INTERNATIONAL STANDARD

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Hand-held non-electric power tools — Noise measurement code — Engineering method (grade 2)

Machines à moteur portatives non électriques — Code pour le mesurage du bruit — Méthode d'expertise (classe de précision 2)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15744 was prepared by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, Subcommittee SC 3, *Pneumatic tools and machines*.

Annexes A, B and C of this International Standard are for information only.

Introduction

The noise test code presented by this International Standard gives methods for determining and declaring the noise emission values of hand-held non-electric power tools: i.e. the total noise level from the power tool expressed as sound power level and as the emission sound pressure level at the work station. These methods have been designed to give results that make it possible to compare the acoustic performance of various power tools.

The power tools are either run at no load, when this gives a representative value, or in an on-load condition but with the process noise muffled so that it is well below the noise level of the power tool. The methods were chosen to give a satisfactory reproducibility of results and are based on present practice in industry.

For many power tools in a real work situation the noise from the process dominates the total noise emission in actual use. The process noise varies within very wide limits and cannot be predicted. Users are cautioned that the emission sound pressure level as determined by this code may not be representative of actual operator exposure levels, which are unique characteristics of individual applications and environmental factors beyond the control of the manufacturers of the equipment covered by this International Standard, and are under the exclusive control (and therefore the responsibility) of the users of the equipment.

This International Standard was prepared with the assistance of both PNEUROP, the European body representing manufacturers of compressors, vacuum pumps, pneumatic tools, pneumatic machines and allied equipment, and CAGI, the compressed air and gas institute, in the United States.

Hand-held non-electric power tools — Noise measurement code — Engineering method (grade 2)

1 Scope

This International Standard specifies methods for the measurement, determination and declaration of the noise emission from hand-held non-electric power tools. It prescribes the loading and working conditions under which can be determined

a) the noise emission, under specified load conditions, expressed as the sound power level, and

b) the emission sound pressure level at the work station under specified load conditions.

This International Standard is applicable to typical hand-held non-electric power tools including rotary tools, orbital and random orbital sanders, rotary and non-rotary reciprocating and percussive tools and a variety of assembly tools. It is not applicable to cartridge-operated tools, fastener driving tools (e.g. nailers, staplers) or any tool powered by an internal combustion engine, nor is it applicable to breakers or other power tools which, when placed on the market, are required to meet the provisions of legislation specifying test methods and imposing limits on noise emission from, for example, equipment used outdoors.

NOTE This noise measurement code could also be applied to other equipment such as winches, pneumatic motors, auto-feed drills and tappers, pumps, hydraulic motors and screw feed systems, provided their principles of operation were in accordance with those of pneumatic and hydraulic equipment.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2787:1984, *Rotary and percussive pneumatic tools — Performance tests*

ISO 3744:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 5391, *Pneumatic tools and machines — Vocabulary*

ISO 8662-2, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 2: Chipping hammers and riveting hammers*

ISO 8662-3, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 3: Rock drills and rotary hammers*

ISO 8662-7, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 7: Wrenches, screwdrivers and nut runners with impact, impulse or ratchet action*

ISO 8662-8, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 8: Polishers and rotary, orbital and random orbital sanders*

ISO 8662-14, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 14: Stone-working tools and needle scalers*

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*

IEC 60651, *Sound level meters*

IEC 60804, *Integrating-averaging sound level meters*

EN 292-2:1991, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications*

3 Terms, definitions and symbols

For the purposes of this International Standard, the terms and definitions given in ISO 5391 and the following apply. For the symbols, see Table 1.

3.1
declared dual-number noise emission value
L, K
measured noise emission value, L, and its associated uncertainty K, both rounded to the nearest decibel

[ISO 4871:1996]

3.2
emission
airborne sound radiated by a well-defined noise source (e.g. the machine under test)

[ISO 11203:1995]

NOTE Emission values may be incorporated in a product label or published in a product specification, or both these. The basic noise emission descriptors are the sound power level of the product itself and the emission sound pressure levels at the work station and at other specified positions (if any) in the vicinity of the product.

