BS ISO 17253:2014

BSI Standards Publication

Earth-moving machinery and rough-terrain variable-reach trucks — Design requirements for machines intended to be driven on road

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National foreword

This British Standard is the UK implementation of ISO 17253:2014.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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ISO 17253

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Earth-moving machinery and rough-terrain variable-reach trucks — Design requirements for machines intended to be driven on road

Engins de terrassement et chariots élévateurs tout terrain à portée variable — Exigences de conception pour engins prévus pour circuler sur route

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 127, *Earth-moving machinery*, Subcommittee SC 1, *Test methods relating to safety and machine performance*.

Introduction

This International Standard 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 International Standard.

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

Earth-moving machinery and rough-terrain variable reach trucks are occasionally driven on the road to and from, and around the confines of marked jobsites and share the road with other road vehicle users. Design and verification for safety on the jobsite are subject to ISO 20474 and ISO 10896-1, but requirements for use on the road are undefined or covered in regional and local legislation, rules, or codes of practice. Such a situation presents lacking and differing requirements, despite a common objective: the safety of the machine when used on the road.

The purpose of this International Standard is to provide design and verification requirements to ensure a consistent level of safety when earth-moving machinery and rough-terrain variable-reach trucks are used on the road.

INTERNATIONAL STANDARD ISO 17253:2014(E)

Earth-moving machinery and rough-terrain variable-reach trucks — Design requirements for machines intended to be driven on road

1 Scope

This International Standard specifies the requirements for seated-operator, ride-on, earth-moving machinery, as defined in ISO 6165, and rough-terrain variable-reach trucks, as defined in ISO 10896-1, intended to be driven on public roads.

It specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards, hazardous situations, and hazardous events when these machines are driven on road.

It is not applicable to the following:

— machines on legs, e.g. walking excavators;

— hazards related to standing-operator (ride-on or non-riding) or remote-control earth-moving machines/rough-terrain variable-reach trucks;

— user requirements, including training, operator licensing, and machine taxation;

— local use restrictions, such as road/bridge capacities;

— environmental requirements, such as engine emissions, noise, refrigerants, or recyclability.

NOTE National or other regulations, which could be more stringent, can apply.

2 Normative references

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

ISO 3450:2011, *Earth-moving machinery — Wheeled or high-speed rubber-tracked machines — Performance requirements and test procedures for brake systems*

ISO 3287, *Powered industrial trucks — Symbols for operator controls and other displays*

ISO 3457, *Earth-moving machinery — Guards — Definitions and requirements*

ISO 5006, *Earth-moving machinery — Operator's field of view — Test method and performance criteria*

ISO 5010, *Earth-moving machinery — Rubber-tyred machines — Steering requirements*

ISO 5676:1983, *Tractors and machinery for agriculture and forestry — Hydraulic coupling — Braking circuit*

ISO 6011, *Earth-moving machinery — Visual display of machine operation*

ISO 6014, *Earth-moving machinery — Determination of ground speed*

ISO 6016, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

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

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6405-2, *Earth-moving machinery — Symbols for operator controls and other displays — Part 2: Specific symbols for machines, equipment and accessories*

ISO 6683, *Earth-moving machinery — Seat belts and seat belt anchorages — Performance requirements and tests*

ISO 6746-1, *Earth-moving machinery — Definitions of dimensions and codes — Part 1: Base machine*

ISO 6746-2, *Earth-moving machinery — Definitions of dimensions and codes — Part 2: Equipment and attachments*

ISO 6750, *Earth-moving machinery — Operator's manual — Content and format*

ISO 9533, *Earth-moving machinery — Machine-mounted audible travel alarms and forward horns — Test methods and performance criteria*

ISO 10261:2002, *Earth-moving machinery — Product identification numbering system*

ISO 10263-5, *Earth-moving machinery — Operator enclosure environment — Part 5: Windscreen defrosting system test method*

ISO 10265, *Earth-moving machinery — Crawler machines — Performance requirements and test procedures for braking systems*

ISO 10532, *Earth-moving machinery — Machine-mounted retrieval device — Performance requirements*

ISO 10896-1:2012, *Rough-terrain trucks — Safety requirements and verification — Part 1: Variable-reach trucks*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12509, *Earth-moving machinery — Lighting, signalling and marking lights, and reflex-reflector devices*

ISO 14401-1, *Earth-moving machinery — Field of vision of surveillance and rear-view mirrors — Part 1: Test methods*

ISO 14401-2, *Earth-moving machinery — Field of vision of surveillance and rear-view mirrors — Part 2: Performance criteria*

ISO 20474 (all parts), *Earth-moving machinery — Safety*

ISO 21507, *Earth-moving machinery — Performance requirements for non-metallic fuel tanks*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6165, ISO 10896-1 and ISO 12100, and the following apply.

3.1
intended operation
operation intended by the manufacturer as described in the operating manual and with respect to any attachments on the machine (e.g. excavation, loading, materials handling, transportation, drilling, spreading, compacting or trenching of earth, rock, or other materials)

3.2
road
public traffic area for use by automotive vehicles for travel or transportation

Note 1 to entry: *Public traffic area* does not include the sites of temporary road works (e.g. for repairs, maintenance, alterations, improvements, installations, or any other works to, above or under a road, including works to road equipment lighting, barriers, walls, etc.) or roads not open to the public (e.g. on new housing and industrial developments), or on which public traffic is not permitted.

