INTERNATIONAL STANDARD

ISO 7916

First edition
1989-12-01

Forestry machinery — Portable brush-saws — Measurement of hand-transmitted vibration

Machines forestières — Débroussailleuses portatives — Mesurage des vibrations transmises aux mains

INTERNATIONAL ISO

Reference number
ISO 7916 : 1989 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7916 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry.*

Annex A forms an integral part of this International Standard. Annex B is for information only.

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Printed in Switzerland

Forestry machinery — Portable brush-saws — Measurement of hand-transmitted vibration

1 Scope

This International Standard specifies general methods for data acquisition and processing concerning hand-transmitted vibrations induced by portable hand-held, combustion engine brush-saws for use primarily in forestry. The methods are valid irrespective of how the brush-saw is operated during the test, for example, whether it is hand-held or fitted in a stand, and whether it is cutting or not.

This International Standard specifies an operator hand-held procedure for acquisition of vibration data from portable brush-saws.

NOTES

1 The hand-arm system exerts an influence on the hand-transmitted vibration, and different hands and grips exert different influences. Therefore, the development of a standardized stand for holding the saw during the measurement is in progress.

2 The measurements in the three axes should be made at, or clearly related to, the surface of the hands where the energy enters the body. As the hands of the person are in direct contact with the vibrating surface of the hand grip, the transducer should be fastened to the vibrating structure.

This International Standard is primarily intended for user and manufacturer purposes.

NOTE 3 — For definitions of terms relating to portable brush-saws, see ISO 7112[1].

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5349 : 1986, *Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand transmitted vibration.*

ISO 8893 : 1989, *Forestry machinery — Portable brush-saws — Engine performance and fuel consumption.*

IEC 651 : 1979, *Sound level meters.*

3 Data acquisition and processing

3.1 Weighted acceleration sum

The acceleration in three perpendicular directions (defined in clause 4) shall be picked up by accelerometers and processed to form an overall vibration value, the weighted acceleration sum ($\overline{a}_{h,w}$) according to figure 1. Mathematically $\overline{a}_{h,w}$ is the mean square of the root (RMS) of the weighted signals from each direction. The weighting filters shall have the characteristics given in ISO 5349. (The definition of the weighting filter is given in annex A.)

NOTES

1 The weighted acceleration sum combines the vibrations from all three axes and should not be compared with the single axis value of ISO 5349.

2 $\overline{a}_{h,w}$ can be calculated from frequency spectra of 1/3 octave or 1/1 octave with the weighting factors for the mid-frequencies calculated from ISO 5349. (The 1/3 octave analysis will be the most accurate.)

3 To obtain more detailed information about the vibration level, the evaluation according to ISO 5349 should be carried out. (The 1/3 octave analysis will give the most detailed information.)

4 The three different acceleration directions may be measured at different times, but under the same operating conditions.

3.2 Mass of accelerometers

The total mass of the accelerometer(s) giving the acceleration at one measuring position shall be as low as possible and may not in any case exceed 25 g, including the mounting but excluding the cables.

3.3 Mounting of accelerometers

If a resilient coating is being used between the hand and the vibrating structure (for example, a cushioned handle), it is permissible to use a suitable mount for the transducer (for example, a thin, suitably formed metal sheet) placed between the hand and the surface of the resilient material. In either case, care shall be taken that the size, shape and mounting of the transducer or of the special transducer support do not significantly influence the transfer of vibration to the hand. Care shall also be taken when mounting the transducer that the transfer function is flat up to 1 500 Hz for all three directions.

