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Forestry and gardening machinery — Noise test code for portable hand-held machines with internal combustion engine — Engineering method (Grade 2 accuracy)

Machines forestières et machines de jardin — Code d'essai acoustique pour machines portatives tenues à la main à moteur à combustion interne — 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 2.

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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 22868 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable forest machinery*.

This second edition cancels and replaces the first edition (ISO 22868:2005), which has been technically revised. It now also deals with pole-mounted powered pruners, hedge-trimmers and garden blowers/vacuums.

Introduction

This document is a type-C standard as stated in ISO 12100.[1)]

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

During the first steps in the preparation of this International Standard it became obvious that the repeatability of the test results could become better if the operator were to be replaced by a simulation process, representing the normal operating modes with chain-saws and trimmers/brush-cutters. Furthermore, it was found that the cutting process performed with chain-saws causes considerable deviations, which are not related to the measured object but to the test procedure itself.

Based on these observations, it was concluded that the operators in both test procedures, i.e. for chain-saws and trimmers/brush-cutters, ought to be replaced by a defined fixture and the cutting process with chain-saws by a brake simulating the load. In this manner, the operating conditions during measurement would simulate normal operating conditions.

The determination of noise emission characteristics is primarily intended for

— manufacturers' declarations of noise emitted,

— comparing the noise emitted by machines in the family concerned, and

— purposes of noise control at source at the design stage.

The use of this noise test code will ensure reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. Noise measurement methods allowed by this International Standard give results with Grade 2 accuracy.

The operating modes specified for the tests are consistent with those involved in the assessment of the exposure sound pressure levels, for example, over a typical working day.

NOTE Exposure sound pressure levels are the mean sound pressure levels experienced by the operator over a defined period of time.

The work cycles chosen for this test code are based on the following considerations of application:

a) chain-saws with an engine of $< 80\ cm^3$ are used for various operations, including felling, bucking and delimbing;

b) chain-saws with an engine of $\geqslant 80\ cm^3$ are normally used for felling and bucking.

Delimbing will cause the saw to run at racing speed; therefore, racing is included only for saws with a $< 80\ cm^3$ engine.

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1) *Safety of machinery — General principles for design — Risk assessment and risk reduction.*

For brush-cutters, grass-trimmers, hedge-trimmers and pole-mounted powered pruners, the cutting mode (full load) is estimated to be valid only for short periods, while racing and idling are the two dominant modes. Moreover, it has also been found to be diverse and not able to be performed under repeatable conditions.

For trimmers, the full load and the racing modes are integrated in one single mode due to the loading effect of the flexible line.

For brush-cutters, hedge-trimmers and pole-mounted powered pruners, it is not possible to simulate the full load mode in a feasible way since there are no constant load conditions comparable to chain-saws. Since the operating mode “racing” is anyhow the worst case, it is used as representative.

For garden blowers, full load and idling are the two dominant modes.

In either case, transport and other tasks between operations will cause the machine to run at idling. Experience has lead to the conclusion that, except for hedge-trimmers and blowers, equal duration for the different working modes is a good estimation of daily exposure.

For hedge-trimmers, experience has shown that the machine is used 1/5 at idling and 4/5 at racing, while for garden blowers it is used 1/7 at idling and 6/7 at racing.

A summary of results from “round robin” tests, carried out between 2007 and 2008 in up to eight test laboratories on a single chain-saw, brush-saw and grass-trimmer, is given in Annex G.

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CAUTION — Some of the test procedures specified in this International Standard involve processes that could lead to a hazardous situation. Any person performing tests in accordance with this International Standard shall be appropriately trained in the type of work to be carried out.