3.3
driving on the road
use of machines on the road (e.g. driving between work sites, to and from the site of normal storage, or driving for refuelling of the machine) for purposes other than intended operation

3.4
tracklaying machine
tracked/crawler machine
machine with endless track drive system

3.5
maximum speed
maximum machine speed in kilometres per hour, either in the forward or reverse direction, whichever is the greater

4 Safety requirements and protective measures

4.1 General safety

Machines intended to be driven on the road shall comply with the requirements and protective measures of this International Standard.

General safety requirements in ISO 20474 or ISO 10896-1 (as appropriate) should be followed, in so far as these are not modified by requirements of this International Standard.

4.2 Dimensions and masses

4.2.1 General

It is recommended that machines be designed in accordance with 4.2.2 to 4.2.6, and equipped so that their dimensions and masses are acceptable for driving on roads.

NOTE 1 The dimensions and masses have been selected as being broadly acceptable but there could be occasions where national and possibly local restrictions are more severe.

NOTE 2 Machines with dimensions and masses exceeding those specified in 4.2.2. to 4.2.6 could be considered as abnormal transport and subject to special permits for their use which are not dealt with in this International Standard.

Test methods for masses are specified in ISO 6016. Unless specifically designed for the purpose of carrying loads on the road (e.g. dumpers), the mass of machines does not include any load other than the attachment(s), tools, and equipment necessary for the intended operation and which the machine is designed to carry while driving on the road.

Dimensional measurements of machinery shall be in accordance with ISO 6746-1 and ISO 6746-2.

Dimensions and masses of machines shall be assessed with equipment and attachments in the transport configuration as specified by the manufacturer.

4.2.2 Maximum mass

It is recommended that the maximum mass of machines designed to be driven on the road not exceed the limits defined in Table 1.

Table 1 — Maximum mass

Machine configuration[a]	Maximum mass kg
Two-axle machines	19 000
Three-axle machines	26 000
Four-axle machines	32 000
Tracklaying machines	24 000

[a] There can be multiple tyres on a single axle. Independent axles on a common lateral plane are considered as one axle (e.g. for multiple wheel rollers).

Subject to local conditions (e.g. bridge and road capacities), the maximum mass, m, expressed in kilograms, of machines on certain roads, can be increased according to Formula (1):

$$m \leq 12\,000 \times A \tag{1}$$

where

A is the number of axles.

NOTE Load restrictions on roads vary according to seasonal changes (e.g. in very low or very high temperature conditions).

4.2.3 Maximum axle load or track load

It is recommended that the maximum axle loads of machines designed to be driven on the road not exceed the limits defined in Table 2.

Table 2 — Maximum axle or track load

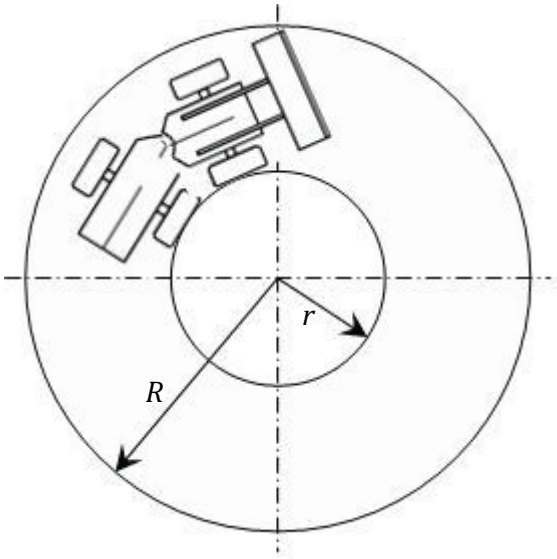
Machine configuration	Maximum axle or track load
Driven and non-driven axles	13 000 kg
Tracklaying machines	9 000 kg/m between first and last track roller (see also 4.4.2)

4.2.4 Maximum length

It is recommended that the maximum length of machines designed to be driven on the road not exceed the limits specified in Table 3. The maximum length includes any mounted equipment or attachments located in the road travel position specified by the manufacturer.

Table 3 — Maximum length

Machine configuration	Maximum length mm
Rigid machines	12 000
Articulated machines	The length of the machine shall be such that the machine is able to manoeuvre in left and right directions for a complete circular trajectory (360°) inside an area defined by two concentric circles, the outer circle having a radius of 12 500 mm and the inner circle having a radius of 5 300 mm, without any of the machine's outermost points (excluding mirrors, indicators, tyre bulge, folding components, such as lift-up steps and flexible mud-flaps) projecting outside the circumferences of the circles (see Figure 1).



R = 12,5 m

r = 5,3 m

Figure 1 — Length requirements for articulated machines

4.2.5 Maximum width

It is recommended that the maximum width of machines designed to be driven on the road not exceed 2 550 mm.