3.3
emission sound pressure
p
sound pressure, at a specified position near a noise source, when the source is in operation under specified operating and mounting conditions on a reflecting plane surface, excluding the effects of background noise as well as the effects of reflections other than those from the plane or planes permitted for the purpose of the test; expressed in pascals

[ISO 11203:1995]

3.4
emission sound pressure level
L_p
ten times the logarithm to the base 10 of the ratio of the square of the emission sound pressure, $p^2(t)$, to the square of the reference sound pressure, p_0^2, measured with a particular time weighting and a particular frequency weighting selected from those defined in IEC 60651; expressed in decibels

NOTE 1 The reference sound pressure is 20 µPa.

NOTE 2 Adapted from ISO 11203:1995.

3.5
hand-held power tool
power tool driven by a rotary or linear motor powered by compressed air, hydraulic fluid, gaseous or liquid fuel, electricity or stored energy (e.g. by a spring) to do mechanical work and so designed that the motor and the mechanism form an assembly that can easily be brought to its place of operation

NOTE The power tool can be operated using one or two hands.

3.6
inserted tool
tool inserted in the hand-held power tool to perform the intended work

3.7
loading device
device providing a simulated work piece for a hand-held power tool under test conditions

3.8
noise emission declaration
information on the noise emitted by the machine, given by the manufacturer or supplier in technical documents or other literature concerning noise emission values

NOTE 1 The noise emission declaration may take the form of either the declared single-number noise emission value or the declared dual-number value.

NOTE 2 Adapted from ISO 4871:1996.

3.9
no-load speed
free speed
idling speed
rotational speed of the output spindle, with no inserted tool mounted, subject to no external load, and operated at maximum energy supply as specified by the manufacturer; expressed in revolutions per minute

3.10
normal sound intensity level
$\overline{L_{\mathrm{In}}}$
ten times the logarithm to the base 10 of the ratio of the component of the sound intensity, in the direction normal (perpendicular) to the measurement surface, to the reference sound intensity; expressed in decibels

NOTE The reference sound intensity is 10^{-12} W/m^2.

3.11
work station
operator's position
position in the vicinity of the machine under test which is intended for the operator

[ISO 11203:1995]

3.12
sound intensity
time-averaged value of the rate of flow of sound energy per unit of surface area in the direction of the local instantaneous acoustic particle velocity

3.13
sound power
W
rate per unit time at which airborne sound energy is radiated by a source, expressed in watts

[ISO 3744:1994]

3.14
sound power level
L_W
ten times the logarithm to the base 10 of the ratio of the sound power radiated by the sound source under test to the reference sound power, expressed in decibels

NOTE 1 The frequency weighting or the width of the frequency band used is indicated, for example: A-weighted sound power level, L_{WA}.

NOTE 2 The reference sound power is 1 pW (10^{-12} W).

NOTE 3 Adapted from ISO 3744:1994.

3.15
standard deviation of reproducibility
σ_R
standard deviation of noise emission values obtained under reproducibility conditions: i.e. the repeated application of the same noise emission measurement method on the same noise source at different times and under different conditions (different laboratory, different operator, different apparatus), and therefore including the standard deviation of repeatability

NOTE Adapted from ISO 4871:1996.

3.16
surface sound pressure level
$\overline{L_{p\mathrm{f}}}$

energy-average of the time-averaged sound pressure levels at all microphone positions on the measurement surface, expressed in decibels, with background noise correction K_1 and environmental correction K_2 applied

[ISO 3744:1994]

NOTE 1 See Table 1 for equivalent A-weighted symbol.

NOTE 2 The background noise correction K_1 and the environmental correction K_2 are defined in ISO 3744:1994.

3.17
time-averaged emission sound pressure level
$L_{p\mathrm{eq}T}$
emission sound pressure level of a continuous steady sound that, within a measurement time interval, T, has the same mean square sound pressure as a sound under consideration which varies with time; expressed in decibels

[ISO 11203:1995]

NOTE See Table 1 for equivalent A-weighted symbol.

