AHRI Standard 261 (SI)

2017 Standard for

Sound Rating of Ducted Air Moving and Conditioning Equipment

AHRI
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

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

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 AHRI Standard 261 (SI)-2012 and differs in the following ways:

- Sound power shall be determined following ANSI/AHRI Standard 230 procedures if Sound Intensity is used.
- Sound ratings can be predicted for untested fan operating points and unit sizes with certain restrictions.

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

©Copyright 2017, by Air-Conditioning, Heating and Refrigeration Institute
Registered United States Patent and Trademark Office

Documents
Document Sharing Hub

Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

TABLE OF CONTENTS

SECTION PAGE

Section 1. Purpose....1

Section 2. Scope....4

Section 3. Definitions....4

Section 4. Requirements for Acquiring Sound Data....6

Section 5. Sound Level Calculations....14

Section 6. Equipment Sound Ratings....16

Section 7. Conformance Conditions....19

TABLES

Table 1. Reproducibility in the Determination of Ducted Equipment Sound Power Levels....13

FIGURES

Figure 1. Typical Ducted Product Application....2

Figure 2. Relationship Between Sound Components and Sound Sources....3

Figure 3. Concept Reverberation Room Ducted Discharge Test Set-up....8

Figure 4. Concept Sound Intensity Ducted Discharge Test Set-up....8

Figure 5. Concept Reverberation Room Ducted Inlet Test Set-up....8

Figure 6. Concept Sound Intensity Ducted Inlet Test Set-up....9

Figure 7. Concept Reverberation Room Casing Radiated Test Set-up....9

Figure 8. Concept Sound Intensity Casing Radiated Test Set-up....9

Figure 9. Concept Reverberation Room Free Discharge (or Inlet) Combined with Casing Radiated Test Set-up....10

Figure 10. Concept Sound Intensity Free Discharge (or Inlet) Combined with Casing Radiated Test Set-up....10

Figure 11. Concept Reverberation Room Free Discharge (or Inlet) Set-up....11

Figure 12. Concept Sound Intensity Free Discharge (or Inlet) Test Set-up....11

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

TABLE OF CONTENTS (CONTINUED)

APPENDICES

Appendix A. References – Normative 20

Appendix B. References – Informative 21

Appendix C. Acoustic Test Elbow Correction (E_2) - Normative 22

Appendix D. Effects of Other Sources - Normative 24

Appendix E. Supply Fan Modulation Device Effects - Normative 25

TABLES FOR APPENDICES

Table C1. Insertion Loss of Unlined Elbows 22

Table C2. Examples of Test Elbow Insertion Loss, dB 23

FIGURES FOR APPENDICES

Figure C1. Insertion Loss of Unlined Acoustic Test Duct Elbows 22

Documents
Document Sharing Hub

Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

SOUND RATING OF DUCTED AIR MOVING AND CONDITIONING EQUIPMENT

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for the indoor portions of factory-assembled ducted air moving and conditioning equipment and not the individual subassemblies: definitions; requirements for acquiring sound data; sound level calculations; equipment sound ratings; and conformance conditions.

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.

1.2 *Rationale*. Ducted Equipment presents unique challenges when providing sound ratings since their ratings are used to both compare products and to provide the information necessary to predict application sound levels. For these reasons, the sound ratings shall define the sound coming from various portions of the equipment (Sound Components). The Sound Components are the Sound Sources that impact the application sound paths.

Ducted air-conditioning equipment can have ducted discharge, ducted inlet, and casing radiated Sound Components. Depending on its applied configuration, free discharge (or free inlet) combined with the casing radiated Sound Component may also be needed. All Sound Components are acoustically described/rated by utilizing a Mapped Sound Rating approach that is typically referenced to the product's supply fan operating map. The supply fan is contained in the Base Unit of the product. In addition, this standard defines an approach to account for the acoustical effects of product Appurtenances (such as modulation devices or discharge/inlet plena) and other Sound Sources (such as the refrigeration circuit, return and exhaust fans, etc.) to the base unit Mapped Sound Rating. Thus, a Mapped Sound Rating can be developed for a given product configuration and each of its various Sound Components defining the sound for any product operating condition. Figure 1 presents an example of a typical product application showing the relationship between the product Sound Components and the various application sound paths. Figure 2 presents an example of a typical vertically ducted product depicting the contribution of the various product Sound Sources on the Sound Components.