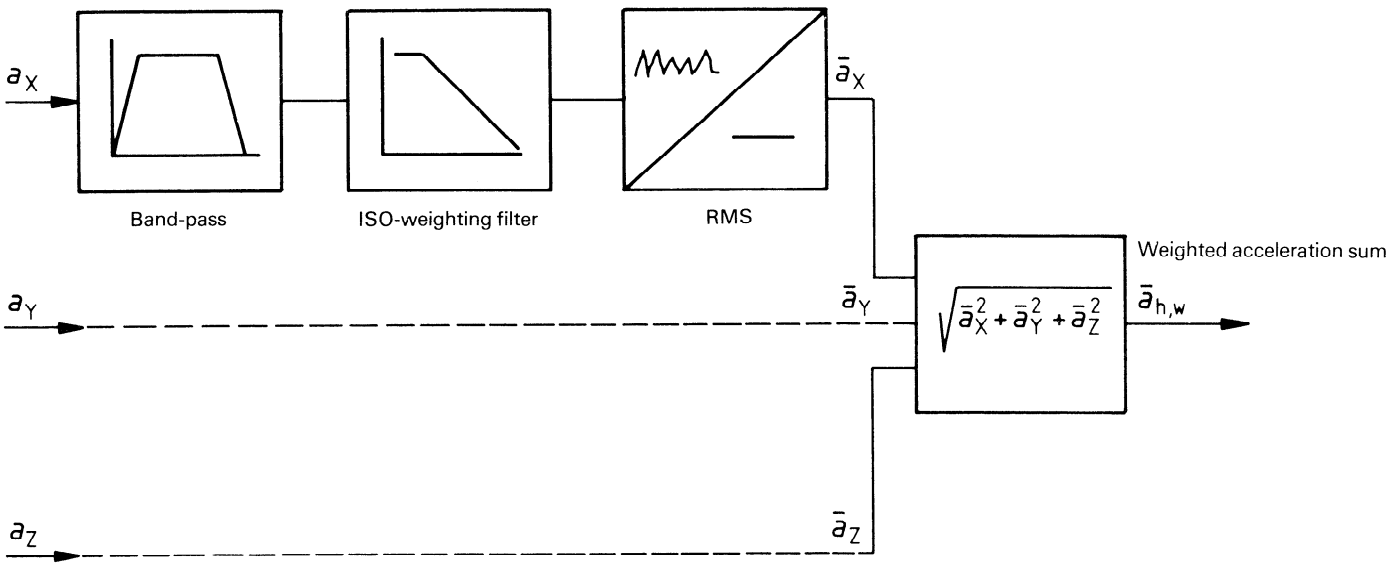

Figure 1 — Weighted acceleration sum ($\bar{a}_{h,w}$)

NOTES

1 The transfer function can be considered flat if an addition of mass to the accelerometer equal to that of the accelerometer and half that of the mount does not have any significant influence on $\bar{a}_{h,w}$ (This additional mass should be placed between the accelerometer and the stud if the mass is of metal, or around the accelerometer if the mass is of clay or wax.)

2 The proposed method for the case of a resilient coating between the hand and the vibrating structure is not satisfactory for all conditions, particularly in the case of thin cushions mainly affecting the transfer of higher frequencies. In such cases it might be preferable to make the measurements with the transducer rigidly attached to the handle or structure and to report separately the type, thickness, physical properties and estimated attenuation achieved by the cushioning material.

3 For general considerations concerning accelerometer mounting, see ISO 5348[2].

4 Positioning of accelerometers

The positions and directions of accelerometers are defined in figure 2, which means that they shall be positioned as near the operator's hands as possible without obstructing the normal grip (the centre of gravity of the accelerometers shall not be more than 20 mm away from the nearest part of the hand).

