
- 10.2.8 Laboratory identification
- 10.2.9 Test personnel identification
- 10.2.10 Type of space (e.g. anechoic) used for testing
- 10.2.11 Physical dimensions of space used for testing, (length, width, height), m
- 10.2.12 Directivity Index for each One-third Octave Band, dB (when calibration is done per Section 5)
- 10.2.13 Temperature, °C
- 10.2.14 Barometric pressure, kPa
- 10.2.15 Relative humidity, %
- 10.2.16 Any adjustment(s) made to the data for environmental conditions
- 10.2.17 Method(s) for correcting the sound power output of the RSS for extreme environmental conditions and/or altitudes and the uncertainties at these conditions
- 10.2.18 Specified test procedure used for calibration of RSS

Section 11. Frequency of Calibration

11.1 *Primary RSS Recalibration.* A Primary RSS shall be calibrated per Section 5 at the manufacturer's recommended intervals; however, this interval shall not exceed three years. If the change in observed sound pressure in the test room from the RSS exceeds the tolerance shown in Table 3, it shall be taken out of service until it has been recalibrated.

11.2 *Secondary RSS Recalibration.* Secondary RSSs shall be recalibrated per Section 6 at the manufacturer's recommended intervals; however, this interval shall not exceed three years. During day-to-day testing if the change in observed sound pressure in the test room from the RSS exceeds the tolerance shown in Table 3, it shall be either taken out of service until it has been recalibrated or determined that the differences are due to changes in the test environment.

One-third Octave Band Frequency Range, Hz	Tolerance Level, dB
50 - 250	1.5
160 – 10,000	1.0

Section 12. Conformance Conditions

12.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such product claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all the requirements of the standard cannot reference, state, or acknowledge the standard in any written, oral, or electronic communication.

APPENDIX A. REFERENCES – NORMATIVE

A1 Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standard. All references in this appendix are considered as part of the standard.

A1.1 ANSI/AHRI Standard 220-2012, *Reverberation Room Procedures for Determining Sound Power of HVAC Equipment*, 2012, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, U.S.A.

A1.2 ANSI/ASA Standard S1.11-2004, *Specifications for Octave-Band and Fractional Octave-Band Analog and Digital Filters*, 2004, American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A.

A1.3 ANSI/ASA Standard S12.55-2006 *Determination of Sound Power Levels of Noise Sources in Anechoic and Hemi-Anechoic Rooms*, 2006, American National Standards Institute, 11 West 42nd Street, New York, NY 10036, U.S.A.

A1.4 *ASHRAE Terminology*, <http://wiki.ashrae.org/index.php/ASHRAEwiki>, 2013, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A.

A1.5 ISO 6926: 1999, *Acoustics - Requirements for the performance and calibration of reference sound sources used for the determination of sound power levels*, 1999, International Organization for Standardization, Case Postale 56, CH-1211, Geneva 21 Switzerland.

A1.6 ISO 9614-1: 1993, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 1: Measurement at discrete points*, 1993, International Organization for Standardization, Case Postale 56, CH-1211, Geneva 21 Switzerland.

APPENDIX B. REFERENCES – INFORMATIVE

B1 Listed here are standards, handbooks, and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

None.

APPENDIX C. ALTERNATIVE PRIMARY RSS CALIBRATION PROCEDURE – NORMATIVE

C1 *General.* Calibration of the RSS in conformance with the provisions of Section 5 of this standard requires that the test environment shall be a hemi-anechoic space meeting or exceeding the qualification requirements of ANSI/ASA S12.55 over the entire frequency range of interest. Laboratories that would otherwise be able to perform the required calibration, but are not qualified for measurements in the 63 Hz Octave Band (or 50, 63, and 80 Hz One-Third Octave Frequency Bands) may use the alternative procedure of this Appendix.

C2 *Procedure.* The RSS calibration procedures found in Section 5 shall be carried out over the 50 to 10,000 Hz one-third octave band frequency range using sound pressure level measurements. These requirements are then duplicated in the 50 through 315 Hz One-third Octave Bands using sound intensity level measurements. Sound intensity level measurements shall be made in accordance with ISO 9614-1 using a spacer recommended by the probe manufacturer with a minimum length of 50 mm ~~a 50 mm spacer~~. The measurement positions and the measurement path of the intensity probe shall be per Clauses 5.4 and 5.5, and as shown in Figure 1 of this standard. If using a windscreen, it shall not affect the microphone response by more than ± 1.5 dB from 50 to 315 Hz. Windscreen corrections shall be determined per Appendix D of this standard. For all measurements, the Sound Intensity Level shall be measured in the outward radial direction. The Sound Power Levels determined from the sound pressure level and sound intensity level measurements shall be compared. If these Sound Power Levels differ by no more than the tolerance of Table C1, then the Sound Power Levels determined from the sound intensity measurements shall be deemed valid and shall be the calibrated levels reported for the 50, 63 and 80 Hz One-third Octave Bands.

Table C1. Tolerance for Sound Power Level Difference		
Octave Band, Hz	One-third Octave Band, Hz	Tolerance, dB
63	50 – 80	± 4.0
125-250	100 – 315	± 1.0

C3 *Calculations.* The reported primary RSS Sound Power Levels and Directivity Index shall be those determined by sound pressure measurements made in accordance with Section 5 for the 100 to 10,000 Hz One-third Octave Bands and 125 to 8,000 Hz Octave Bands. For the 50 to 80 Hz One-third Octave Bands and 63 Hz Octave Band, the reported Sound Power Level and Directivity Index shall be determined from the sound intensity level measurements. The calibration report shall be marked to indicate the levels that were determined from sound intensity level measurements.

