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**Garden equipment — Safety
requirements for combustion-engine-
powered lawnmowers —**

Part 1:
Terminology and common tests

**AMENDMENT 1: Annex G (Vibration test
code — Hand-arm vibration and whole-
body vibration)**

*Matériel de jardinage — Exigences de sécurité pour les tondeuses à
gazon à moteur à combustion interne —*

Partie 1: Terminologie et essais communs

*AMENDEMENT 1: Annexe G (Code d'essai de vibration — Vibrations
main-bras et vibrations transmises à l'ensemble du corps)*



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This document was prepared by Technical Committee ISO/TC 23 *Tractors and machinery for agriculture and forestry*, Subcommittee SC 13 *Powered lawn and garden equipment*.

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Garden equipment — Safety requirements for combustion-engine-powered lawnmowers —

Part 1: Terminology and common tests

AMENDMENT 1: Annex G (Vibration test code — Hand-arm vibration and whole-body vibration)

Normative references

Add the following references.

ISO 5349-1, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements*

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

Annex G

Replace Annex G with the following. Note that G.1 has not been revised, but has been kept here for context.

G.1 General

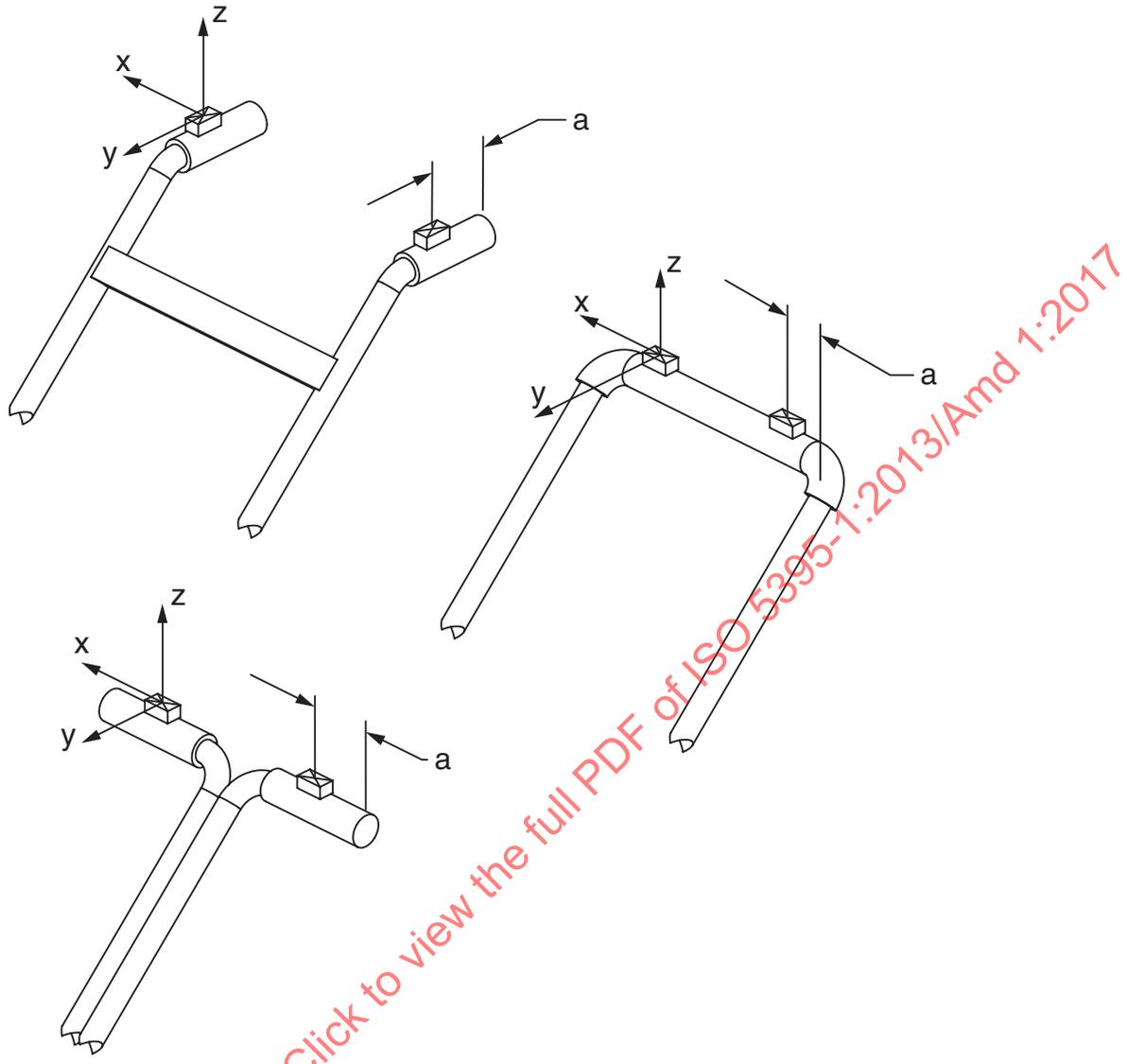
This annex specifies a vibration test code for determining, efficiently and under specified conditions, the magnitude of vibration at the handles of pedestrian-controlled lawnmowers, including sulkies, steering controls of ride-on lawnmowers and whole-body vibrations for operators on sulkies and ride-on lawnmowers.

