

International Standards for Specifying Noise Emissions

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The basic elements of a “buy-quiet” program are well known. One or more databases of noise emission data are helpful in preparing noise requirements, and a noise specification sheet is an essential element of a program. The noise limit must be specified, and both the noise metric and the standard used to make the measurement must be included in the specification. The machine operating conditions during measurement must be agreed upon. A method for the verification that a specification has been met is also important. The emphasis in this article is on international standards related to the specification of noise emissions. There are standards that can be used for determining both sound power and sound pressure, some applicable to any equipment and some applicable to specific types of machines. In addition to an American national standard on noise specifications, there are also many country-specific standards and numerous European norms. This article mentions the American situation briefly, but a listing of other country-specific documents and European norms is not included in this article.

In the United States, the *Technology for a Quieter America* (TQA) report¹ published in October 2010 contains information on “buy-quiet” programs, especially in connection with occupational noise issues. The National Aeronautics and Space Administration (NASA) developed a roadmap for implementing buy-quiet programs aimed at preventing hearing loss,² and the National Institute for Occupational Safety and Health (NIOSH) is in the process of developing a similar program.³ Internationally, the *Buy-Quiet 2011 Symposium* in Paris was an International INCE Symposium that brought together individuals from many countries with experience in developing and implementing such programs. The keynote address and the abstracts (with links to the presentation slides) were published in the September 2011 issue of *Noise/News International*.⁴ As these programs evolve, it will be necessary to specify the standards used to determine the noise emissions of products as well as the noise metric (sound power or pressure) to be used.

At the INTER-NOISE 2011 Congress in Osaka, Japan, establishing a new technical study group on buy-quiet programs was approved by the International Institute of Noise Control Engineering (I-INCE). In support of the work, the author submitted a short draft report⁵ titled “Guidelines for the Development of ‘Buy-Quiet’ Programs.” One of the missing elements in the draft was a description of the international standards available for the specification of noise emissions. The intent of this article is to provide such a description that would be useful for the I-INCE project as well as other buy-quiet programs in development.

American National Standard S1.16-1992 (R2012), Guidelines for the Specification of Noise of New Machinery, contains information on noise emission standards published by organizations in the U.S. Although the standard was reaffirmed in 2012, it was originally published in 1992 and needs to be updated.

For the new technical study group mentioned above, the primary emphasis will be on the noise emissions of *stationary* sound sources. For that reason, the compilations below do not include emission standards for moving sources.

Noise Emission Standards

In the TQA report, Chapter 6 on Standards and Regulations for Product Noise Emissions is an overview of the subject in the U.S. and particularly in Europe. The chapter can be read online¹

and will not be summarized here. The noise emission standards published by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are of particular importance. These standards were not listed in the TQA report but will be listed here. ISO noise emission standards can broadly be divided into two categories – generic standards that can be used for determining the noise emissions of any piece of equipment and standards that are applicable to a specific type of equipment.

The former are the work of ISO Technical Committee 43/Subcommittee 1, Noise. Except for standards published for use by the information technology industry, these standards generally do not contain information on the operating conditions of the equipment to be used during measurement. There are a large number of ISO technical committees, and many of these have published noise emission standards applicable to a specific type of equipment. Appendix C of the TQA report⁴ contains additional information on standards development with emphasis on activities in the U.S. and on ISO/IEC activities. The list below is reproduced from the TQA report.

International Committees with an Interest in Noise

The following technical committees of the International Organization for Standardization (<http://www.iso.org>) have an interest in noise or sound:

