AHRI Standard 530-2011

2011 Standard for
Rating of Sound and Vibration for Refrigerant Compressors

Approved American National Standard ANSI

Approved by ANSI on 4 November 2011

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IMPORTANT

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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 530-2005.

Note:

This version of the standard differs from that of 2005 in the following ways:

1. Reverberation Room requirements including instrumentation and qualification shall be in accordance with AHRI Standard 220.
2. Reverberation Room testing shall be done per AHRI Standard 220.
3. Sound Power Levels shall be computed per AHRI Standard 220 for testing done in a reverberation room.
4. Anechoic/Hemi-Anechoic Test Room requirements including instrumentation and qualification shall be in accordance with ANSI S12.55/ISO 3745.
5. Anechoic/Hemi-Anechoic Test Room testing shall be done per ANSI S12.55/ISO 3745.
6. Sound Power Levels are to be computed per ANSI S12.55/ISO 3745 for testing done in an Anechoic/Hemi-Anechoic Test Room.

Note: The AHRI Technical Committee on Sound will investigate alternative measurement methods for possible inclusion in future revisions of this standard.

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RATING OF SOUND AND VIBRATION FOR REFRIGERANT COMPRESSORS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for the rating of sound and vibration for Refrigerant Compressors: definitions; test requirements; rating requirements; minimum data requirements for published 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.

Section 2. Scope

2.1 *Scope.* This standard applies to External-drive, Hermetic, and Semi-Hermetic Positive Displacement Refrigerant Compressors. In the case of External-drive Refrigerant Compressors, the driving mechanism shall be excluded from the sound and vibration measurements. However, for Semi-Hermetic Refrigerant Compressors where the driving mechanism is an integral part of the compressor assembly as defined in Section 3, it shall be included in the measurements.

2.1.1 *Exclusion.* An External-drive Refrigerant Compressor, coupling and motor assembly mounted on a common base is excluded from this standard, since the vibration measurement method specified in the standard does not apply to this type of product.

Section 3. Definitions

All terms in this document shall follow the standard industry definitions in the current edition of ASHRAE *Terminology of Heating, Ventilation, Air-Conditioning, and Refrigeration* unless otherwise defined in this section.

3.1 *Amplitude Root Mean Square (rms).* Refer to definition 3.16.

3.2 *Anechoic Test Room*. A test room whose surfaces absorb essentially all of the incident sound energy over the frequency range of interest, thereby affording free-field conditions over the measurement surface.

3.3 *Bandwidth.* The difference between the upper and lower frequencies in a contiguous set of frequencies. It is typically measured in Hz.

3.4 *Flat Top Window*. A weighting function applied during fast fourier transform analysis to obtain the true amplitudes of periodic components of a time signal. It is designed specifically to minimize the amplitude error. It facilitates calibration by using a calibration tone which may lie anywhere between two lines of the analyzer. Maximum amplitude error is less than 0.01 dB.

3.5 *Fundamental Frequency*. The speed of the compressor drive/shaft expressed in Hz.

3.5.1 *Fundamental Pulsation Frequency*. The dominant frequency observed in the pressure pulse. For reciprocating compressors, where all events are equally spaced in time, this is usually the number of cylinders times the Fundamental Frequency.

3.6 *Harmonics.* Sinusoidal quantity that has a frequency which is an integral multiple of the frequency of the periodic quantity to which it is related.

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3.7 *Hemi-Anechoic Test Room.* A test room with a hard, reflecting floor whose other surfaces absorb essentially all of the incident sound energy over the frequency range of interest, thereby affording free-field conditions above a reflecting plane.

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

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

3.10 *One-Third Octave Band.* A band of sound covering a range of frequencies such that the highest is the cube root of two times the lowest. Note: The One-Third Octave Bands used in this standard are those shown in Table 1 and as defined in ANSI Standard S1.11.

3.11 *Pulsation.* The fluctuation of the pressure in a discharge or suction line about some mean pressure.

3.12 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.12.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

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

3.14 *Refrigerant Compressor*.

3.14.1 *External-drive (Open Type) Refrigerant Compressor.* A compressor with a shaft or other moving parts extending through a casing to be driven by an external power source, thus requiring a shaft seal or equivalent rubbing contact between fixed and moving part.