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.

G.2 Characterization of hand-arm vibration – Pedestrian-controlled lawnmowers

G.2.1 Direction of measurement

Translational vibration transmitted to the hand is related to the x, y, or z directions shown in [Figure G.1](#).



Key
 a 100 mm

Figure G.1 — Examples of transducer location/orientation (pedestrian-controlled machines)

If the handle design is not covered by one of the examples, the transducer for the hand-arm vibrations shall be located at the normal operating hand position between the thumb and index finger. This position shall be described in the test report.

G.2.2 Location of measurement

The machine shall be held with both hands. Measurements shall be carried out with the transducer as close as possible to a point on the grip surface between the thumb and the index finger (see examples in [Figure G.1](#)).

G.2.3 Magnitude of vibration

The magnitude of vibration shall be the frequency-weighted acceleration a_{hw} in m/s^2 , expressed as a root-mean-square (RMS) value. The frequency weighting shall be according to ISO 5349-1.

The duration time T shall be not less than 8 s for each measurement.

G.2.4 Combination of vibration directions

See ISO 20643:2005/Amd 1:2012, 6.4.

The vibration total value a_{hv} is determined from:

$$a_{hv} = \sqrt{a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2}$$

where a_{hwx} , a_{hwy} , a_{hwz} are the RMS values of the frequency-weighted acceleration in the x-direction, y-direction, and z-direction, respectively.

G.3 Characterization of hand-arm and whole -body vibration – Ride-on lawnmowers

G.3.1 Direction of measurement

G.3.1.1 Translational hand-transmitted vibration from a steering wheel is related to the steering wheel as follows:

- x-direction: the radial direction;
- y-direction: the direction tangential to the rim of the steering wheel;
- z-direction: the direction orthogonal to both the x-direction and the y-direction.