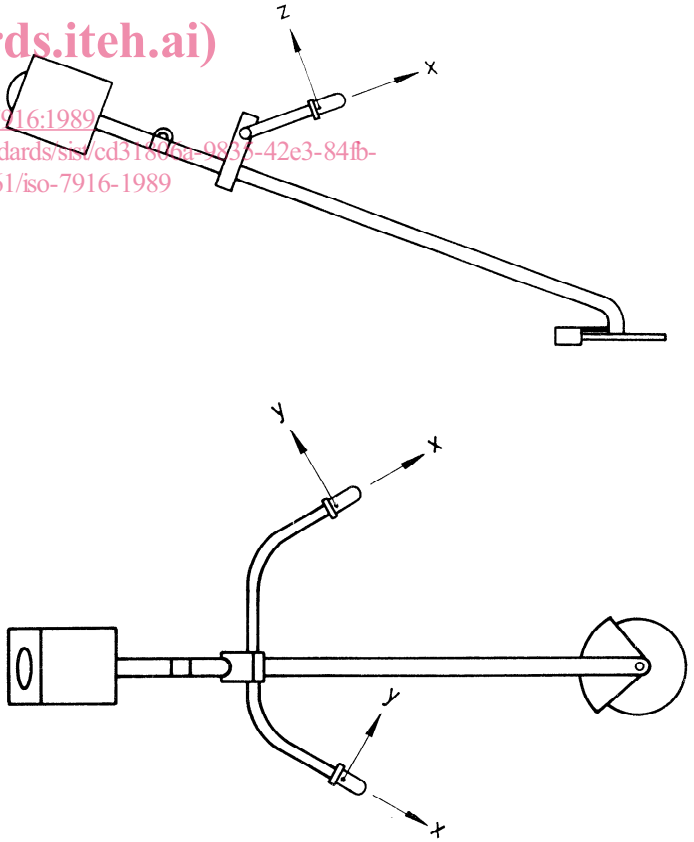

Figure 2 — Accelerometer positions

5 Accuracy of measurement

5.1 Measuring equipment

The accuracy of the measuring equipment excluding accelerometer mounting shall be within ± 10 % in the frequency range 8 Hz to 1 500 Hz. (See ISO 5347[3] concerning calibration.)

5.2 Electric noise

Special care shall be taken to avoid electric noise generated by the saw. (A suppressed spark-plug is recommended.) When the saw is running at the test place with the accelerometers free from contact with the saw but in the proximity of the saw (at a maximum distance of 20 mm from the measuring positions) the electric noise shall not exceed 5 % of the maximum measured value reported.

5.3 Rotational frequency indicator

The accuracy of the rotational frequency indicator shall be within ± 2,5 % of the reading.

6 Rotational frequency range and measured value

6.1 Nominal rotational frequencies

The weighted acceleration sums ($\overline{a}_{h,w}$) at the left and right handles shall be measured at the following rotational frequencies:

a) idling rotational frequency as recommended by the manufacturer (idling);

b) rotational frequency at maximum engine power in accordance with ISO 8893 (full load);

c) racing = 133 % of the rotational frequency at maximum engine power or maximum rotational frequency, whichever is the less.

6.2 Measuring interval

Each measured value when using the wide band weighting network from figure 1 shall be taken as the RMS-value over 2 s (equal to 1 s RC-detector time constant or time weighting characteristic S "slow" according to IEC 651). The rotational frequency shall be kept within ± 3,5 s^{-1} of the nominal rotational frequency during the registration.

6.3 Reported weighted acceleration sum ($\overline{a}_{h,w}$)

Each reported value of the $\overline{a}_{h,w}$ shall be the RMS-value of at least five values measured according to 6.2.

7 Measuring object

Measurements shall be carried out on a normal production saw. The engine shall have been run in and warmed up before the test is commenced, carburettor and ignition set according to the instructions of the manufacturer. The fuel tank shall be at least half-full. The cutting equipment shall be new and shall be sharpened for best cutting performance in accordance with the manufacturer's recommendations.

8 Hand-held method

8.1 Conditions

8.1.1 Measuring conditions

The measurements shall be carried out under the conditions described above.

8.1.2 Wood specifications

For cutting tests, sound green, well-grown, freshly felled softwood or the equivalent should be used. It shall be firmly attached to the ground and arranged as a continuous plank so that a stable cutting speed is possible. The thickness of the plank shall be approximately 2/3 of the difference in radius between saw-blade and washer. The width of the plank in the cutting direction shall be such that a stable cutting speed is possible.

8.2 Operations

8.2.1 General conditions

The brush-saw shall be operated upright in accordance with figure 3. The saw shall be connected to the harness and held with both hands in a manner consistent with day-long use of the saw.

8.2.2 Operation sequence

The operation sequence shall be:

— idling,

— cutting (full load)[1],

— racing,

at the rotational frequencies defined in 6.1.

This sequence shall be repeated five times.

8.2.3 Operating conditions

8.2.3.1 Idling

At idling, the saw shall be held with both hands in a position normally used at working. The cutting equipment shall not move.

8.2.3.2 Cutting (full load)

Full load shall be obtained with the throttle fully open.

The saw shall cut wood and the engine rotational frequency shall be controlled by the cutting force.

1) If this International Standard is applied for brush-saws with cutting equipment other than circular saw-blades, the full load test should be deleted.

