
Earth-moving machinery — Safety —
Part 13:
Requirements for rollers

Engins de terrassement — Sécurité —

Partie 13: Exigences applicables aux compacteurs

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html

This document was prepared by Technical Committee ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 2, *Safety, ergonomics and general requirements*.

This second edition cancels and replaces the first edition (ISO 20474-13:2008), which has been technically revised with the following changes:

- references to national and regional provisions in the withdrawn ISO/TS 20474-14 have been deleted;
- safety requirements and protective measures have been updated.

It is intended to be used in conjunction with ISO 20474-1.

A list of all parts in the ISO 20474 series, published under the general title, *Earth-moving machinery — Safety*, can be found on the ISO website.

Introduction

This document is a type-C standard as stated in ISO 12100.

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.

ISO 20474 provides acceptable safety requirements for earth-moving machinery. This standard does not necessarily provide requirements to meet all national and regional regulatory provisions, e.g. Japan does not allow object handling with earth-moving machinery.

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Earth-moving machinery — Safety —

Part 13: Requirements for rollers

1 Scope

This document gives the safety requirements specific to rollers as defined in ISO 6165. It is intended to be used in conjunction with ISO 20474-1, which specifies general safety requirements common to two or more earth-moving machine families. The specific requirements given in this document take precedence over the general requirements of ISO 20474-1.

This document deals with all significant hazards, hazardous situations and events relevant to the earth-moving machinery within its scope (see ISO 20474-1:2017, Annex A) when used as intended or under conditions of misuse reasonably foreseeable by the manufacturer. It specifies the appropriate technical measures for eliminating or reducing risks arising from relevant hazards, hazardous situations or events during commissioning, operation and maintenance.

This document is not applicable to machines manufactured before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3450, *Earth-moving machinery — Wheeled or high-speed rubber-tracked machines — Performance requirements and test procedures for brake systems*

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 6165, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 8811, *Earth-moving machinery — Rollers and compactors — Terminology and commercial specifications*

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*

ISO 13850, *Safety of machinery — Emergency stop function — Principles for design*

ISO 17063, *Earth-moving machinery — Braking systems of pedestrian-controlled machines — Performance requirements and test procedures*

ISO 20474-1:2017, *Earth-moving machinery — Safety — Part 1: General requirements*

ISO 20643, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 20474-1, ISO 8811, and the following, apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 roller

self-propelled or towed machine having a compaction device, consisting of one or more metallic cylindrical bodies (drums) or rubber tyres, which compacts material such as crushed rock, earth, asphalt or gravel through a rolling or vibrating action of the compaction device

Note 1 to entry: The metallic cylindrical bodies can be rubber-coated or fitted with pads.

[SOURCE: ISO 6165:2012, 4.10, modified — By adding Note 1.]

3.1.1 single-drum roller

self-propelled compaction machine with one vibrating metallic cylindrical body (drum) and two rubber tyres or two tracks

3.1.2 tandem roller

self-propelled compaction machine with one metallic cylindrical body (drum) in the front and one in the rear

Note 1 to entry: The cylindrical drums can be static or vibrating and can be split.

3.1.3 combined roller

self-propelled compaction machine with one or more metallic cylindrical body (drum) and more than two rubber tyres

3.1.4 three-wheel roller

self-propelled compaction machine with one metallic cylindrical body (drum) in the front (or rear) and two in the rear (or front)

Note 1 to entry: The drums can be split.

3.1.5 pneumatic tyre roller

self-propelled compaction machine with three or more tyres in the front and the rear

3.2 direct-control machine

self-propelled earth-moving machinery where the machine is controlled by an operator in physical contact with the machine

[SOURCE: ISO 6165:2012, 3.2]

3.2.1 ride-on machine

self-propelled *direct-control machine* (3.2) where the control devices are located on the machine and the machine is controlled by a seated or standing operator

[SOURCE: ISO 6165:2012, 3.2.1]

3.2.2**non-riding machine**

self-propelled *direct-control machine* (3.2) where the control devices are located on the machine and the machine is controlled by a pedestrian operator (neither seated nor standing on the machine)

[SOURCE: ISO 6165:2012, 3.2.2]

3.3**remote-control machine**

self-propelled earth-moving machinery where the machine is controlled by the transmission of signals from a control box (transmitter) that is not located on the machine to a receiving unit (receiver) located on the machine

[SOURCE: ISO 6165:2012, 3.3, modified — Note 1 to entry regarding wire and wireless remote control has not been included.]