- TC 4 Roller bearings
- TC 21/SC 3 Equipment for fire protection and fire fighting/fire detection and alarm systems
- TC 22/SC 22 Motorcycles
- TC 23/SC 2 Tractors and machinery for agricultural forestry/common tests
- TC 23/SC 3 Tractors and machinery for agricultural forestry/safety and comfort
- TC 23/SC 17 Tractors and machinery for agricultural forestry/manually portable forest machinery
- TC 36 Cinematography
- TC 39/SC 6 Machine tools/noise of machine tools
- TC 43/SC 1 Acoustics/noise
- TC 43/SC 2 Acoustics/building acoustics
- TC 60 Gears
- TC 70 Internal combustion engines
- TC 72/SC 8 Textile machinery and accessories/safety requirements for textile machinery
- TC 86 Refrigeration and air conditioning
- TC 86/SC 3 Testing and rating of factory-made refrigeration systems (excluding systems covered by Subcommittees 5, 6, and 7)
- TC 86/SC 5 Refrigeration and air conditioning/testing and rating of household refrigeration appliances
- TC 86/SC 6 Factory-made air-cooled, air-conditioning and air-to-air heat pump units
- TC 108/SC 2 Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles, and structures
- TC 115 Pumps
- TC 117 Industrial fans
- TC 118/SC 3 Compressors and pneumatic tools, machines, and equipment/pneumatic tools and machines
- TC 118/SC 6 Compressors and pneumatic tools, machines, and equipment/air compressors and compressed air systems
- TC 127/SC 2 Earth-moving machinery/safety, ergonomics, and general requirements
- TC 131/SC 8 Fluid power systems/product testing
- TC 160/SC 2 Glass in buildings/use considerations
- TC 188 Small craft

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IEC (<http://www.iec.ch>) noise emission standards are mainly applied to household appliances and rotating equipment.

The next two sections of this paper are listings of ISO and IEC standards related to noise emissions. Noise emissions from transportation sources are not included in the listings.

Standards for Noise Emissions

As mentioned above, generic standards for determining noise emissions are produced by ISO TC 43/SC 1, Noise. These documents relate either to the determination of sound power level or emission sound pressure level; those two topics are separated in the listing below. In addition, ISO TC 43/SC 1 publishes standards related to specific types of equipment and standards related to declaration and verification of noise emissions. These documents are also listed below. There are four noise emission standards from ISO TC 43/SC 2, Building Acoustics, and then a very large number of standards for different types of machinery. These are listed below. A number of technical committees produce IEC standards related to noise (also listed below).

ISO Standards from ISO TC 43/SC 1, Measurement Methods – Sound Power

- ISO 3740:2000 – Acoustics: Determination of sound power levels of noise sources; guidelines for the use of basic standards.
- ISO 3741:2010 – Acoustics: Determination of sound power levels and sound energy levels of noise sources using sound pressure; precision methods for reverberation test rooms.
- ISO 3743-1:2010 – Acoustics: Determination of sound power levels and sound energy levels of noise sources using sound pressure; engineering methods for small movable sources in reverberant fields; Part 1: Comparison method for a hard-walled test room.
- ISO 3743-2:1994 – Acoustics: Determination of sound power levels of noise sources using sound pressure; engineering methods for small, movable sources in reverberant fields, Part 2: Methods for special reverberation test rooms. (ISO 3743-2:1994/NP Amendment 1.)
- ISO 3744:2010 – Acoustics: Determination of sound power levels and sound energy levels of noise sources using sound pressure; engineering methods for an essentially free field over a reflecting plane.
- ISO 3745:2012 – Acoustics: Determination of sound power levels and sound energy levels of noise sources using sound pressure; precision methods for anechoic rooms and hemi-anechoic rooms.
- ISO 3746:2010 – Acoustics – determination of sound power levels and sound energy levels of noise sources using sound pressure; survey method using an enveloping measurement surface over a reflecting plane.
- ISO 3747:2010 – Acoustics: Determination of sound power levels and sound energy levels of noise sources using sound pressure; engineering/survey methods for use *in situ* in a reverberant environment.

Measurement Methods – Sound Power Using Sound Intensity

- ISO 9614-1:1993 – Acoustics: Determination of sound power levels of noise sources using sound intensity; Part 1: Measurement at discrete points.
- ISO 9614-2:1996 – Acoustics: Determination of sound power levels of noise sources using sound intensity; Part 2: Measurement by scanning.
- ISO 9614-3:2002 – Acoustics: Determination of sound power levels of noise sources using sound intensity; Part 3: Precision method for measurement by scanning.