1 Scope

This International Standard specifies a noise test code for determining, efficiently and under standardized conditions, the noise emission characteristics of portable, hand-held, combustion-engine-powered forest and garden machines, including chain-saws, brush-cutters, grass-trimmers, pole-mounted powered pruners, hedge-trimmers and garden blowers/vacuums. Noise emission characteristics include the A-weighted emission sound pressure level at the operator position and the A-weighted sound power level.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 354, *Acoustics — Measurement of sound absorption in a reverberation room*

ISO 3744, *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 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 6531, *Machinery for forestry — Portable chain-saws — Vocabulary*

ISO 7112, *Machinery for forestry — Portable brush-cutters and grass-trimmers — Vocabulary*

ISO 7293, *Forestry machinery — Portable chain saws — Engine performance and fuel consumption*

ISO 8893, *Forestry machinery — Portable brush-cutters and grass-trimmers — Engine performance and fuel consumption*

ISO 11201, *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*

IEC 61672-1, *Electroacoustics — Sound level meters — Part 1: Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6531 and ISO 7112 apply.

4 Quantities to be measured and quantities to be determined

The quantities to be measured are the time-averaged sound pressure levels defined in the relevant basic noise measurement standards (ISO 3744, ISO 11201), A-weighted and — if required — in frequency bands.

The quantities to be determined are the sound power levels and the emission sound pressure levels, A-weighted and — if required — in frequency bands.

5 A-weighted sound power level determination

For the determination of the A-weighted sound power level, ISO 3744 shall be used, subject to the following modifications or additions.

a) The microphone array shall be six microphone positions, in accordance with Figure 1 and Table 1.

NOTE 1 The six-microphone array is permitted because experimental data have shown that use of this array does not yield results that differ significantly from those obtained with the 10-microphone array specified in ISO 3744.

b) The measurement surface shall be a hemisphere with a radius, r, of $\geqslant 2d_O$, preferably 4 m; d_O is determined by the reference box and its defined location above ground, see Figure 1. If a bigger radius is needed it shall be chosen from 6 m, 8 m and 10 m. A smaller radius is permitted if it is demonstrated that the results are within 0,5 dB compared with measurements with a hemisphere of $r = 4$ m.

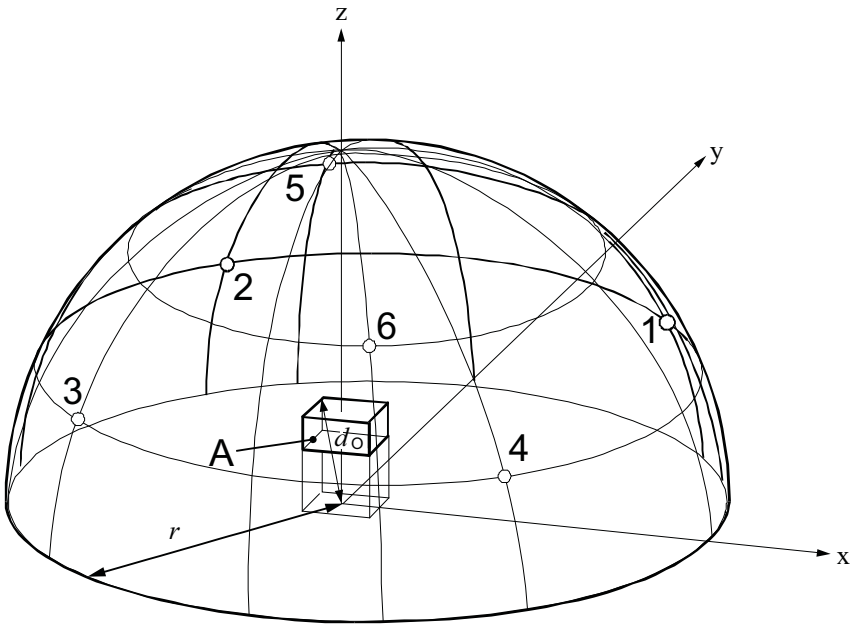
NOTE 2 The smaller radius could be necessary in an anechoic room where a radius of 4 m cannot be provided.

c) The conditions for the particular type of machine to be tested and its mounting and orientation shall be according to the corresponding annex of this International Standard.

d) Environmental conditions shall be within the limits specified by the manufacturer of the measuring equipment. The ambient air temperature shall be in the range −10 °C to 30 °C and the wind speed shall be less than 5 m/s. A microphone windscreen shall be used whenever the wind speed exceeds 1 m/s.

e) Measurements shall be made using an integrating-averaging sound level meter as defined in IEC 61672-1; alternatively, instruments with the time-weighting characteristics “slow”, as defined in IEC 61672-1, may be used.

f) The value of K_{2A}, determined in accordance with ISO 3744:2010, Annex A, shall at maximum be 2 dB.