All Sound Components are tested utilizing either a reverberation room (qualified by test) or using Sound Intensity. Reverberation room tests are conducted using the Comparison Method and a calibrated Reference Sound Source (RSS), while the sound intensity tests are conducted using measurements made at discrete points or by the scanning method. Sound ratings are in the form of octave band Sound Power Levels, dB, from 63 to 8,000 Hz derived from one-third octave band measurements. In addition to the stated octave band ratings, this standard can be used to provide one-third octave band sound ratings from 50 to 10,000 Hz.

Note: The specified sound intensity method, ANSI/AHRI Standard 230, is derived from ISO 9614-1 and 9614-2.

Documents
Document Sharing Hub
Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

In the example presented in Figure 1, there are two Sound Components present, ducted discharge and free inlet combined with casing radiated. The ducted discharge sound component affects or defines the source strength for two of the four typical application sound paths shown below 1) the supply airborne sound and 2) the supply breakout sound. The free inlet combined with casing radiated sound component affects or defines the source strength for the 3) return airborne and 4) wall transmission application sound paths.

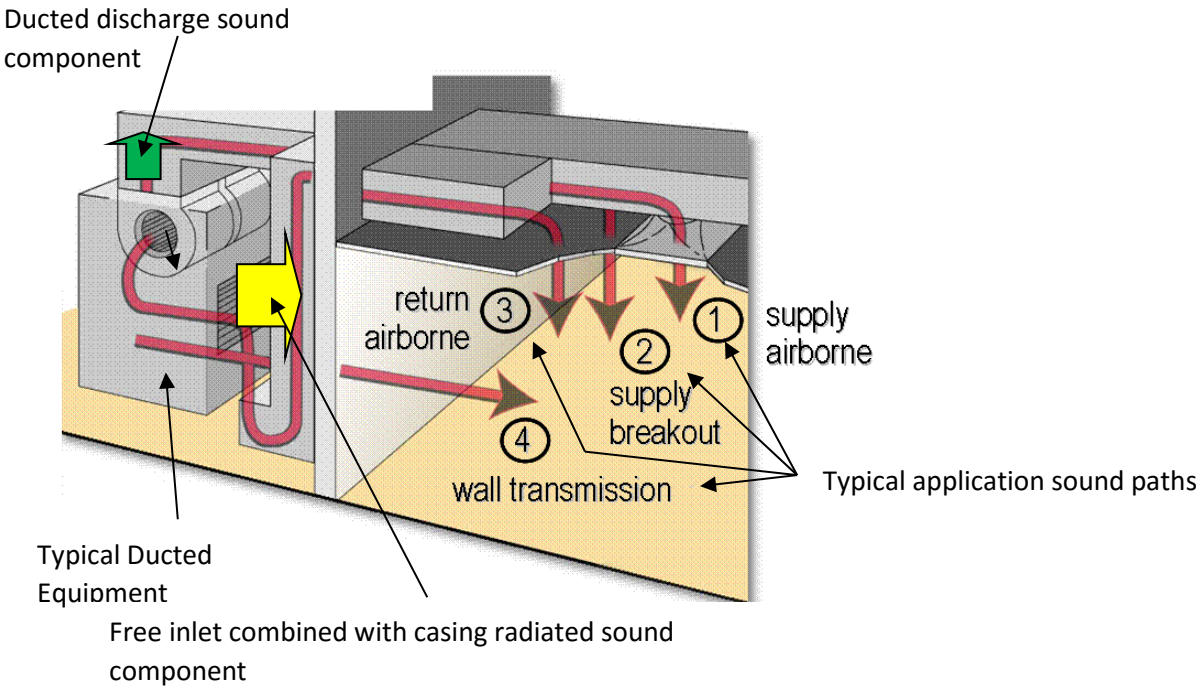


Figure 1. Typical Ducted Product Application

Documents
Document Sharing Hub
Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

In Figure 2, a typical vertical ducted unit is presented with its Sound Components and their contributing product Sound Sources. In this example, there are two Sound Components, the ducted discharge and the ducted inlet. The ducted discharge sound component is first defined by the supply fan discharge sound in the Base Unit coupled with the discharge plenum. The contribution of appurtenance sound from supply fan discharge airflow impinging the heat exchanger in the discharge plenum must also be added to the supply fan discharge sound. Finally, the effects of the other sources on the ducted discharge sound from the condenser fans and the refrigerant circuit must be considered. For the ducted inlet sound component, the sound from the return side of the return fan is first considered. In this case, the return side sound from the supply fan contributes as another sound source.

