AHRI Standard 220

## 2014 Standard for

# Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equipment

AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
we make life better™

2111 Wilson Boulevard, Suite 500
Arlington, VA 22201, USA
www.ahrinet.org
PH 703.524.8800
FX 703.562.1942

Documents
Document Sharing Hub

Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS

Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT

Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...

**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.

Note:

This standard supersedes ANSI/AHRI Standard 220-2012.

This standard describes the methodology for determination of Sound Power Levels of broad-band, and/or discrete-frequency noise, and narrow-band noise sources in reverberation rooms. It is based on ANSI S12.51/ISO 3741. The method described herein requires reverberation room pre-qualification through test and the use of the Comparison Method to determine Sound Power Levels. This standard specifies the physical environment, procedures and equipment to qualify the reverberation room by test. Pre-qualifying the room ensures adequate modal density with the use of one source location to obtain acceptable accuracy and repeatability of results. The Reference Sound Source (RSS) used for the Comparison Method relies on ANSI/AHRI Standard 250 to accurately calibrate the RSS at all frequencies of interest. The use of the Comparison Method reduces a number of potential sources of data collection and calculation errors. The standard contains information on instrumentation, installation and operation of the source, procedures for determining the number of microphone positions or length of traverse, and procedures for the calculation of Sound Power Levels.

This standard is more restrictive than ANSI Standard S12.51/ISO 3741, which allows the user to test using either the Direct Method or the Comparison Method and also allows the user to employ a space with general characteristics. The intent of ANSI S12.51/ISO 3741 is to have a room that shall provide a “good” environment for testing, with the understanding that if the end result has a variation that is too high the user can increase the number of measurement locations to improve the spatial averaging and thus lower the variation. This is not practical for sources that are difficult to move.

Price $10.00 (M) $20.00 (NM)
Printed in U.S.A.

©Copyright 2014, by Air-Conditioning, Heating, and Refrigeration Institute
Registered United States Patent and Trademark Office

Documents Document Sharing Hub

Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS
Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT
Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...

## TABLE OF CONTENTS


SECTION PAGE

Section 1. Purpose....1

Section 2. Scope....1

Section 3. Definitions....2

Section 4. Requirements for Qualification of Reverberation Rooms....3

Section 5. Reverberation Room Qualification Procedures....5

Section 6. Sound Power Testing Requirements and Calculations....8

Section 7. Information to BBe Recorded....12

Section 8. Test Report....12

Section 9. Conformance Conditions....13


## TABLES


Table 1. Maximum Standard Deviations of Sound Power Level Reproducibility Determined in Accordance wtwith this Standard....1

Table 2. Broadband Standard Deviation Limits....3

Table 3. Discrete Frequency Standard Deviation Limits....3

Table 4. Test Frequencies for Discrete Frequency Qualification....7

Table 5. One-third Octave Band Frequency Range....8

Table 6. Background Correction Limits by One-third Octave Band....10

Table 7. One-third Octave Band Numbers and A-Weighting Factors....11


## APPENDICES


Appendix A. References – Normative....14

Appendix B. References – Informative....14

Appendix C. Sample Calculation Results – Informative....15



Documents
Document Sharing Hub

Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS

Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT

Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...

## TABLES FOR APPENDICES

Table C1. One-third Octaves .....15

Table C2. UUT $L_w$ .....15

Documents
Document Sharing Hub

Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS

Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT

Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...