Measurement Methods – Emission Sound Pressure Level

- ISO 11200:1995 – Acoustics: Noise emitted by machinery and equipment; Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions.
- ISO/CD 11200 – Acoustics: Noise emitted by machinery and equipment; Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions, ISO 11200:1995/Correction 1:1997.
- ISO 11201:2010 – Acoustics: Noise emitted by machinery and

equipment; Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections.

- ISO 11202:2010 – Acoustics: Noise emitted by machinery and equipment; Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections.
- ISO 11203:1995 – Acoustics: Noise emitted by machinery and equipment; Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level.
- ISO 11204:2010 – Acoustics: Noise emitted by machinery and equipment; Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections.
- ISO 11205:2003 – Acoustics: Noise emitted by machinery and equipment; Engineering method for the determination of emission sound pressure levels *in situ* at the work station and at other specified positions using sound intensity.

Other Standards Related to Declaration and Verification

- ISO 4871:1996 – Acoustics: Declaration and verification of noise emission values of machinery and equipment.
- ISO 9296:1988 – Acoustics: Declared noise emission values of computer and business equipment.
- ISO 11689:1996 – Acoustics: Procedure for the comparison of noise-emission data for machinery and equipment.
- ISO 12001:1996 – Acoustics: Noise emitted by machinery and equipment; rules for the drafting and presentation of a noise test code.
- ISO 7574-1:1985 – Acoustics: Statistical methods for determining and verifying stated noise emission values of machinery and equipment; Part 1: General considerations and definitions.
- ISO 7574-2:1985 – Acoustics: Statistical methods for determining and verifying stated noise emission values of machinery and equipment; Part 2: Methods for stated values for individual machines.
- ISO 7574-3:1985 – Acoustics: Statistical methods for determining and verifying stated noise emission values of machinery and equipment; Part 3: Simple (transition) method for stated values for batches of machines.
- ISO 7574-4:1985 – Acoustics: Statistical methods for determining and verifying stated noise emission values of machinery and equipment; Part 4: Methods for stated values for batches of machines.

Emission Standards for Specific Sources

- ISO 7779:2010 – Acoustics: Measurement of airborne noise emitted by information technology and telecommunications equipment.
- ISO 9295:1988 – Acoustics: Measurement of high-frequency noise emitted by computer and business equipment.
- ISO 7235:2003 – Acoustics: Laboratory measurement procedures for ducted silencers and air-terminal units; Insertion loss, flow noise and total pressure loss.
- ISO 9645:1990 – Acoustics: Measurement of noise emitted by two-wheeled mopeds in motion; Engineering method.
- ISO 11094:1991 – Acoustics: Test code for the measurement of airborne noise emitted by power lawn mowers, lawn tractors, lawn and garden tractors, professional mowers, and lawn and garden tractors with mowing attachments.
- ISO 5135:1997 – Acoustics: Determination of sound power levels of noise from air-terminal devices, air-terminal units, dampers and valves by measurement in a reverberation room.
- ISO 14163:1998 – Acoustics: Guidelines for noise control by silencers.
- ISO 1680:1999 – Acoustics: Test code for the measurement of airborne noise emitted by rotating electrical machines.
- ISO 10302-1:2011 – Acoustics: Measurement of airborne noise emitted and structure-borne vibration induced by small air-moving devices; Part 1: Airborne noise measurement.
- ISO 10302-2:2011 – Acoustics: Measurement of airborne noise emitted and structure-borne vibration induced by small air-

moving devices; Part 2: Structure-borne vibration measurements.