3.4**towed roller**

roller (3.1) that is not self-propelled but which is propelled instead by a towing machine on which the operator station is located

[SOURCE: ISO 6165:2012, 4.10.1]

4 Safety requirements and protective measures**4.1 General**

Rollers shall comply with the safety requirements and protective measures of ISO 20474-1, in as far as those are not modified by the specific requirements of this clause.

4.2 Non-riding machines**4.2.1 General**

ISO 20474-1:2017, 4.1, shall apply — as applicable — with the additions in 4.2.2 and 4.2.3 below.

4.2.2 Handle bar

To prevent dangerous vertical swinging of the steering element (handle bar) of the single-drum non-riding roller, movement of the handle shall be not less than 0, 2 m and not more than 1, 4 m above the ground (see Figure 1).

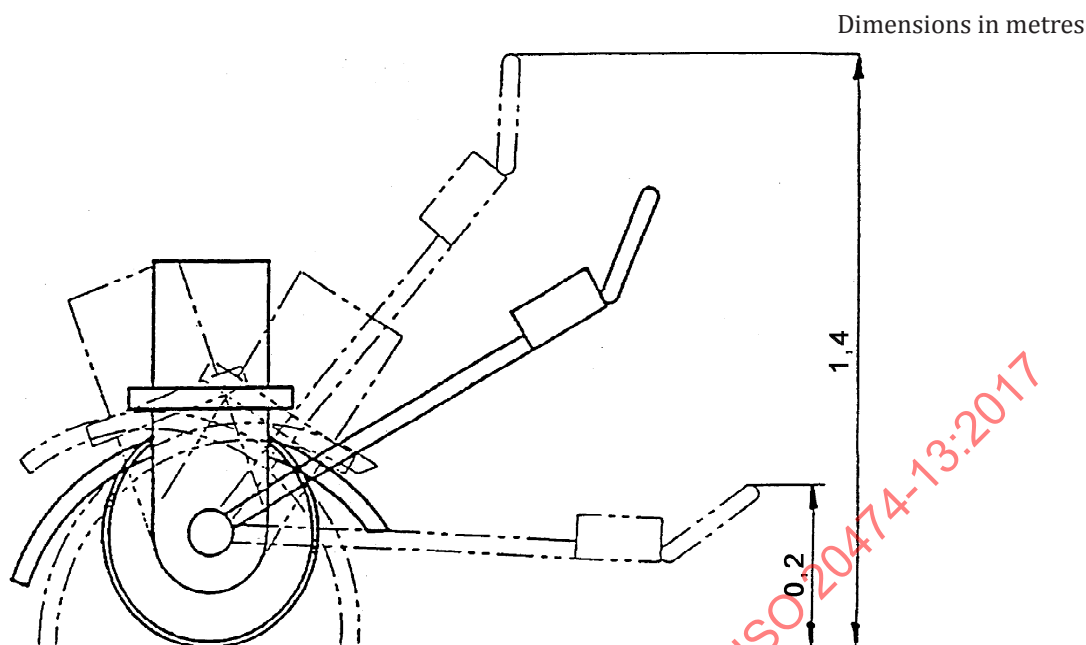


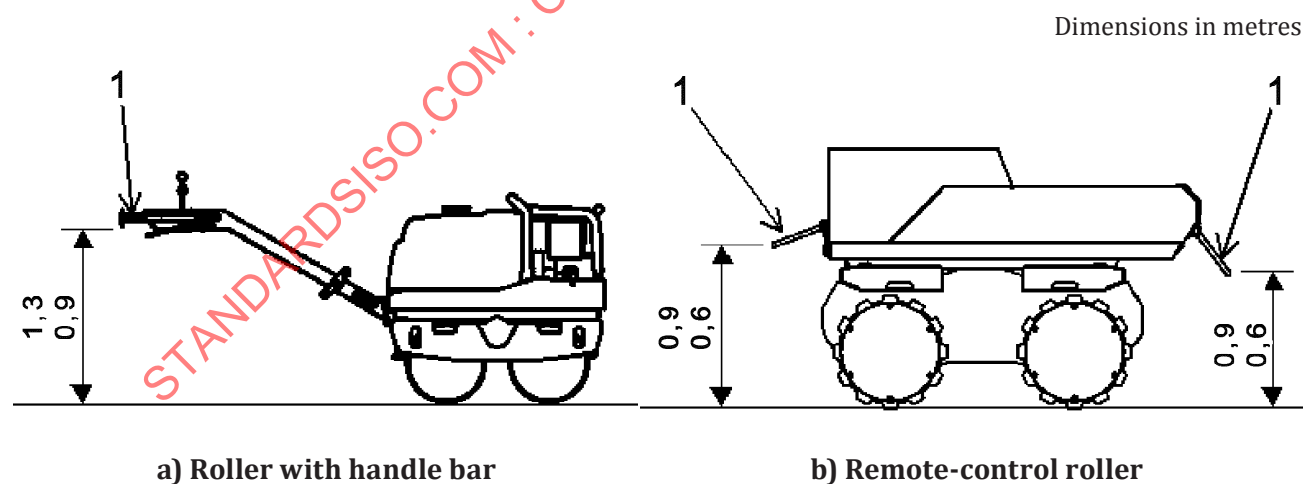
Figure 1 — Vertical swinging of single-drum non-riding roller