# REVERBERATION ROOM QUALIFICATION AND TESTING PROCEDURES FOR DETERMINING SOUND POWER OF HVAC EQUIPMENT

## Section 1. Purpose

**1.1** *Purpose.* The purpose of this standard is to provide the methodology for the determination of Sound Power Levels of noise sources that emit Broadband Sound and/or Discrete Frequency Sounds/Tones in reverberation rooms. The method described herein requires reverberation room pre-qualification through test and the use of the Comparison Method to determine Sound Power Levels. This standard specifies the physical environment, procedures, and equipment used to qualify the reverberation room by test. Pre-qualifying the room ensures adequate modal density with the use of one source locations to obtain acceptable accuracy and repeatability of results. The Reference Sound Source (RSS) used for the Comparison Method relies on ANSI/AHRI Standard 250 to accurately calibrate the RSS at all frequencies of interest. Sound rating values are often useful for applications and design, therefore it is important to acquire data and qualify measurement rooms in One-third Octave Bands. The use of the Comparison Method reduces a number of potential sources of error. The standard contains information on instrumentation, installation and operation of the source, procedures for determining the number of microphone positions or length of traverse, and procedures for the calculation of Sound Power Level. Measurements made in conformity with this standard will, with very few exceptions, result in standard deviations equal to or less than specified in Table 1.

The frequencies covered in this standard range from the 50 Hz to the 10,000 Hz One-third Octave Band (63 Hz to 8000 Hz Octave Bands). The 50 to 80 Hz one-third octave band sound for HVAC equipment affects product applications and often cannot be ignored. The product specific AHRI standard will specify the frequency range of interest for qualification, calculation, and reporting. This standard is based on ANSI S12.51/ISO 3741 but provides additional exceptions and extensions.

**Table 1. Maximum Standard Deviations of Sound Power Level Reproducibility Determined in Accordance with this Standard**

| One-third Octave Band Center Frequency, Hz | One-third Octave Band Maximum Standard Deviation of Reproducibility, $\sigma_{R0}$, dB |
|---|---|
| 50 - 80 | 4.0 |
| 100 - 160 | 3.0 |
| 200 - 315 | 2.0 |
| 400 - 5000 | 1.5 |
| 6000 - 10000 | 3.0 |

**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 HVAC products where sound power is determined by measurement using the Comparison Method in a reverberation room that meets the qualification requirements as defined in Section 4 of this standard.



Documents
Document Sharing Hub
Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS
Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT
Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...

## 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** *Broadband Sound.* Sound that is random in nature with frequency components distributed over a broad frequency band. Typically pure tones or periodic disturbances will not be distinguishable in this type of sound spectrum.

**3.2** *Comparison Method.* A method of determining Sound Power Level by comparing the average Sound Pressure Level produced in the room to a Reference Sound Source of known sound power level output. The difference in Sound Power Level is equal to the difference in Sound Pressure Level when conditions in the room are the same for both sets of measurements.

**3.3** *Direct Method.* A method of determining sound power level from the measured sound pressure levels produced by the source under test in a reverberation room and from the reverberation time and volume of the reverberation room.

**3.4** *Discrete Frequency Sounds/Tones.* These consist of one or more sound waves, each of which is essentially sinusoidal.

**3.5** *Discrete Frequency Source.* A noise source that produces Discrete Frequency Sounds/Tones.

**3.6** *Low Frequency Data.* Data in the 63 Hz Octave Band (50, 63, and 80 Hz One-third Octave Bands).

**3.7** *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.

**3.8** *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 Standard S1.11.

**3.9** *Reference Sound Source (RSS).* A portable, aerodynamic sound source that produces a known stable broadband sound power output.

**3.10** *"Shall" or "Should."* "Shall" or "should" shall be interpreted as follows:

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

**3.10.2** *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

**3.11** *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.

**3.11.1** *A-weighted Sound Power Level ($L_{wA}$).* The logarithmic summation of A-weighted, one-third octave band Sound Power Levels.

**3.12** *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.

**3.13** *Unit Under Test (UUT).* HVAC equipment or duct termination for which the sound power is to be determined.



--`,,```,,,,````-`-`,,`,,`,`,,`---
Documents
Document Sharing Hub
Copyright Air-Conditioning, Heating and Refrigeration Institute
Provided by IHS
No reproduction or networking permitted without license from IHS
Licensee=Southern Company Service/5929653100, User=alexa, joe
Not for Resale, 04/10/2016 02:07:02 MDT
Full document details: AHRI Standard 220-2014 (SI) - Reverberation Room Qualification and Testing Procedures for Determining Sound Power of HVAC Equi...