INTERNATIONAL STANDARD

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Forestry machinery — Vibration test code for portable hand-held machines with internal combustion engine — Vibration at the handles

Machines forestières — Code d'essai des vibrations pour machines portatives tenues à la main à moteur à combustion interne — Vibrations au niveau des poignées

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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 22867 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable forest machinery*.

This first edition cancels and replaces ISO 7505:1986 and ISO 7916:1989, of which it constitutes a technical revision.

Introduction

The determination of vibration characteristics is primarily used for

— manufacturer's declarations,

— comparing the data between machines in the family concerned,

— development work at the design stage, and

— the estimation of the vibration risk considering the specific conditions (parameters).

The use of this vibration test code will ensure reproducibility of the determination of the vibration characteristics.

The operating modes are of interest for assessment of the vibration exposure, for example, over a typical working day.

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

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

b) chain-saws with an engine displacement 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.

For brush-cutters and grass-trimmers, 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, 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.

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

Forestry machinery — Vibration test code for portable hand-held machines with internal combustion engine — Vibration at the handles

CAUTION — Some of the tests 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. All national regulatory conditions and health and safety requirements shall be followed.

1 Scope

This International Standard specifies a vibration test code for determining, efficiently and under standardized conditions, the magnitude of vibration at the handles of portable hand-held, internal-combustion-engine-powered forestry machines such as chain-saws, brush-cutters and grass-trimmers. The code is applicable to manufacturer's product controls as well as type tests. It is intended that the results obtained will be able to be used to compare different machines or different models of the same type of machine. Although the magnitudes measured are obtained in an artificial operation, they nevertheless give an indication of the values to be found in a real work situation.

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 5347 (all parts), *Methods for the calibration of vibration and shock pick-ups*

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

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

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

ISO 8041, *Human response to vibration — Measuring instrumentation*

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

ISO 16063 (all parts), *Methods for the calibration of vibration and shock transducers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6531, ISO 7112 and ISO 8041 apply.

4 Quantities to be measured and determined

The quantities to be measured are the weighted accelerations in the three perpendicular directions, a_{hwx}, a_{hwy} and a_{hwz}.

The quantities to be determined are the vibration total values, a_{hv}, and the equivalent vibration total values, $a_{hv,eq}$, for each handle. See Annexes A and B.

NOTE Mathematically, a_{hv} is the root sum of the squares of the three root-mean-square (r.m.s.) single-axis acceleration values of the frequency-weighted hand transmitted vibration values a_{hwx}, a_{hwy}, a_{hwz}.

5 Instrumentation

5.1 General

The vibration measurement system including frequency weighting for hand–arm shall be in accordance with ISO 8041.

5.2 Accelerometer

The total mass of the vibration accelerometer giving the acceleration in the three directions at each measuring position shall be as low as possible, and shall not in any case exceed 25 g, including the mounting but excluding the cable. For further information see ISO 5349-2:2001, 6.1.5.

NOTE The sensitive element intended to pick up the vibration and to convert it into electrical signals is an accelerometer. A tri-axial accelerometer will permit measurements in the x, y and z axes, simultaneously.

5.3 Fastening of accelerometer

The accelerometer and the mechanical filter, if used, shall be mounted firmly on the handle by means of a fastening device. Guidance is given in ISO 5348 and ISO 5349-2.

For measurement on handles with resilient covers (for example, a cushioned handle), it is permissible to use a suitable adaptor for the accelerometer. The adaptor shall consist of a suitable, formed, light, rigid plate with a suitable mounting arrangement for the accelerometer used. Care shall be taken that the mass, size and shape of the adaptor do not significantly influence the signal from the accelerometer in the frequency range of interest. For more information, see ISO 5349-2:2001, 6.1.4.2.

5.4 Calibration

The whole measuring chain, including the accelerometer, shall be checked before and after use and — when necessary — to ensure accuracy during any sequence of measurements, in accordance with ISO 8041.The accelerometers shall be calibrated in accordance with ISO 5347 and ISO 16063.

5.5 Speed indicator

The rotational frequency of the engine shall be measured with an accuracy of ± 1,5 % of the reading. The speed indicator and its engagement with the machine shall not affect the operation during the test.

6 Measurement direction and location

Measurements shall be made at each hand-grip, where the operator normally holds the machine. Measurements shall be made in the three directions x, y and z.

The centre of gravity of the accelerometers shall be positioned at a maximum distance of 20 mm from the handle contour. One of the axis of the accelerometer shall be parallel to the axis of the handle.

NOTE The specific conditions for the particular types of machines covered by this International Standard are given in Annexes A and B.

7 Operating conditions, test procedure and presentation of results

Measurements shall be carried out on a new machine, featuring standard equipment as provided by the manufacturer, and with the tank(s) at least half filled.

NOTE The specific conditions for the particular types of machines covered by this International Standard are given in Annexes A and B.

The measured vibration of the machine can be influenced by the operator. The operator shall therefore be skilled and able to operate the machine properly.

The measurement shall be continued until the validity requirement given in Clause 8 is fulfilled.

The total vibration for each handle shall be calculated in accordance with Annex A or B, as appropriate.

8 Validity test

The validity is assured for every combination of handle and operating mode, when either the coefficient of variation, C_V, of the consecutive weighted values is less than 0,4 or the standard deviation, s_{n-1}, is less than 0,4 m/s^2.