4.2.3 Protection against crushing

Non-riding and remote-control machines shall be provided with protection against crushing that is designed to prevent the operator from being trapped between the machine and an obstacle. See [Figure 2](#).

This device shall be so designed as to stop the machine within a distance that is less than the total operating range of the device.

The stopping device shall have an effective operating force not exceeding 230 N.



Key

1 stopping device

Figure 2 — Position of crushing protection (stopping device) on non-riding and remote-control machines

4.3 Operator station (ride-on machines)

4.3.1 General

ISO 20474-1:2017, 4.3.1, shall apply, together with the additions and modification given in [4.3.2](#) to [4.3.4](#) below.

4.3.2 Operator's position

If the operator's position is offset from the space envelope width centreline, then the internal distance from the seat centreline to the side of the enclosure shall not be less than 295 mm.

4.3.3 Operator's station with cab

The first two paragraphs of ISO 20474-1:2017, 4.3.1.1, and the whole of ISO 20474-1:2017, 4.3.1.2, do not apply to rollers.

Rollers with an operating mass > 4 500 kg shall be so designed that an operator's cab can be fitted.

4.3.4 Doors and windows

Doors and windows latched in open positions shall not extend beyond the main outer dimensions of the machine, when the machine is in operation as intended.

4.4 Operator's seat

ISO 20474-1:2017, 4.4, shall apply, except for ISO 20474-1:2017, 4.4.1.4.

4.5 Controls and indicators

4.5.1 General

ISO 20474-1:2017, 4.5, shall apply, together with the additions given in [4.5.2](#) to [4.5.4](#) below.

4.5.2 Travel control of non-riding rollers with handle bar

The machine travel control of non-riding rollers with an attended operator shall be of the hold-to-run type for both directions.

4.5.3 Controls for towed machines

For towed rollers, it shall be possible to control the on-off operation of the vibration from the operator station on the towing machine.

4.5.4 Brake systems

4.5.4.1 Ride-on machines

For ride-on rollers, ISO 20474-1:2017, 4.7, shall apply, with the following additions.

The brake system shall be in accordance with ISO 3450.

For service and secondary brake systems:

- the brake system shall apply to all power-driven drums and wheels;
- in case of split drums, every drum part shall have the same brake torque;

- the brake systems of single drum rollers and combined rollers shall apply to all wheels and to the drum.

Consideration should be given for the performance of the brake system to the intended slopes as foreseen by the manufacturer.

All brake systems shall be controlled from the operator station.

4.5.4.2 Non-riding machines

The brake systems of non-riding rollers shall be in accordance with ISO 17063.

4.5.5 Emergency stop

An emergency stop in accordance with ISO 13850 shall be fitted within the zone of comfort as specified in ISO 6682. It shall stop all hazardous functions of the machine.

4.6 Access system to operator station and to maintenance points

4.6.1 General

ISO 20474-1:2017, 4.2, shall apply, together with [4.6.2](#) below.

4.6.2 Guard rail

Walkways to the operator station and to platforms shall be provided with guard-rails if the vertical drop exceeds 1 m.

4.7 Noise

ISO 20474-1:2017, 5.1.3, shall apply, with the following addition.

The noise emission of non-riding and remote-controlled rollers with a working width ≤ 1 m shall be determined according to [Annex A](#).

4.8 Vibration

The hand-arm vibration of non-riding rollers with a working width ≤ 1 m shall be determined according to [Annex B](#).

5 Information for use

5.1 Warning signals and devices

ISO 20474-1:2017, 6.1, shall apply.

5.2 Operator's manual

ISO 20474-1, 6.2, shall apply with the following additions:

- a reference to hand-arm vibration as per [4.7](#) and [Annex B](#);
- instruction in the need for a stopping device for non-riding and remote controlled rollers;
- safety precautions for starting and stopping non-riding rollers;
- instructions for proper use, including cleaning and maintenance of the water sprinkler system;

- additional information concerning the stability of the machine (permissible slope, etc.).