Dimensions in millimetres

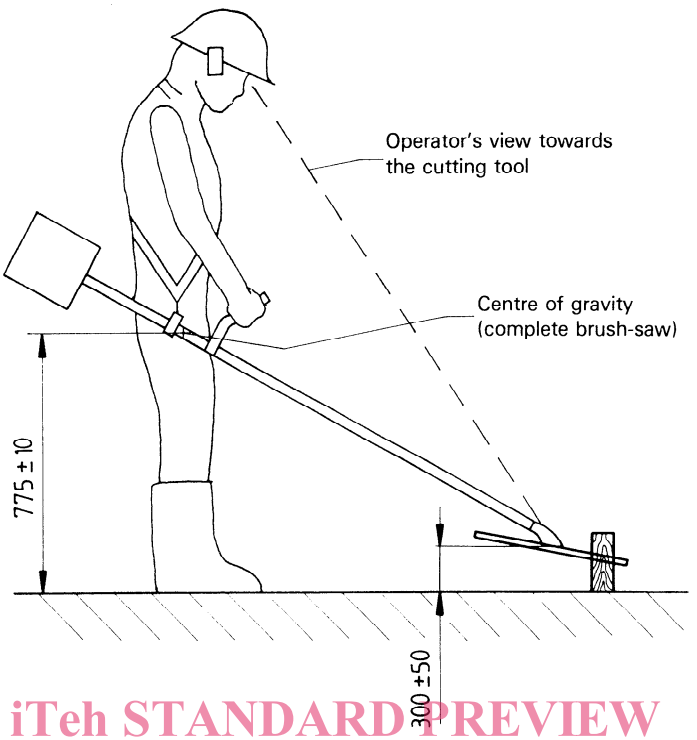

Figure 3 — Brush-saw position for cutting test

The plank shall be cut across the grain.

The distance between the centre of the cutting blade and the ground shall be 300 mm ± 50 mm (see figure 3).

8.2.3.3 Racing

At racing the saw shall be held with both hands in a position normally used in working. The rotational frequency shall be controlled by operating the throttle, if the maximum possible rotational frequency exceeds 133 % of the maximum power rotational frequency.

9 Test report

The test report shall include the following information:

a) reference to this International Standard;

b) date and place of measurement;

c) observer and operator;

d) description of the saw;

1) manufacturer;

2) model (type);

3) serial No.;

4) cutting equipment (type and dimensions);

5) type of handle coating;

e) measuring equipment;

f) description of the accelerometer mounting;

g) procedure to obtain $\overline{a}_{h,w}$;

h) initiator of test;

i) reference to the test method (hand-held or test rig);

j) table with test data according to table 1.

Table 1 — Presentation of test data

Operation condition	Rotational frequency	Weighted acceleration, $\overline{a}_{h,w}$ m/s^2										
		Left handle						Right handle					
		Test					$\overline{a}_{h,w}$	Test					$\overline{a}_{h,w}$
		1	2	3	4	5		1	2	3	4	5	
Idling Full load Racing													

Annex A
(normative)

Frequency range and weighting filter

The frequency weighting filter used when forming the $\overline{a}_{h,\,w}$ (see 3.1) is defined in table A.1. The filter characteristics are shown in figure A.1. (The weighting filter includes the band-pass filtration shown in figure 1.)

Table A.1 — Frequency weighting filter for hand-arm

Frequency, f Hz	Nominal value dB	Tolerances dB	
f < 3,15	Slope of − 12 dB/oct	+ 3	− ∞
3,15	− 12	+ 3	− ∞
5	− 4	+ 3	− 4
6,3	0	+ 1	− 4
8	0	± 1	
10	0	± 1	
12,5	0	± 1	
16	0	± 1	
20	− 2	± 1	
20 < f < 800	Slope of − 6 dB/oct	± 1	
800	− 34	± 1	
1 000	− 36	+ 1	− 3
1 250	− 38	+ 1	− 5
1 600	− 45	+ 2	− ∞
f > 1 600	Slope of − 12 dB/oct	+ 2	− ∞