If the measured values for a combination of handle and operating mode exceed 0,4 for both coefficient of variation and standard deviation, only the non-complying combination shall be repeated until the criterion of 0,4 is met.

For the purposes of this document, the coefficient of variation, C_V, of a test series is defined as the ratio between the standard deviation, s_{n-1}, of a series of measurement values and the mean value, $\overline{x}$, of the series:

$$C_V = \frac{s_{n-1}}{\overline{x}}$$

where

$$s_{n-1} = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}$$

$$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

where

x_i is the i-th value measured;

n is the number of measurement values.

9 Measurements and calculations

The measurements and calculations are generally done in the following sequence, as illustrated in Figure 1.

a) Measure the weighted acceleration of an operating mode in the three directions, $a_{hwx,J}$, $a_{hwy,J}$ and $a_{hwz,J}$, for the left and right handles, where J is the operating mode idling (Id), full load (Fl) or racing (Ra).

b) Calculate the root sum of squares of accelerations $a_{hv,J}$ of the three directions x, y and z for the operating mode selected.

c) Repeat a) and b) at least three times.

d) Calculate the arithmetic mean of the operating mode $\overline{a}_{hv,J}$.

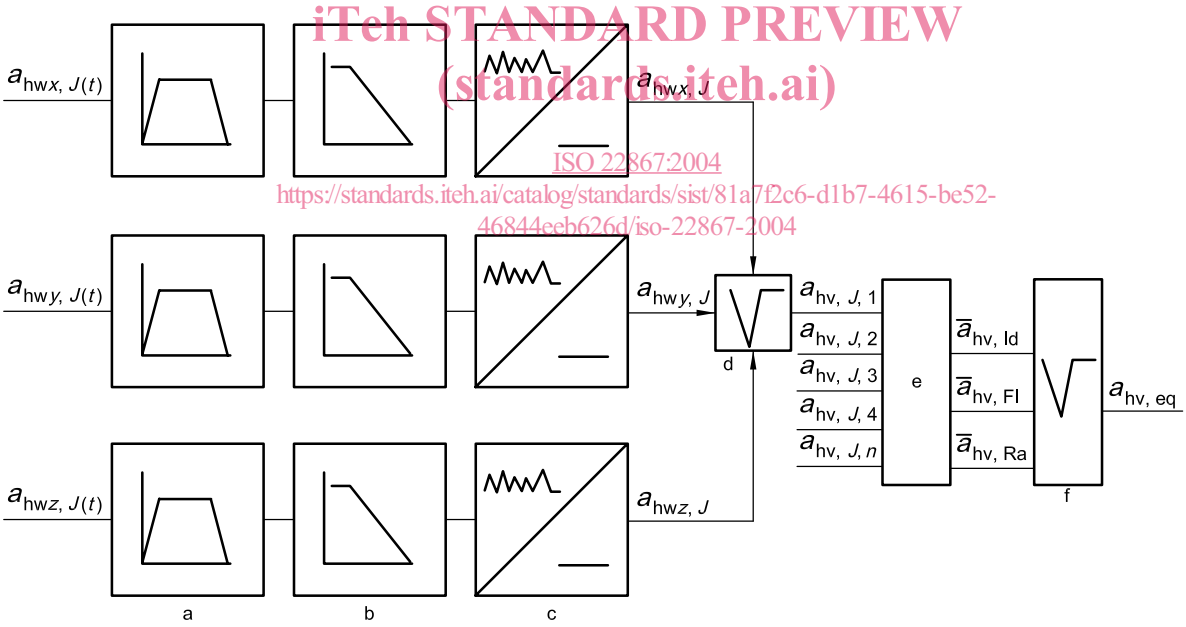
e) Repeat a), b) and d) as many times as necessary, depending on the coefficient of variation C_v and the standard deviation s_{n-1} (see Clause 8).

f) Perform a) to e) for the remaining operating modes.

g) Calculate the equivalent vibration total value $a_{hv,eq}$ for each handle according to A.4.2 and B.4.2.

h) Determine the declared value.

NOTE The information to be reported is specified in Annexes A and B.



Key

a Pass band.
b Weighting filter.
c Root mean square (r.m.s).
d See Note to Clause 4.
e Average value for each operating mode.
f See A.4.2 and B.4.2.

Figure 1 — Sequence of measurement and calculation of vibration data

10 Measurement uncertainties and declaration of vibration values

Vibration declaration is the responsibility of the manufacturer. If undertaken, it shall be done so that it is possible to verify the declared values.

The declaration shall include a reference to this vibration test code and to the basic standard used. Deviations, if any, from this test code and/or the basic standard shall also be indicated.

Calculated equivalent vibration values for the work cycles (see A.4.2 and B.4.2) shall be declared. The average vibration value for idling, full load and racing (if applicable) shall be provided by the manufacturer on request.

The uncertainties associated with the measurements shall be taken into account when deciding on the values to be declared.

NOTE The methodology used for taking uncertainty into account needs to be based on the use of measured values and measured values and uncertainties. The latter are the uncertainty associated to the measurement procedure (which is determined by the grade of accuracy of the measurement method used) and the production uncertainty (variation of vibration emission from one machine to another of the same type made by the same manufacturer). One method for the calculation of uncertainty is given in EN 12096.