5.3 Marking

ISO 20474-1:2017, 6.3, shall apply.

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Annex A (normative)

Noise-test code for non-riding and remote-control vibratory rollers with working width ≤ 1 m

A.1 General

This noise-test code specifies all the information necessary for carrying out efficiently and under standardized conditions the determination, declaration and verification of the noise-emission characteristics of non-riding and remote-control vibratory rollers with a working width ≤ 1 m.

NOTE The test track width given here and as described in the Noise Directive 2000/14/EC does not practically allow measurement of machines with a working width exceeding 1 m, due to random effects from the test track boundary.

Noise-emission characteristics include emission sound-pressure levels at workstations and the sound-power level. The determination of these quantities is necessary for

- manufacturers' declarations of the noise emitted,
- comparing the noise emitted by machines in the machine family concerned, and
- for noise control at the source at the design stage.

The use of this noise-test code ensures 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. The noise-measurement methods which may be used are engineering methods in accordance with ISO 3744:2010, Grade 2.

Test conditions and procedures for the determination of noise emission (according to this annex) and hand-arm vibration (according to [Annex B](#)) are identical. It is therefore possible and recommended to record the noise emission and the hand-arm vibration simultaneously during one measurement. The measuring effort is thereby reduced.

A.2 Test area

A.2.1 Design of test site

The test may be carried out outdoors or in an appropriate room.

Sound-reflecting material (e.g. concrete, closed-pore asphalt or steel plates) of at least 10 m $\times$ 10 m and a zone of at least 25 m $\times$ 25 m with no reflecting obstacles are required around the test track.