Key

A reference box

d_O characteristic source dimension

r hemisphere radius $\geqslant 2d_O$

Figure 1 — Microphone positions on hemisphere

Table 1 — Coordinates of microphone positions

Position no.	Coordinate		
	x	y	z
1	+ 0,65 r	+ 0,65 r	0,38 r
2	− 0,65 r	+ 0,65 r	0,38 r
3	− 0,65 r	− 0,65 r	0,38 r
4	+ 0,65 r	− 0,65 r	0,38 r
5	− 0,28 r	+ 0,65 r	0,71 r
6	+ 0,28 r	− 0,65 r	0,71 r

NOTE See also Annex H concerning the microphone positions.

6 A-weighted emission sound pressure level measurement at the operator position

6.1 General

For the measurement of the A-weighted emission sound pressure level, ISO 11201 shall be used, subject to the following modifications and additions.

a) The conditions for the particular type of machine to be tested and its mounting shall be in accordance with the corresponding annex of this International Standard.

b) The surface shall comply with the provisions of either 6.2 or 6.3. Reproducibility of results using natural grass or other organic material is likely to be worse than that required for Grade 2 of accuracy. In case of dispute, measurements shall be carried out in the open air and on the artificial surface (see 6.2).

c) Environmental conditions shall be within the limits specified for the measuring equipment. The ambient air temperature shall be in the range −10 °C to 30 °C, and the wind speed shall be less than 5 m/s. A microphone windscreen shall be used whenever the wind speed exceeds 1 m/s.

d) Measurements shall be made using an integrating-averaging sound level meter as defined in IEC 61672-1; alternatively, instruments with the time-weighting characteristics “slow”, as defined in IEC 61672-1, may be used.

e) The location of a particular type of machinery respective to the microphone array shall be in accordance with the corresponding annex of this International Standard.

6.2 Requirements for artificial surface

The artificial surface shall have absorption coefficients in accordance with Table 2, measured according to ISO 354.

Table 2 — Absorption coefficient

Frequencies Hz	Absorption coefficients	Tolerance
125	0,1	± 0,1
250	0,3	± 0,1
500	0,5	± 0,1
1 000	0,7	± 0,1
2 000	0,8	± 0,1
4 000	0,9	± 0,1

The artificial surface shall be placed on a hard, reflecting surface at the centre of the test environment and shall have a size of at least 3,6 m × 3,6 m. The construction of the supporting structure shall be such that the requirements for acoustic properties are met with the absorptive material in place. The structure shall support the test set-up such that compression of the absorbing material is avoided.

6.3 Requirements for natural ground surface

The ground at the centre of the test site shall be flat and have good sound-absorbing properties. The surface shall be either forest ground or grass, with the grass or other organic material having a height of (50 ± 20) mm.

7 Testing and operating conditions

Measurements shall be carried out on a new, normal production machine fitted with standard equipment in accordance with the instruction handbook.

The engine and the machine shall be run-in prior to the test in accordance with the manufacturer's instructions. The engine shall be at normal stable operating temperature before the test is started.

The carburettor shall be set to give the specific machine conditions required by the corresponding annex of this standard.

The cutting devices shall be lubricated in accordance with the instruction handbook. No alterations to the initial settings are permitted once measurements have commenced.

An engine speed indicator shall be used to check the speed of the engine. It shall have a measurement uncertainty of ± 1,0 % of the reading. The indicator and its engagement with the machine shall not affect the operation during testing.

NOTE 1 The specific conditions for a particular machine are given in the corresponding annexes.

Noise emission quantities shall be determined under the specific conditions for the particular type of machine specified in the corresponding annex. The following additionally applies.

a) Perform a minimum of four measurements with a short break and significant change of speed between each measurement. Separate each measurement at, for example, idle, by a short period of racing, and vice versa. After this speed variation, stable speed conditions shall be obtained before testing is continued.

