Note: This standard has been withdrawn because the terms and values produced by using it have not been widely accepted and are no longer supported by the member companies.

AHRI Standard 1140

Withdrawn from publication July 23, 2021

Standard for 2012

Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration Equipment

AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

we make life better®

2311 Wilson Boulevard, Suite 400
Arlington, VA 22201, USA
www.ahrinet.org
PH 703.524.8800
FX 703.562.1942

Documents
Document Sharing Hub

Full document details: AHRI Standard 1140-2012 - Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration 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This standard has been withdrawn because the terms and values produced by using it have not been widely accepted and are no longer supported by the member companies.

Withdrawn from publication July 23, 2021.
AHRI administratively withdrew support of ANS. (Was ANSI/AHRI Standard 1140-2012.)

This standard supersedes AHRI Standard 1140-2006.

Foreword:

Sound quality is subjective and its acceptability depends upon many factors including, but not limited to, the type of equipment being evaluated, the intended application for the equipment, ambient background sound where the equipment is to be applied and the listening audience. A variety of procedures are described and recommendations made to help the user select the most appropriate method for a given situation. However, it will be the responsibility of the user to insure that the chosen procedure does indeed provide a reasonable Sound Quality Indicator for the equipment being evaluated.

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1140-2012 - Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration Equipment

TABLE OF CONTENTS

SECTION		PAGE
Section 1.	Purpose	1
Section 2.	Scope	1
Section 3.	Definitions	1
Section 4.	Test Requirements	2
Section 5.	Sound Quality Evaluation Procedures	2
Section 6.	Minimum Data Requirements for Published Values	3
Section 7.	Conformance Conditions	3

APPENDICES

Appendix A.	References – Normative	4
Appendix B.	References – Informative	4
Appendix C.	AHRI Sound Quality Indicator Calculation Procedure – Normative	5
Appendix D.	Adjustments for Subjective Response to Discrete Frequencies (Tones) – Informative	10
Appendix E.	Example Calculation of AHRI Sound Quality Indicator – Informative	11
Appendix F.	Example Output from AHRI Calculation Software Including AHRI SQI Metric and Zwicker ISO 532B Loudness Metrics – Informative….	12
Appendix G.	Tone Prominence Calculation - Informative	13

TABLES FOR APPENDICES

Table C1.	Rating Indices	7
Table D1.	One-third Octave Band Adjustments for Tone Response	10
Table E1.	Example Calculation of AHRI Sound Quality Indicator (SQI)	11

Documents
Document Sharing Hub

Full document details: AHRI Standard 1140-2012 - Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration Equipment

SOUND QUALITY EVALUATION PROCEDURES FOR AIR-CONDITIONING AND REFRIGERATION EQUIPMENT

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish sound quality evaluation procedures for air-conditioning and refrigeration equipment and to provide definitions; test requirements; sound quality evaluation procedures; 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 factory-made, residential and commercial air-conditioning as well as transport refrigeration equipment.

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 *Center Frequency.* The arithmetic center of a constant bandwidth filter or the geometric center (midpoint on a logarithmic scale) of a constant bandwidth filter. Each Octave Band or One-third Octave Band is named for the Center Frequency (geometric mean) of the band.

3.2 *Loudness.* Numerical designation of the strength of a sound which is proportional to its subjective magnitude as estimated by typical observers.

3.2.1 *Phon.* The Loudness level of a sound. It is numerically equal to the Sound Pressure Level of a 1 kHz free progressive wave which is judged by listeners with full hearing capability to be as loud as the unknown sound.

3.2.2 *Sone*. A linear unit of Loudness. The ratio of Loudness of a sound to that of a 1 kHz tone 40 dB above the threshold of hearing. One Sone is the Loudness of a sound whose Loudness level is 40 Phons.

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

3.5 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit its application. These values apply to all units of like nominal size and type (identification) produced by the same manufacturer. The term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.5.1 *Application Rating*. A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

AVA Documents
Document Sharing Hub

Full document details: AHRI Standard 1140-2012 - Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration Equipment

3.5.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

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

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

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

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

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

3.8 *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.

3.8.1 *A-weighted Sound Power Level, L_{WA}*. The logarithmic summation of A-weighted, one-third octave band Sound Power Levels.

3.9 *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.

3.9.1 *A-weighted Sound Pressure Level, L_{PA}*. The logarithmic summation of A-weighted, one-third octave band Sound Pressure Levels.

3.10 *Sound Quality Indicator (SQI).* The calculated metric determined when following AHRI's procedure for quantifying sound quality (Appendix C) whereby measured sound levels are weighted to adjust for psychoacoustic sensitivity to frequency distribution and any discreet tones which may be present and then converted to a single number Sound Quality Indicator.

Section 4. Test Requirements

4.1 *Test Requirements*. When available, data obtained following standard AHRI/ISO sound rating procedures for the product under test shall be used for the sound quality evaluation. In some cases, it may be necessary to obtain data for the sound quality evaluation in test environments other than those required by the sound rating standard for the product of interest. In these instances, the product under test shall be operating such that it meets the AHRI thermal test and rating point for the condition being evaluated. The test environment and test method shall be clearly described.

Section 5. Sound Quality Evaluation Procedures

5.1 *AHRI Calculation Procedure*. The AHRI calculation procedure is derived from the work of R.J. Wells and W.E. Blazier, *A Procedure for Computing The Subjective Reaction To Complex Noise From Sound Power Data*, and is the preferred method of assessing the quality of sound for products within the scope of this standard. This method utilizes one-third octave band sound power data obtained in conformance with the appropriate AHRI sound measurement standard for the product under test. These measured levels are weighted to adjust for psychoacoustic sensitivity to frequency distribution and any discreet tones which may be present; and then, they are converted to a single number Sound Quality Indicator (SQI).

A description of the AHRI calculation procedure is included as Appendix C, and an example of the use of this method is included as Appendix E.

5.2 *ISO 532– Method B (Zwicker)*. This standard specifies a method for calculating the Loudness of steady complex sounds for which one-third octave band data have been obtained. Method B is applicable not only to sounds with smooth broadband spectra but also to sounds with strong line spectra or irregular spectra. The Loudness level in Phons and Loudness in Sones are determined when using Method B.

Documents
Document Sharing Hub
Full document details: AHRI Standard 1140-2012 - Sound Quality Evaluation Procedures for Air-Conditioning and Refrigeration Equipment