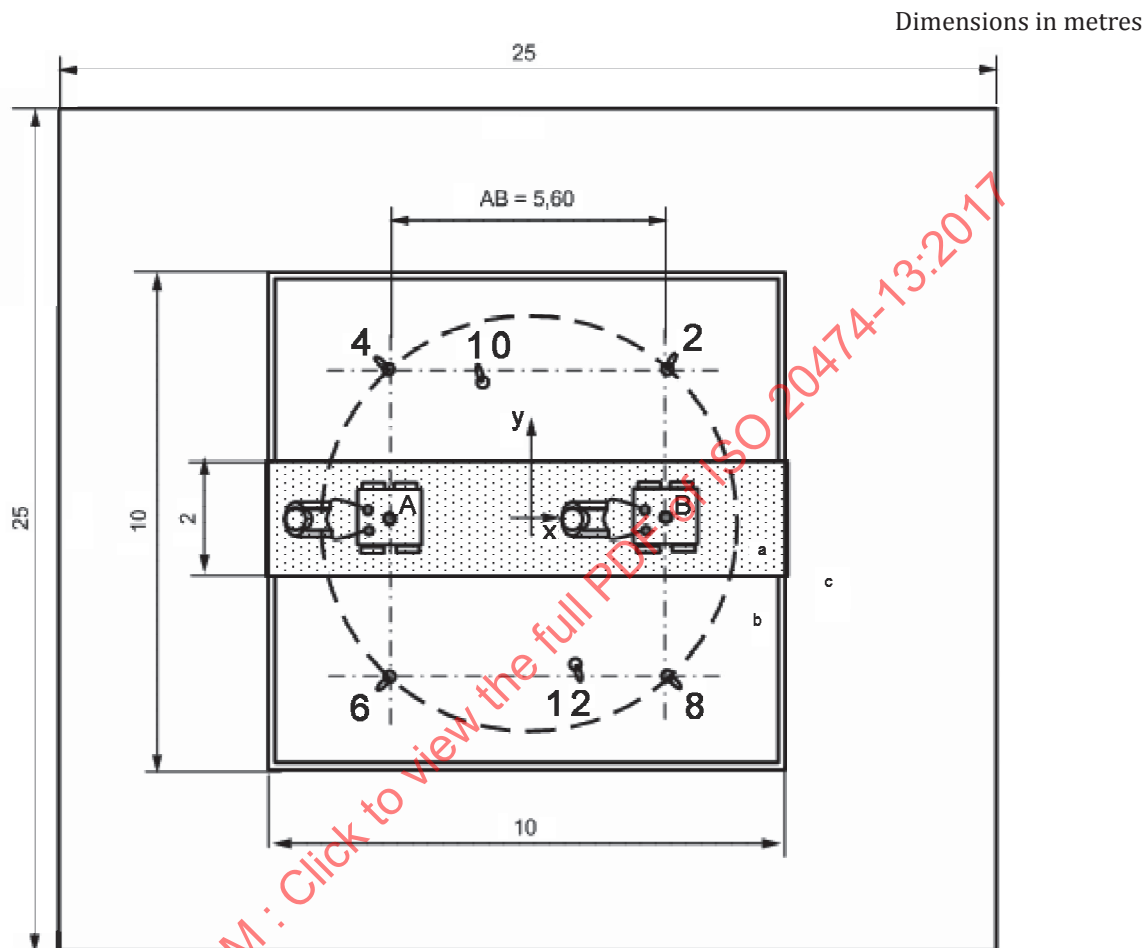
A.2.2 Design of test track

The test course of gravel shall be designed as shown in [Figure A.1](#).

The compression ground shall have the following characteristics:

- dry gravel with sufficient hardness of a mean gravel diameter of 16 mm (particle size 10 mm to 22 mm), with a grading curve as shown in [Figure A.2](#);
- the gravel shall be replaced if the mean gravel diameter decreases by 30 % or more;

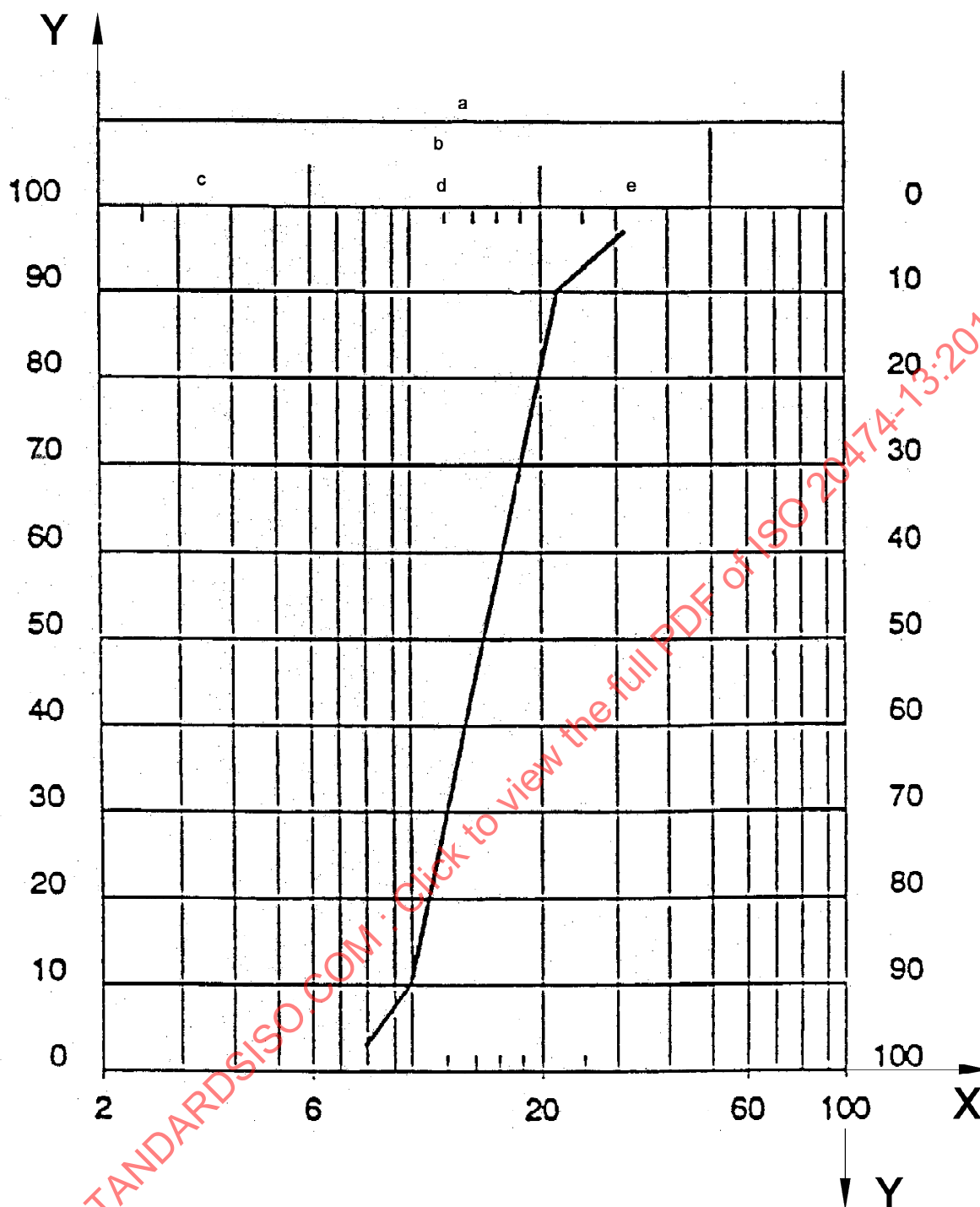
- the dumping height of the gravel shall be at least 0,50 m due to the depth effect of the compacting machines;
- the test course of gravel shall have the same horizontal level as the sound-reflecting surface being rammed in order to prevent the gravel from creeping.