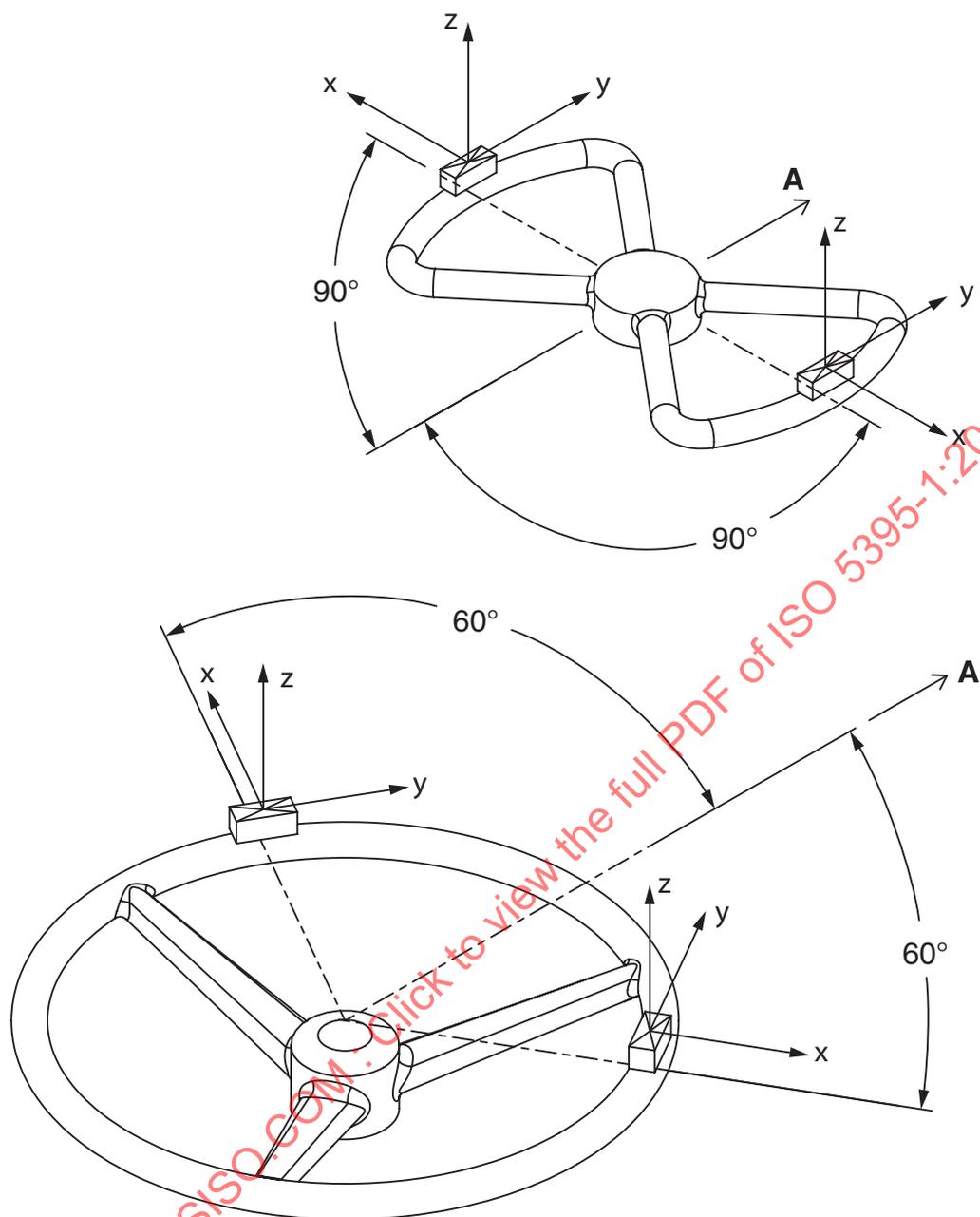
Those directions are illustrated in [Figure G.2](#).

For some machines, a steering control (e.g. levers) is used instead of a steering wheel. In such cases, the directions shall be documented in the test report.

G.3.1.2 Translational whole-body-transmitted vibration to the human body is related to the appropriate directions of an orthogonal coordinate system (see [Figure G.3](#)).

The terminology commonly used in biodynamics relates the coordinate systems to the human skeleton in a normal anatomical position. The directions are as follows:

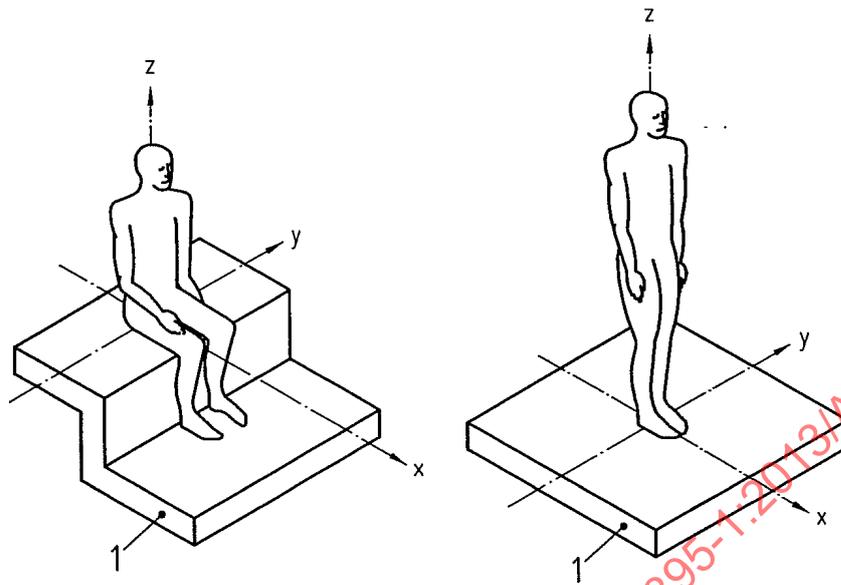
- x-direction: back to chest;
- y-direction: right side to left side;
- z-direction: foot (or buttocks) to head.



Key

A machine front

Figure G.2 — Examples of transducer location/orientation for hand-arm vibration (ride-on machine)

**Key**

1 supporting surface

Figure G.3 — Directions of the basicentric coordinate system for mechanical whole-body vibration influencing human beings

G.3.2 Location of measurement

The specific requirements shall be according to EN 1032:2003+A1:2008, 6.2.

G.3.3 Magnitude of vibration

The specific requirements shall be according to EN 1032:2003+A1:2008, 6.3.

Measurement time shall be according to G.5.3.

G.3.4 Multi-axial vibration measurements

The specific requirements shall be according to EN 1032:2003+A1:2008, 6.4.

G.4 Instrumentation**G.4.1 General**

The vibration measurement system shall be in accordance with ISO 8041.

Instrumentation for measuring the parameters (e.g. for controlling the working conditions), whose characteristics are not covered by ISO 8041, shall be documented in the vibration test report. The justification for use of such instrumentation shall be given, together with a detailed specification of the instrumentation.

Tachometers shall have an accuracy of $\pm 2,5\%$.

Calibration shall be in accordance with ISO 16063 for the hand-arm and for whole-body vibration.

G.4.2 Instrumentation for measurement of hand-arm vibration of pedestrian-controlled lawnmowers

Vibration measurement systems shall be in accordance with ISO 8041.

G.4.3 Instrumentation for measurement of hand-arm and whole-body vibration of ride-on lawnmowers

For specification of other instrumentation, see EN 1032:2003+A1:2008, Clause 7.

G.5 Determination of working procedure, testing and measurement

G.5.1 Preparation and testing of the machinery

G.5.1.1 General

Measurements shall be carried out on a new normal production machine featuring standard equipment provided by the manufacturer with the machine. The machine shall be maintained and serviced in accordance with the manufacturer's instructions.

The lawnmower shall be tested for all cutting means supplied with the lawnmower and all attachments supplied by the lawnmower manufacturer giving the highest vibration value. The configurations of the lawnmower tested shall be recorded.

Knives of cylinder lawnmowers shall be lubricated. For cylinder lawnmowers, the rotating cutting cylinder(s) and/or the stationary cutting edge(s) shall be adjusted such that either:

- a sheet Kraft paper, of nominal 80 g/m² construction, is cut at least along 50 % of the maximum width of cut of the cutting means, or
- the gap between moving and stationary cutting means at standstill does not exceed 0,15 mm over the whole width of cut when checked with calibrated strip gauges.

Before the test is commenced, run the engine for a minimum of 10 min with the cutting means engaged. For cylinder lawnmowers, care shall be taken to avoid overheating the cutting means by operating continually (without cutting grass) and therefore appropriate interruptions for cooling and lubrication can be introduced. The fuel tank shall contain sufficient fuel to enable the engine to run normally during all tests.