Standards Developed by ISO TC43/SC2, Building Acoustics

- ISO 3822-1:1999 – Acoustics: Laboratory tests on noise emission from appliances and equipment used in water supply installations; Part 1: Method of measurement.
- ISO 3822-2:1995 – Acoustics: Laboratory tests on noise emission from appliances and equipment used in water supply installations; Part 2: Mounting and operating conditions for draw-off taps and mixing valves.
- ISO 3822-3:1997 – Acoustics: Laboratory tests on noise emission from appliances and equipment used in water supply installations; Part 3: Mounting and operating conditions for in-line valves and appliances.
- ISO 3822-4:1997 – Acoustics: Laboratory tests on noise emission from appliances and equipment used in water supply installations; Part 4: Mounting and operating conditions for special appliances.

Standards Developed by Other ISO Committees

TC 23/SC 2, Tractors and Machinery for Agriculture and Forestry, Common Tests

- ISO 7216:1992 – Acoustics: Agricultural and forestry wheeled tractors and self-propelled machines; Measurement of noise emitted when in motion.

TC 23/SC 3, Tractors and Machinery for Agriculture and Forestry, Safety and Comfort

- ISO 5131:1996 – Acoustics: Tractors and machinery for agriculture and forestry; Measurement of noise at the operator's position; Survey method.

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- ISO 5131:1996 – Acoustics: Tractors and machinery for agriculture and forestry; Measurement of noise at the operator's position; Survey method.

TC 39/SC 6, Machine Tools, Noise of Machine Tools

- ISO 230-5:2000 – Test code for machine tools; Part 5: Determination of the noise emission.
- ISO 7960:1995 – Airborne noise emitted by machine tools; Operating conditions for woodworking machines.

TC 42, Photography

- ISO 10996:1999 – Photography, still-picture projectors; Determination of noise emissions.

TC 60, Gears

- ISO 8579-1:2000 – Acceptance code for gear units; Part 1: Test code for airborne sound.

TC 70, Internal Combustion Engines

- ISO 6798:1995 – Reciprocating internal combustion engines; Measurement of emitted airborne noise; Engineering method and survey method.
- ISO 8528-10:1998 – Reciprocating internal combustion engine driven alternating current generating sets; Part 10: Measurement of airborne noise by enveloping-surface method.
- ISO 13332:2000 – Reciprocating internal combustion engines; Test code for the measurement of structure-borne noise emitted from high-speed and medium-speed reciprocating internal combustion engines measured at engine feet.

TC 72/SC 8, Textile Machinery and Accessories, Safety Requirements for Textile Machinery

- ISO 9902-1:2001 – Textile machinery: Noise test code; Part 1: Common requirements.
- ISO 9902-2:2001 – Textile machinery: Noise test code; Part 2: Spinning preparatory and spinning machinery.
- ISO 9902-3:2001 – Textile machinery: Noise test code; Part 3: Nonwoven machinery.
- ISO 9902-4:2001 – Textile machinery: Noise test code; Part 4: Yarn processing, cordage and rope manufacturing machinery.
- ISO 9902-5:2001 – Textile machinery: Noise test code; Part 5:

Weaving and knitting preparatory machinery.

- ISO 9902-6:2001 – Textile machinery: Noise test code; Part 6: Fabric manufacturing machinery.
- ISO 9902-7:2001 – Textile machinery: Noise test code; Part 7: Dyeing and finishing machinery.

TC 118/SC 3, Compressors and Pneumatic Tools, Machines, and Equipment, Pneumatic Tools and Machines

ISO 15744:2002 – Hand-held non-electric power tools: Noise measurement code; Engineering method (Grade 2).

TC 118/SC 6, Compressors and Pneumatic Tools, Machines, and Equipment, Air Compressors and Compressed Air Systems

ISO 2151:2004 – Acoustics: Noise test code for compressors and vacuum pumps; Engineering method (Grade 2).

TC 131/SC 8, Fluid Power Systems, Product Testing

- ISO 4412-1:1991 – Hydraulic fluid power: Test code for determination of airborne noise levels; Part 1: Pumps.
- ISO 4412-2:1991 – Hydraulic fluid power: Test code for determination of airborne noise levels; Part 2: Motors.
- ISO 4412-3:1991 – Hydraulic fluid power; Test code for determination of airborne noise levels; Part 3: Pumps; Method using a parallelepiped microphone array.