Key

- AB measuring length
 A start
 B end
 2, 4, 6, 8, 10, 12 microphone positions for sound-power level determination
 a Gravel test course (depth = 0,50 m).
 b Hard reflecting plane 10 m × 10 m.
 c Plane without reflecting obstacles 25 m × 25 m.

Figure A.1 — Test site and arrangement with test track



Key

- X percentage of mass of the total volume
- Y grain size
- a Screening gravel.
- b Gravel size.
- c Fine grain.
- d Middle grain.
- e Coarse grain.

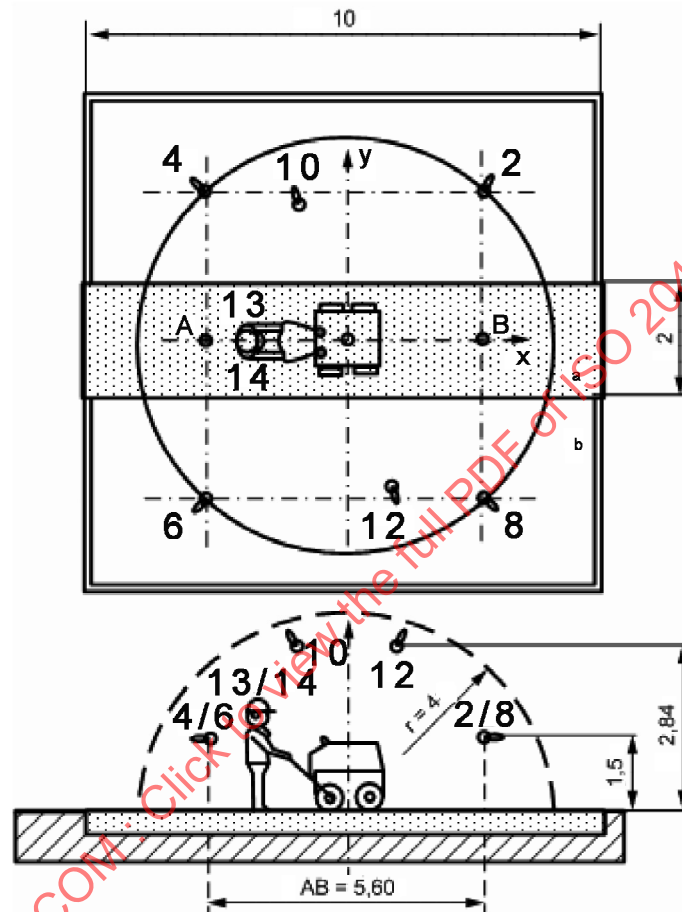
Figure A.2 — Grading size diagram of the material to be compacted (gravel)

A.2.3 Measurement surface

A.2.3.1 Shape and size of measurement surface

The measurement surface used for determining the A-weighted sound-power level shall be a hemisphere of radius $r = 4$ m, bounded by the sound-reflecting surface (see [Figures A.3](#) and [A.4](#)).

Dimensions in metres



Key

AB measuring length ($AB = 5,60$ m)

A start

B end

2, 4, 6, 8, 10, 12 microphone positions for sound-power level determination (see [Table A.1](#))

13, 14 microphone positions for emission sound-pressure level determination

a Gravel test course (depth = 0,50 m).

b Hard reflecting plane 10 m × 10 m.