APPENDIX D. PROCEDURE FOR DETERMINING WINDSCREEN CORRECTIONS – NORMATIVE

D1 In a hemi-anechoic room meeting the requirements of ANSI/ASA S12.55, place the RSS near the center of the room on the reflecting plane. Place the microphone on the measurement hemisphere at the 10th microphone height (0.95 m above the reflecting plane). Orient the microphone towards the acoustical center of the source. The source and the microphone shall remain stationary during testing. Measure the one-third octave band Sound Pressure Level and/or Sound Intensity Level without the windscreen installed on the microphone(s) while the source operates normally. Then repeat the measurement with the windscreen installed on the microphone(s).

For each One-third Octave Band, subtract the data with windscreen from the data without windscreen. If more than one windscreen is to be used during calibration testing, their effect shall be determined at this position. The differences between with and without windscreen shall be used to adjust the measured One-third Octave Band(s) data taken during calibration of the RSS. Add these one-third octave band values to correct the measured sound pressure level or sound intensity level data taken in Section 5.6 or Appendix C of this standard. Additionally, wind velocities at the microphone or windscreen shall not exceed 0.25 m/s for this measurement procedure.

APPENDIX E. EXAMPLE FOR THE DETERMINATION OF THE DIRECTIVITY INDEX AND RESULTANT RSS CALIBRATION – INFORMATIVE

E1 As described in Section 5.8, the Directivity Index is calculated using Equation 1. The Directivity Index for each height is the difference between the measured Sound Pressure Levels at each height and the average Sound Pressure Levels. Table E1 shows how the average Sound Pressure Levels are determined for the 100 Hz, 125 Hz, and 160 Hz One-third Octave Bands. Table E2 shows the measured Sound Pressure Levels at each microphone height. In Table E3, the Directivity Indices are calculated by subtracting the Sound Pressure Level at each height from Table E2 from the average Sound Pressure Level calculated in Table E1. The maximum Directivity Index for each frequency is shown at the bottom of Table E3. Table E4 presents the Sound Pressure Level, conversion factor between sound pressure and sound power, the Sound Power Level, and the Directivity Index.

Table E1. Example for the Determination of the Directivity Index and Resultant RSS Calibration			
RSS Average Sound Pressure Levels in One-third Octave Bands, L_p			
Microphone Height, m	100 Hz	125 Hz	160 Hz
1.95	63.1	62.8	62.1
1.85	63.4	63.0	62.0
1.75	63.4	62.8	61.9
1.65	63.4	62.7	61.8
1.55	63.2	62.7	61.9
1.45	63.2	62.5	61.6
1.35	61.7	61.1	61.1
1.25	62.5	62.0	61.6
1.15	62.3	61.7	61.5
1.05	61.9	61.4	61.4
0.95	61.6	61.6	61.4
0.85	61.1	60.6	60.9
0.75	60.9	60.5	60.6
0.65	60.3	59.9	60.5
0.55	59.7	59.9	60.3
0.45	59.0	59.3	59.9
0.35	58.6	58.7	59.4
0.25	57.9	58.5	59.2
0.15	57.4	57.9	58.4
0.05	56.7	57.1	57.9
Surface L_p (Avg)	61.5	61.2	60.9

Table E2. RSS Maximum Sound Pressure Levels in One-third Octave Bands, L_{pi}

Microphone Height, m	100 Hz	125 Hz	160 Hz
1.95	65.5	65.1	65.1
1.85	66.3	66.1	64.0
1.75	65.4	65.7	64.0
1.65	65.6	65.3	63.9
1.55	65.8	64.7	64.0
1.45	65.6	64.6	63.8
1.35	65.0	64.7	64.2
1.25	64.9	64.3	63.4
1.15	65.0	64.3	63.6
1.05	64.4	64.4	63.9
0.95	64.2	63.5	63.3
0.85	63.5	63.5	63.8
0.75	63.1	63.3	63.7
0.65	63.1	62.8	63.5
0.55	63.0	63.0	63.7
0.45	62.3	62.3	63.0
0.35	61.9	62.3	61.9
0.25	61.4	61.0	62.6
0.15	60.8	60.6	61.1
0.05	59.1	59.5	60.2

Microphone Height, m	100 Hz	125 Hz	160 Hz
1.95	4.0	3.9	4.2
1.85	4.8	4.9	3.1
1.75	3.9	4.5	3.1
1.65	4.1	4.1	3.0
1.55	4.3	3.5	3.1
1.45	4.1	3.4	2.9
1.35	3.5	3.5	3.3
1.25	3.4	3.1	2.5
1.15	3.5	3.1	2.7
1.05	2.9	3.2	3.0
0.95	2.7	2.3	2.4
0.85	2.0	2.3	2.9
0.75	1.6	2.1	2.8
0.65	1.6	1.6	2.6
0.55	1.5	1.8	2.8
0.45	0.8	1.1	2.1
0.35	0.4	1.1	1.0
0.25	-0.1	-0.2	1.7
0.15	-0.7	-0.6	0.2
0.05	N/A	N/A	N/A
Maximum Directivity Index, D_i	4.8	4.9	4.2

Frequency, Hz	RSS Sound Pressure, L_p	Conversion from L_p to L_w	RSS Sound Power, L_w	Directivity Index, D_i
100	61.5	14.0	75.5	4.8
125	61.2	14.0	75.2	4.9
160	60.9	14.0	74.9	4.2
Note:				
1) L_p to L_w conversion factor calculation = $10 \cdot \text{Log} (2 \cdot P_1 \cdot r^2)$ where r is in meters				