3.14.2 *Hermetic Refrigerant Compressor*. A compressor and motor enclosed in the same housing without an external shaft or shaft seals. The motor operates in the refrigerant.

3.14.3 *Semi-Hermetic Refrigerant Compressor*. A compressor directly coupled to an electric motor and contained within a gas-tight bolted casing. The motor operates in the refrigerant.

3.15 *Reverberation Test Room*. A reverberation room or reverberation chamber is an acoustically designed room for uniform distribution of acoustic energy. It is used to determine the Sound Power Level of a source and also to find the absorption coefficient of a material (sound absorption).

3.16 *Root Mean Square* (rms). The square root of the average of the sum of the squared instantaneous values of a function measured over the sample period.

$$S_{rms} = \left[\frac{\sum_{i=1}^{n} S_i^2}{n} \right]^{1/2} \qquad 1$$

Where:

i = individual sample
n = Number of sample measurements
S = Dynamic signal from sound, vibration, or pressure measuring instruments
S_{rms} = Root Mean Square value of S (Figure 1 depicts the peak to peak and the rms wave amplitude levels of a non-sinusoidal vibration or pressure signal.)

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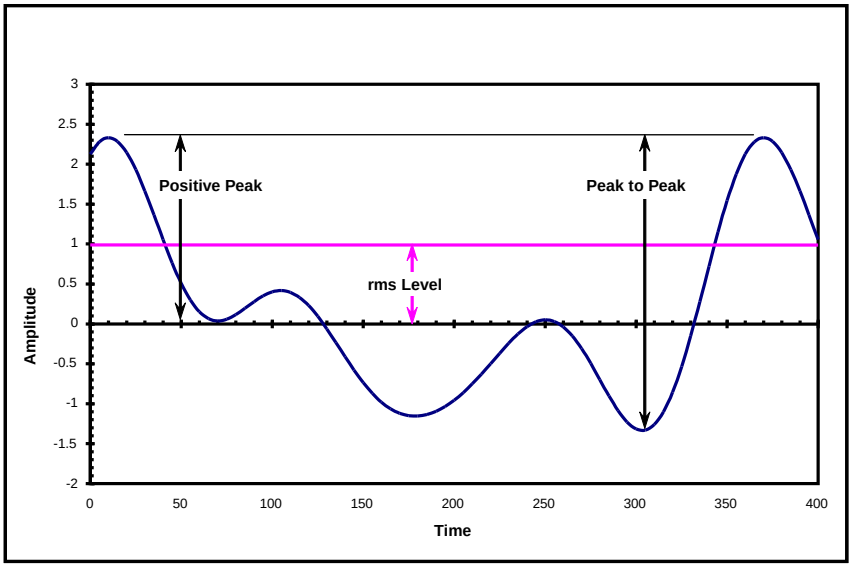


Figure 1. Time Domain Wave Amplitude Descriptors

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

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

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

3.18 *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 power, expressed in decibels (dB). The reference sound power used in this standard is one picowatt (pW).

3.18.1 *A-Weighted Sound Power Level (L_{WA}).* The logarithmic summation of A-Weighted, One-Third Octave Band levels.

3.19 *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 µPa, expressed in decibels (dB).

3.20 *Working Load.* The portion of the compressor weight supported by the individual isolator.

Section 4. Test Requirements

4.1 *General Test Requirements.*

4.1.1 *Compressor Mounting.* The compressor to be tested shall be mounted on a mass at least four times the mass of the compressor. The isolators used shall be those recommended for that particular compressor by the manufacturer. Isolator stiffness in N/m at the Working Load shall be reported as specified in Appendix D.

4.1.2 *Compressor Line Connections.* To minimize the external load on the compressor, discharge and suction line connections shall be made at the compressor with flexible tubing, such as an extruded Teflon tube with a stainless steel wire braid cover and a length to diameter ratio of at least 50. The lines need to be supported to minimize the static load on the compressor.

To provide uniform flow, the lines shall have the same nominal inside diameter as the tubing size recommended by the compressor manufacturer. If mechanical connectors are used, the inner diameter of the connector shall be the same as the inner diameter of the refrigerant line, unless the connector is part of the compressor assembly.

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