3.18
uncertainty
K
value of the measurement uncertainty associated with a measured noise emission value, expressed in decibels

[ISO 4871:1996]

Table 1 — Symbols

Symbol	Description
D	Diameter of energy absorber
F_A	Feed force
K_1, K_{1A}	Background noise correction, A-weighted background noise correction
K_2, K_{2A}	Environmental correction, A-weighted environmental correction
K_{WA}, K_{pA}, $K_{pC,peak}$	Measurement uncertainties
L	Noise emission value
$\overline{L}$	Arithmetical mean of noise emission values
$\overline{L_{In}}$	Normal sound intensity level
L_p	Emission sound pressure level
L_{peqT}	Time-averaged emission sound pressure level
L_{pAeqT}	A-weighted time-averaged emission sound pressure level (usually abbreviated to L_{pA}) [a]
$L_{pC,peak}$	C-weighted peak emission sound pressure level
$\overline{L_{pf}}$, $\overline{L_{pfA}}$	Surface sound pressure level, A-weighted surface sound pressure level
L'_{pAi}	A-weighted sound pressure level measured at the i-th microphone position
L_W, L_{WA}	Sound power level, A-weighted sound power level
Q	Numerical difference between L_{WA} and L_{pA}
R	Measurement surface hemisphere radius and cylinder radius
S	Measurement surface area
h	Free length of inserted tool
σ_R	Standard deviation of reproducibility

[a] It shall be measured with an instrument which complies with the requirements of IEC 60804.

4 Machinery families

4.1 Applicability of this International Standard

The hand-held non-electric power tools to which this International Standard is applicable comprise a range of types and models, based on similar mechanical parts, technology and design, and giving similar acoustic properties.

They can be grouped into the following families:

a) **rotary tools**, including drills, tappers, grinders, belt sanders, polishers, rotary files, rotary sanders, die grinders and circular saws;

b) **orbital and random orbital sanders**;

c) **rotary reciprocating tools**, including jig saws, nibblers, oscillating saws, reciprocating saws, reciprocating files and shears, having a rotary drive;

d) **non-rotary reciprocating tools**, including reciprocating saws, files and knives and oscillating saws and knives, having a non-rotary drive;

e) **percussive non-rotary tools**

— where the piston and working tools are in two parts (not integrated), such as chipping hammers and riveting hammers,

— where the piston itself is the working tool, such as rammers, tampers and scaling hammers, and

— needle scalers;

f) **percussive rotary tools**, including drifters, plug-hole drills, rotary hammers, rock drills and stopers;

g) **non-impact assembly tools**, such as non-ratchet screwdrivers and nut-runners;

h) **ratcheting assembly tools**, including screwdrivers and wrenches with ratchet clutches (also known as slip clutches), and pawl-type ratchet wrenches;

i) **impact assembly tools**, such as impact wrenches and screwdrivers, and air-hydraulic impulse wrenches and screwdrivers.

See also Table 2.

4.2 Other equipment

The use of this International Standard may be extended to other equipment that does not have a dedicated noise test code, provided the principles of operation of that equipment accord with the general principles for the operation of pneumatic and hydraulic equipment.

EXAMPLES Winches, pneumatic motors, auto-feed drills and tappers, pumps, hydraulic motors, screw feed systems.

5 Sound power level determination

5.1 General

The acoustic environment, instrumentation, quantities to be measured and determined, and measurement procedure shall be as specified in ISO 3744:1994.

The sound power level shall be given as an A-weighted sound power level in decibels, with a reference of 1 pW. The A-weighted sound pressure levels, from which the sound power is to be determined, should be measured directly, and not calculated from frequency band data.

5.2 Measurement surface

For all hand-held non-electric power tools, the sound power level shall be determined using a hemispherical/cylindrical measurement surface, consisting of a hemisphere standing on a cylindrical pedestal (see Figure 1). The technical justification for the selection of this surface is given in Annex C.

Measurements shall be made in a free field over a reflecting plane.

Five microphone positions shall be located 1 m from the geometric centre of the power tool. Four positions shall be spaced at regular intervals on a plane defined as passing through the geometric centre of the power tool and parallel to the reflecting plane; the fifth position shall be located at a distance of 1 m above the geometric centre of the power tool, as shown in Figure 1.