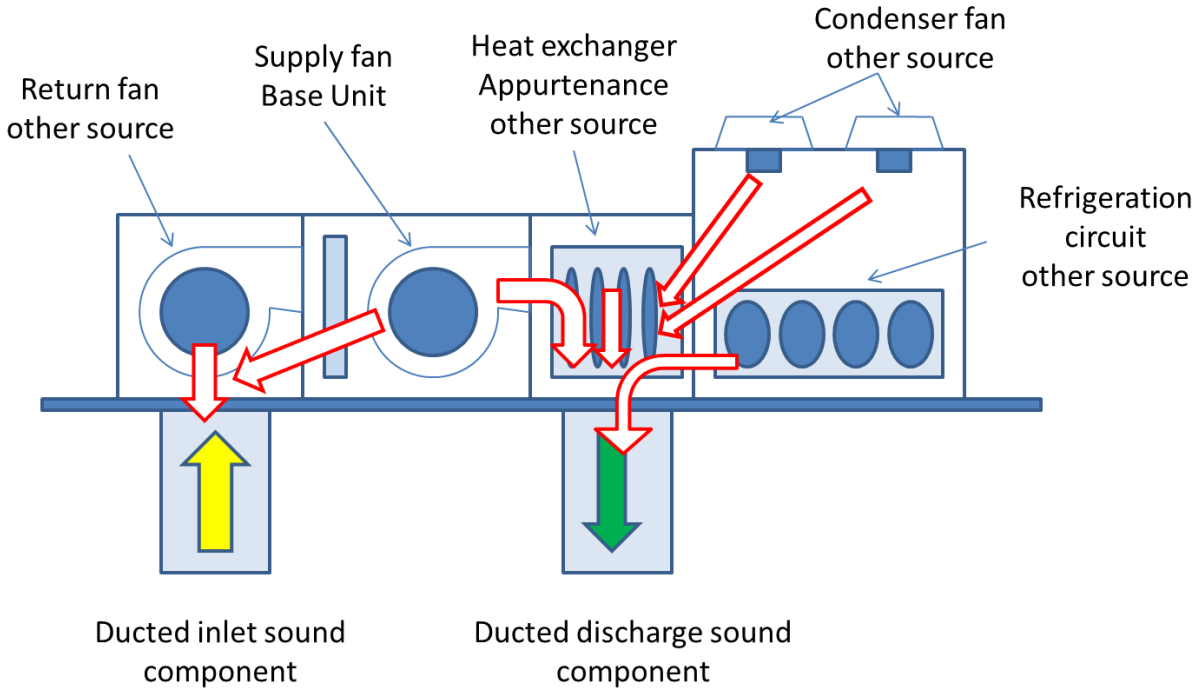


Figure 2. Relationship Between Sound Components and Sound Sources

Documents
Document Sharing Hub
Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

Section 2. Scope

2.1 *Scope.* This standard applies to Ducted Equipment containing fans and specifies methods for determining the sound power ratings, using sound data for rating the various product Sound Components across the operating range. Mapped Sound Ratings reported are octave-band Sound Power Levels from 63 Hz to 8,000 Hz. In addition to the stated octave band Mapped Sound Ratings, this standard can additionally be used to provide one-third octave band Mapped Sound Ratings from 50 to 10,000 Hz.

2.2 *Exclusions*. This standard does not apply to the following AHRI classes of equipment:

2.2.1 Outdoor heat rejection sections of equipment addressed in AHRI Standard 270 and AHRI Standard 370
2.2.2 Non-ducted equipment addressed in AHRI Standard 300 and AHRI Standard 350
2.2.3 Terminal equipment addressed in AHRI Standard 881 (SI)
2.2.4 Ductless fan coil units addressed in ANSI/AHRI Standard 440
2.2.5 Active Chilled Beams addressed in AHRI 1241 (SI).

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. For acoustic related terms refer to ASA Standard Term Database (http://asastandards.org/asa-standard-term-database/.)

3.1 *Acoustic Baffle*. A barrier that creates a well-defined duct termination and test surface for a ducted sound intensity measurement. The barrier is rigid and non-absorbing.

3.2 *Acoustic Test Duct*. A duct used to convey the sound of the unit configuration under test to the reverberation room or intensity surface during a ducted discharge or ducted inlet sound component test. A Duct End Correction shall be added to the sound data measured in the reverberation room or from the intensity method to account for the presence of the duct termination.