The measurements shall be carried out with an operator who shall be 1,75 m ± 0,05 m tall.

A test series shall consist of fifteen vibration measurements at each transducer position.

Measurement for the three directions shall be made simultaneously.

Tests shall be made in conditions likely to be found on most days during intended use of the machine. Unlikely extreme conditions (e.g. heat, cold, rain, mud) for the type of machine shall be avoided. The measurements shall be made within the temperature range 5 °C to 35 °C. The conditions prevailing at the time of test shall be recorded.

NOTE For testing of machines equipped with large pneumatic tyres, the temperature range may need to be more restricted.

G.5.1.2 Additional preparation and testing for whole-body vibration

Measurements for determination of the vibration values shall be repeated fifteen times for the selected operating mode. The test series shall be carried out on a test track with a flat horizontal level hard surface with a length of at least 20 m, with each type of equipment for which results of measurements are required (e.g. set of tyres, type of cabin and seat).

Before starting the measurements, sufficient time (at least 10 min) for warming-up the machine, including the tyres, and reaching normal operating conditions shall be allowed, during which the machine is travelling and the seat suspension (if fitted) is operating.

G.5.2 Hand-arm vibration measurement

G.5.2.1 General

Measurements for determination of the vibration values shall be repeated fifteen times for the selected operating mode. The test series shall be carried out with each type of equipment for which results of measurements are required (e.g. possible cutting cylinder variants).

Testing shall be carried out with the machine stationary and at the maximum operating engine speed with the cutting means engaged. The maximum operating engine speed shall be checked before testing (see 3.19). Any sealed adjustments shall not be moved when checking the maximum operating engine speed. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions. Measurements for sulkies and ride-on machines shall be carried out on a flat horizontal level hard surface (e.g. concrete, asphalt). Measurements for pedestrian-controlled lawnmowers shall be carried out on a surface in accordance with E.6.

The hands of the operator shall be in the designated gripping area, close to the transducer positioned as indicated in [Figures G.1](#) and [G.2](#). The operator shall be in the normal operating position. Tyre pressures shall be in accordance with the manufacturers' specifications. When the machine is designed to be operated with a grass catcher, the measurement shall be carried out with this configuration. The grass catcher shall be empty. The machine shall be tested with the cutting-means assembly, listed in the instruction handbook, giving the highest vibration values. Cutting means and knives of cylinder lawnmowers shall be adjusted as specified in F.6.

G.5.2.2 Pedestrian-controlled machines

The measurements shall be carried out with an operator who shall be 1,75 m ± 0,05 m tall.

Adjustable handles of pedestrian-controlled machines shall be set to suit the operator. The cutting height shall be set to 30 mm or the next higher cutting position when set on a flat horizontal level hard surface. Machines with a maximum cutting height setting of 30 mm or less shall be set at their maximum height setting.

G.5.2.3 Sulkies and ride-on machines

The operator shall have a mass of 90 kg ± 5 kg.

If the operator position on the ride-on machine or sulky and the steering devices is adjustable, it shall be set to suit the operator. The cutting height shall be set to 30 mm or the next higher cutting position when set on a flat horizontal level hard surface. Machines with a maximum cutting height setting of 30 mm or less shall be set at their maximum height setting.

G.5.3 Whole-body vibration measurement

Whole-body vibration measurement shall be carried out with the machine travelling in a straight line on the test track at a speed closest to 6 km/h. The height of cut shall be set at the lowest position and the cutting means engaged. Each reading shall be obtained from a signal time suitable for the test equipment being used. Duration of each measurement shall not be less than 8 s. If an equivalent level of accuracy can be achieved using a shorter duration than 8 s, this shall be justified when used.

G.6 Determination of the measurement result

G.6.1 Hand-arm vibrations

The reported RMS value for hand-transmitted vibration is the arithmetic mean of the fifteen vibration total values, measured on the steering wheel/controls. If values have been obtained for different hand positions, the greatest value shall be the basis for the declaration.