TC 192, Gas Turbines

- ISO 10494:1993 – Gas turbines and gas turbine sets: Measurement of emitted airborne noise; Engineering/survey method.

IEC Standards for Noise Emissions

TC 2, Rotating Machinery

- IEC 60034-9 ed4.1 Consol. with am1 (2007-07) – Rotating electrical machines; Part 9: Noise limits.

TC 5, Steam Turbines

- IEC 61063 ed1.0 (1991-04) – Acoustics; Measurement of airborne noise emitted by steam turbines and driven machinery.

SC 65B, Measurement and Control Devices

- IEC 60534-8-1 ed2.0 (2005-09) – Industrial-process control valves; Part 8-1: Noise considerations; Laboratory measurement of noise generated by aerodynamic flow through control valves.
- IEC 60534-8-2 ed2.0 (2011-10) – Industrial-process control valves; Part 8-2: Noise considerations; Laboratory measurement of noise generated by hydrodynamic flow through control valves.
- IEC 60534-8-3 ed3.0 (2010-11) – Industrial-process control valves; Part 8-3: Noise considerations; Control valve aerodynamic noise prediction method.
- IEC 60534-8-4 ed2.0 (2005-08) – Industrial-process control valves; Part 8-4: Noise considerations; Prediction of noise generated by hydrodynamic flow.

IEC TC 59, Performance of Household and Similar Electrical Appliances

- IEC 60704-1 ed3.0 (2010-02) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 1: General requirements.
- IEC 60704-2-7 ed1.0 (1997-09) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2: Particular requirements for fans.
- IEC 60704-2-8 ed1.0 (1997-02) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2: Particular requirements for electric shavers.
- IEC 60704-2-9 ed1.0 (2003-06) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-9: Particular requirements for electric hair care appliances.
- IEC 60704-2-14 ed1.0 (2007-12) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-14: Particular requirements for refrigerators, frozen-food storage cabinets and food freezers.
- IEC 60704-3 ed2.0 (2006-02) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 3: Procedure for determining and verifying declared noise emission values.

IEC SC 59A, Electric Dishwashers

- IEC 60704-2-3 ed2.1 Consol. with am1 (2005-08) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-3: Particular requirements

for dishwashers.

- IEC 60704-2-3-am1 ed2.0 (2005-07) – Amendment 1, Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-3: Particular requirements for dishwashers.

IEC SC 59C, Heating Appliances

- IEC 60704-2-5 ed3.0 (2005-07) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-5: Particular requirements for electric thermal storage room heaters.

IEC SC 59D, Home Laundry Appliances

- IEC 60704-2-4 ed3.0 (2011-11) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-4: Particular requirements for washing machines and spin extractors.
- IEC 60704-2-6 ed3.0 (2012-03) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-6: Particular requirements for tumble dryers.

IEC SC 59F, Surface-Leaning Appliances

- IEC 60704-2-1 ed2.0 (2000-12) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-1: Particular requirements for vacuum cleaners.
- IEC 60704-2-2 ed2.0 (2009-07) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-2: Particular requirements for fan heaters.

IEC SC 59K, Ovens and Microwave Ovens, Cooking Ranges, and Similar Appliances

- IEC 60704-2-10 ed2.0 (2011-09) – Household and similar electrical appliances; Test code for the determination of airborne

acoustical noise; Part 2-10: Particular requirements for electric cooking ranges, ovens, grills, microwave ovens and any combination of these.

- IEC 60704-2-13 ed2.0 (2011-01) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-13: Particular requirements for range hoods.

IEC SC 59L, Small Household Appliances

- IEC 60704-2-11 ed1.0 (1998-12) – Household and similar electrical appliances; Test code for the determination of airborne acoustical noise; Part 2-11: Particular requirements for electrically-operated food preparation.

IEC TC 88, Wind Turbines

- IEC 61400-11 ed2.1 Consol. with am1 (2006-11) – Wind turbine generator systems; Part 11: Acoustic noise measurement techniques.

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