Measuring travel time, t_F , calculated by

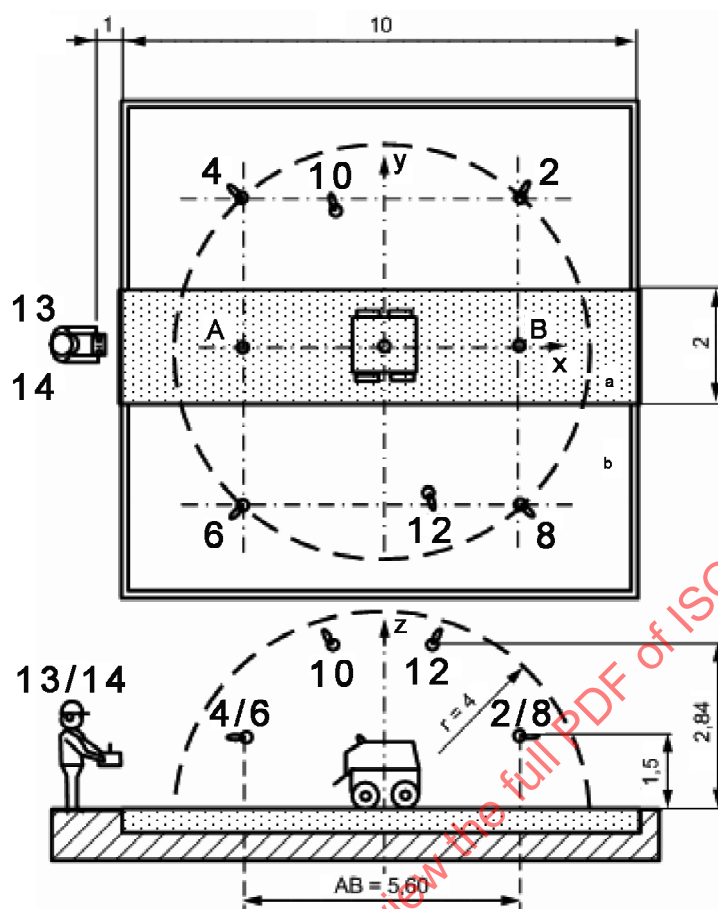
$$t_F = \frac{AB}{v_F}$$

where

v_F is the working speed in m/s;

t_F = measuring time, t_M .

Figure A.3 — Arrangement of test positions for direct control non-riding rollers

**Key**AB measuring length ($AB = 5,60$ m)

A start

B end

2, 4, 6, 8, 10, 12 microphone positions for sound-power level determination (see [Table A.1](#))

13, 14 microphone positions for emission sound-pressure level determination

a Gravel test course (depth = 0,50 m).

b Hard reflecting plane 10 m × 10 m.

Figure A.4 — Arrangement of test positions for remote-controlled rollers**A.2.3.2 Microphone positions**Six microphone positions are specified on the hemisphere (see [Figures A.3](#), [A.4](#) and [Table A.1](#)).

Table A.1 — Coordinates of microphones

Measuring point	Coordinates m		
	<i>x</i>	<i>y</i>	<i>z</i>
2	2,8	2,8	1,5
4	-2,8	2,8	1,5
6	-2,8	-2,8	1,5
8	2,8	-2,8	1,5
10	-1,08	2,6	2,84
12	1,08	-2,6	2,84

A.3 Determination of A-weighted sound-power level

A.3.1 General

This clause specifies additional requirements for the determination of the A-weighted sound-power level according to ISO 3744.

A.3.2 Test procedure

A.3.2.1 Operating conditions

For the measurements, the machine shall be in accordance with the manufacturer's specifications.

Water and fuel tanks shall be half-filled. The sprinkler facility shall not be switched on.

The drawbar of hand-guided machines shall be freely movable between the upper and lower stops.

The engine shall be at the rated speed ($\pm 5\%$) as specified by the manufacturer.

The maximum forward working speed shall be selected. Ensure that the machine runs at the correct speed. The vibration setting that gives the highest noise contribution shall be selected.

Before starting the measurement, the operating temperature shall be reached.

A.3.2.2 Test track preparation and conditions

The compacted material of the test surface shall be loosened before starting the whole test procedure.

Test track material shall be dry. If it is wet or frozen this could influence the measurement result.

Machines with smooth drums could have difficulties running the first pass on the loosened track with vibrations. If that is the case, pre-compact the material by running over the track without vibrations.

The test track for remote-controlled rollers shall be identical to that of non-riding rollers (see [Figure A.1](#)).

A.3.2.3 Environment

Air temperature should be above 10 °C.

A.3.2.4 Measurement procedure

Simultaneous measurement at all microphone positions is preferred (it is also possible to perform consecutive measurements).

For the measurement duration, t_M , the surface of the test track $AB = 5,60$ m is compacted by the machine in forward operation. Subsequently, the machine is moved back to the starting point.

Start the measurement when the middle of the machine is in line with point A and stops at point B of the measuring stretch (see [Figures A.3](#) and [A.4](#)). In all cases, the compaction shall go on along the whole stretch of gravel. Therefore, it shall be ensured that the machine works with the full compaction power within the measuring distance.