   At least four separate periods of noise data shall be obtained, totalling at least 20 s.

   Each signal duration used shall be at least 2 s over which the engine speed is within ± 3,5 r/s.

   NOTE 2 The collection of data for the different operating modes need not be carried out in any fixed sequence.

b) The range of all values noted for each operating mode shall not be greater than 2 dB. If this range is exceeded, repeat the tests until four consecutive results fall within a range of 2 dB. The final value to be retained for each microphone position is the arithmetical mean of these four successive values satisfying this requirement.

For all the conditions specified in the annexes, carry out this procedure when measuring the A-weighted emission sound pressure levels. When determining the A-weighted sound power level, this procedure shall be applied to the sound pressure levels averaged over the six microphone positions.

8 Information to be reported

The following information, as applicable, shall be recorded and reported for all measurements:

a) machine under test:

   1) description of the machine (including its engine displacement, manufacturer, type and serial number, and cutting attachment);

   2) operating conditions, as listed in Tables 3 and 4, during acoustical evaluation;

   3) dimensions of the log (when applicable);

b) acoustic environment (description of test environment):

   1) if outdoors, a sketch showing the location of the machine with respect to the surrounding terrain, including a physical description of the test environment including a description of the nature of the ground plane;

   2) if indoors, a description of the physical treatment of walls, ceiling and floor, including a sketch showing the location of the machine and room contents;

   3) value of K_{2A};

c) instrumentation:

1) equipment used for the measurements, including name, type, serial number and manufacturer;

2) method used to calibrate the instrumentation system;

3) date and place of the most recent calibration of the acoustical calibrator;

d) acoustical and other data:

1) A-weighted sound pressure levels of the background noise at the microphone positions;

2) measured values and mean values in accordance with Tables 3, 4 and 5;

3) remarks, if any;

4) air temperature and wind speed;

5) date and place of the measurements.

Table 3 — A-weighted emission sound pressure level determination — Reporting measured values, mean values and emission values

Operating condition	Engine speed	Measured A-weighted sound pressure levels L'_{pA} dB					Arithmetic mean value $\overline{L'_{pAX}}$	Correction factor K_{1A}	A-weighted emission sound pressure levels L_{pAX}
		Test no.							
	r/s	1	2	3	4	n	dB	dB	dB
Idling (Id)									
Full load (Fl)[a]									
Racing (Ra)[a]									

The emission sound pressure level for the respective operating condition X is calculated from

$$L_{pAX} = \overline{L'_{pAX}} - K_{1A}$$

where K_{1A} is the background noise correction according to ISO 11201.

[a] According to the test procedure for the machine type (see corresponding annex).

Table 4 — A-weighted sound power level determination — Reporting measured A-weighted sound pressure levels

Test	Operating condition	Engine speed r/s	L'_{pA1} dB	L'_{pA2} dB	L'_{pA3} dB	L'_{pA4} dB	L'_{pA5} dB	L'_{pA6} dB	$\overline{L'_{pA}}$ dB
1	Full load (Fl)[a]								
	Racing (Ra)[a]								
2	Full load (Fl)[a]								
	Racing (Ra)[a]								
3	Full load (Fl)[a]								
	Racing (Ra)[a]								
4	Full load (Fl)[a]								
	Racing (Ra)[a]								
n	Full load (Fl)[a]								
	Racing (Ra)[a]								
Average sound pressure level $\overline{L'_{pAX}}$	Full load (Fl)	$\overline{L'_{pAFl}}$ =	dB						
	Racing (Ra)	$\overline{L'_{pARa}}$ =	dB						

L'_{pA1} to L'_{pA6} are the measured time-averaged sound pressure levels at the corresponding microphone positions.

$\overline{L'_{pA}}$ is the average of sound pressure levels L'_{pA1} to L'_{pA6} according to ISO 3744:2010, Equation (12).

$\overline{L'_{pAX}}$ is the arithmetic average of the values for $\overline{L'_{pA}}$ from each test for the respective operating condition (Fl and Ra).

Individual values for L'_{pA} shall only be reported if available. The test procedure may include automatic averaging.

[a] According to the test procedure for the machine type (see corresponding annex).