3.3 *Acoustic Test Duct Elbow.* An elbow that may be added to the Acoustic Test Duct to facilitate testing. An Acoustic Test Duct Elbow Correction, shall be made (in addition to the Duct End Correction) to the sound data to account for the presence of the Acoustic Test Duct Elbow.

3.4 *Acoustic Test Duct Elbow Correction (E_2).* A correction in a frequency band to account for insertion loss effects of the elbow on the sound propagating through the Acoustic Test Duct. The table in Appendix C of this standard defines the Acoustic Test Duct Elbow Correction.

3.5 *Appurtenance*. An addition to a Base Unit for purposes of air modulation, heat transfer, control, isolation, safety, static pressure regain, etc. Examples of Appurtenances include:

3.5.1 Coil(s)
3.5.2 Electric heater(s)
3.5.3 Air filter(s)
3.5.4 Damper(s)
3.5.5 Moisture eliminator(s)
3.5.6 Fan-motor drive(s)
3.5.7 Gas heat exchanger(s)
3.5.8 Inlet or discharge plena
3.5.9 Air mixing device(s)
3.5.10 Flow straightener(s)
3.5.11 Modulating device(s) in the fan inlet/discharge
3.5.12 Application duct geometry(s) (such as duct elbow configurations)
3.5.13 Alternate unit casing construction(s) (such as double walled, lined, perforated face)

Documents
Document Sharing Hub
Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment

3.6 *Air-conditioner*. One or more factory-made assemblies which normally include an evaporator or cooling coil, a compressor and condenser combination, and may include a heating function. Where such equipment is provided in more than one assembly, the separated assemblies shall be designed to be used together.

3.7 *Base Unit*. A factory-made encased assembly consisting of one or more fans meant to be connected to a duct and other necessary equipment to perform one or more of the functions of circulating, cleaning, heating, cooling, humidifying, and mixing of air, but which may or may not include a source of heating or cooling.

3.8 *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.

3.9 *Ducted Equipment*. Heating, ventilating and air conditioning equipment having one or more supply fans which employ ductwork to convey the conditioned air to and/or from the desired space. Ducted Equipment may have various combinations of discharges and inlets as follows:

3.9.1 Ducted discharge(s) and ducted inlet(s)
3.9.2 Ducted discharge(s) with free inlet(s)
3.9.3 Ducted inlet(s) with free discharge(s)

This equipment may be ducted in various configurations horizontally and vertically, and may incorporate multiple inlets and outlets.

3.10 *Duct End Correction (E_1)*. A correction in a frequency band that accounts for the acoustic energy in an Acoustic Test Duct that is prevented from entering the test space by the impedance mismatch created by the termination of the Acoustic Test Duct. A method for computing the Duct End Correction is described in Section 5.2.1 of this standard.

3.11 *Effective Diameter (D_e)*. The diameter of a circular duct which is equal in area to a specific Acoustic Test Duct.

3.12 *Heat Pump*. One or more factory-made assemblies which normally include an indoor conditioning coil, a compressor and outdoor heat exchanger (including means to provide a heating function), and may optionally include a cooling function. When such equipment is provided in more than one assembly, the separated assemblies shall be designed to be used together.

3.13 *Hertz (Hz)*. Unit of frequency in cycles per second.

3.14 *Mapped Sound Rating.* Equipment sound ratings that are based upon a series of tests performed across the range of operating conditions determined typically from a flow pressure map for the product supply fan and as defined by the equipment manufacturer. Contributions due to Appurtenances and other sources such as return fans, exhaust fans, and the refrigeration circuit are superimposed on the supply fan sound rating map. One-third octave band Sound Power Levels are obtained for each test point of the series to provide octave band sound power ratings. The mapped rating process is defined in Section 6.2. A special case exists when a supply fan is used in conjunction with a return or exhaust fan in the Base Unit (See Appendix D).

3.15 *Octave Band*. A band of sound covering a range of frequencies such that the highest is twice the lowest.

3.16 *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.

3.17 *Reference Sound Source (RSS).* A portable, aerodynamic sound source that produces a known stable broad band sound power output as defined in ANSI/AHRI Standard 250.

3.18 *Reproducibility*. The degree of agreement in test results obtained with the same method on identical test items in different laboratories with different operators using different equipment.

Documents
Document Sharing Hub
Full document details: AHRI Standard 261-2017 (SI) - Sound Rating of Ducted Air Moving and Conditioning Equipment