For each machine, three passes over the test track shall be carried out. The completion of the three passes is considered as a measuring cycle.

The compacted material of the test surface shall not be loosened between the three passes.

The r.m.s. values of the sound-pressure levels shall be taken for each pass.

The machine shall be moved along the centreline of the test course as in usual operation.

The same person shall operate the machine during the whole test. That person shall be skilled in handling and operating the machine.

A.3.3 Calculation of the sound-power level

The A-weighted sound-power level is calculated as the arithmetic mean value of the three passes.

The A-weighted sound-power level of the machine shall be rounded down or up to the nearest integral value in decibels ($<0,5$ round down, $\geq 0,5$ round up).

A.3.4 Determination of emission sound-pressure spectra

If required, sound-pressure spectra may be registered at microphone position 10 in accordance with ISO 3744.

A.4 Determination of A-weighted emission sound-pressure level at operator's position

A.4.1 General

This clause specifies additional requirements for the determination of the A-weighted emission sound-pressure level of non-riding and remote-controlled vibratory rollers according to ISO 11201.

A.4.2 Test procedure

The test shall be carried out in accordance with [A.3.2](#).

For non-riding rollers, the position of the operator shall be as shown in [Figure A.3](#).

For remote-controlled rollers, the position of the operator shall be as shown in [Figure A.4](#).

Since the sound-pressure level varies in relation to the operator's height, this height shall be $1,80 \text{ m} \pm 0,05 \text{ m}$.

NOTE For a source with an A-weighted sound-power level of 100 dB situated 0,3 m above the ground (centre of machine), the theoretical difference in A-weighted sound-pressure level between a position at 1,5 m behind the source and 1,8 m above the ground (operator) and a position at 1,5 m behind and 1,6 m above ground (0,20 m shorter operator) is 0,6 dB.

A.4.3 Calculation of the emission sound-pressure level

The A-weighted sound-pressure level is calculated as the arithmetic mean value of the three passes. The reported value is the highest of the two measurement positions (13, 14).

The A-weighted sound-pressure level at the operator's position shall be rounded down or up to the nearest integral value in dB (<0, 5 round down, ≥0, 5 round up).

A.4.4 Determination of emission sound-pressure spectra

If required, sound-pressure spectra may be registered at the workstation in accordance with ISO 11201 (microphone position 14, right ear, see [Figures A.3](#) and [A.4](#)).

A.4.5 Sound-pressure level as function of time

If required, the sound-pressure level may be recorded as a function of time at microphone positions 10 and 14 (right ear).

A.5 Uncertainty

The measurement uncertainty and, in the case of series machines, the uncertainty due to production variations shall be considered when determining the value of the A-weighted sound-power level and that of the A-weighted emission sound-pressure level at the operator's position.

Current experience shows that the total uncertainty (measurement plus production), K_{WA} for the A-weighted sound-power levels and K_{pA} for the A-weighted emission sound-pressure level of non-riding and remote-controlled rollers is less than the values given in [Table A.2](#).

Table A.2 — Uncertainties

K_{WA} dB	K_{pA} dB
1,0–2,0	2,0–3,0

A.6 Information to be recorded

ISO 3744 and ISO 11201 shall apply, with the following additions:

- engine speed for each run;
- vibration frequency for each run;
- measurement duration, t_M , for each run;
- height of the operating personnel;
- grading curve of the gravel;
- description of the test environment;
- A-weighted sound-power level for each run and the resulting sound-power level as an emission value;
- A-weighted emission sound-pressure level at the operator's position for each run and the arithmetic mean value (separately for left and right ear) of each;
- sound-pressure spectra, where appropriate;
- sound-pressure level as a function of time, where appropriate.

A.7 Information to be reported

Report all the information specified in [A.6](#).

The test report shall include the statement that the sound-power level and the emission sound-pressure level at the operator's position have been determined entirely in accordance with the specifications of this annex.

A.8 Declaration and verification of noise-emission values

The declared A-weighted sound-power level shall be the sum of the measured value and the associated uncertainty, K_{WA} (see [A.5](#)).

NOTE The declared value of the A-weighted sound-power level is identical to the guaranteed sound-power level according to the Noise Directive 2000/14/EC.

The declared A-weighted emission sound-pressure level at the operator's position shall be the sum of the measured value and the associated uncertainty, K_{pA} (see [A.5](#)).

The noise declaration shall explicitly state that the noise-emission values have been obtained according to this noise-test code.

Verification shall be done using this noise-test code. If the value measured during verification is less than or equal to the declared value, the declared value shall be verified.