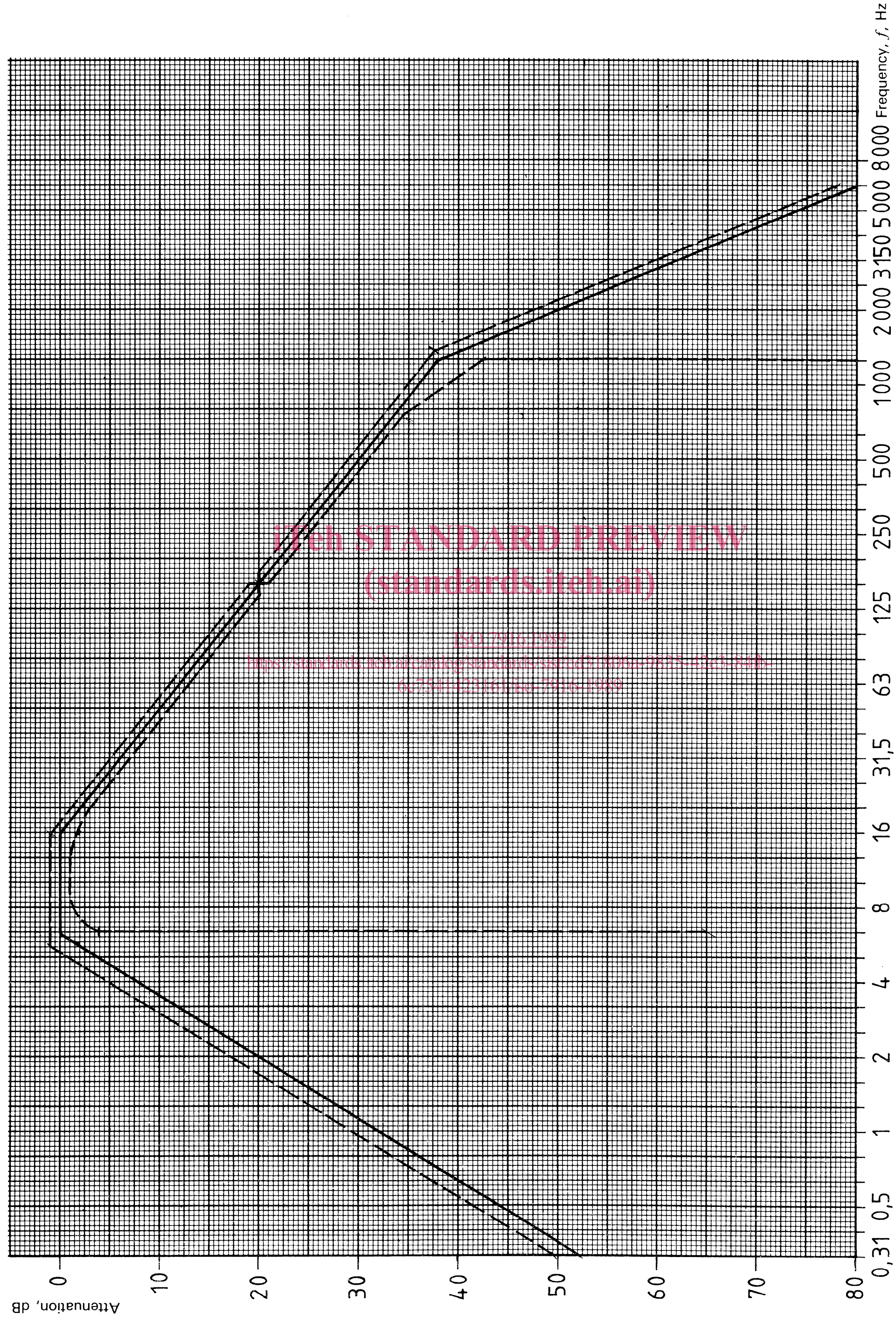

Figure A.1 — Frequency weighting filter for hand-arm

Annex B
(informative)

Bibliography

[1] ISO 7112 : 1982, *Machinery for forestry — Portable brush saws — Vocabulary.*

[2] ISO 5348 : 1987, *Mechanical vibration and shock — Mechanical mounting of accelerometers.*

[3] ISO 5347 : —[1] (all parts), *Methods of calibration of vibration and shock pick-ups.*

1) To be published.