The maximum width includes any mounted equipment or attachments located in the road travel position as specified by the manufacturer but shall exclude mirrors and tyre bulge.

Machines shall be assessed with any functional components, such as lift-up steps, stabilizers, etc. in their transport position.

4.2.6 Maximum height

It is recommended that the maximum height of machines designed to be driven on the road not exceed 4 000 mm with maximum size (rolling radius) tyres, excluding a flexible antennae. The maximum height

includes any mounted equipment, attachments, or combination of equipment and attachment(s) located in the road travel position as specified by the manufacturer.

NOTE See also 4.11.4.

4.3 Speed

The maximum speed shall be verified in accordance with ISO 6014. A tolerance on the speed of +10 % or +3 km/h, whichever is the lesser, is permitted. The test shall be conducted with maximum size (rolling radius) tyres at the recommended cold inflation pressure as specified by the manufacturer and with the machine in the lightest operational condition.

The maximum design speed of machines equipped with one or more smooth steel wheels (rollers) should be limited to 16 km/h. If the intended operation provides for use at a higher speed, means shall be provided to avoid exceeding 16 km/h when the machine is being driven on the road (e.g. a specific road travel mode setting).

NOTE The speed of machines with smooth steel wheels can be subject to local use restrictions which are not dealt with in this International Standard.

4.3.1 Speed marking

Machines shall have a provision (e.g. an attachment point) for the installation of a speed marking sign, slow-moving vehicle plate, or marks communicating speed or use as required by national regulations. It is recommended that the space made available have a width of 365 mm and a height of 350 mm (the dimensions of the SMV plate). See ISO 12509 for installation conditions.

NOTE It is possible that more than one marking is required (e.g. a speed marking sign and SMV plate).

4.3.2 Speedometer

Machines with a maximum speed >30 km/h shall be equipped with means for the operator to easily determine the speed at which the machine is being driven. Machines with a maximum speed ≥40 km/h shall be fitted with a speedometer.

NOTE The speedometer need not function in the reverse direction.

The speedometer shall comply with 4.11.3 and be located so that it is readily visible to the operator in the driving position.

4.4 Road preservation

Machines shall meet the requirements of 4.4.1 and 4.4.2 to minimize the risk of road damage.

4.4.1 Tyres and rims

Tyres should be compatible with the axle loading and design speed of the machine and shall be marked with the (tyre) manufacturer's name, the load index, and the speed rating.

Tyres can be pneumatic or solid. Pneumatic tyres can be foam filled (to protect against loss of stability in case of puncture or rupture) or have a liquid ballast.

In circumstances where it is necessary to install tyres which have a speed rating which is not compatible with the maximum speed of the machine (e.g. a low speed high capacity tyre for the intended operation, or in cases where the use of foam fill or liquid ballast is permitted by the manufacturer), instructions can be provided to the operator to show the maximum allowable speed for the installed tyres.

NOTE Load index and speed rating data can be determined using ISO 4250,[2][3][4] the European Tyre and Rim Technical Organization (ETRTO) or Tire and Rim Association (TRA) standards manuals.

Steel wheels or steel tyres (e.g. rollers) are permissible for driving on the road provided they do not have any tread pattern.

4.4.2 Tracks

Tracklaying machines shall have a tread lug pattern such that their static ground contact pressure is ≤0,8 MPa, measured in accordance with Annex A.

Steel-tracked machines shall have a resilient material (e.g. rubber pads temporarily affixed to the track) interposed between ground and the track, and be so arranged that the steel parts of the track do not come into contact with the road.

4.5 Dynamic stability

Machine behaviour while being driven on the road shall be assessed at various speeds (including maximum speed) and during turning. Control of the machine shall be possible while it is being driven on the road under normal conditions, as specified by the manufacturer, including the use of representative trailers, if permitted. Suspension of equipment or attachment (e.g. ride control), axle or wheel can be used to improve controllability. The weight distribution of the machine in the intended travel configuration(s) (including any imposed load from a trailer, where applicable) shall ensure a minimum static axle load of 20 % of the total machine mass on the steered axle(s), measured on a substantially horizontal surface.

NOTE ISO 14792[11] and ISO 15037-2[12] can be used for general guidance in determining machine behaviour when driving on the road.

4.6 Steering system

The performance of the steering system of wheeled machines — including machines with a design speed ≤20 km/h, but excluding rough terrain trucks (RTTs) —:shall comply with ISO 5010. If, due to the design speed of the machine, the test speeds cannot be attained, tests shall be conducted at maximum speed.

The performance of the steering system of RTTs shall comply with the applicable sections in ISO 10896-1.

Machines with design speeds less than or equal to 20km/h do not require secondary steering.

For machines (excluding RTTs)with a design speed >20 km/h, a secondary steering system is required where the steering input force under emergency conditions (failure of the normal operating steering system) exceeds 350 N.

If the steering system has switchable steering modes (e.g. 2-wheel steering, 4-wheel steering, crab, or inversed function in certain machine configurations), it shall be possible to positively engage the mode(s) suitable for driving on the road as specified by the manufacturer. Inadvertent activation of other steering modes shall be minimized in accordance with the requirements of 4.11.2. It should be possible to easily identify the steering mode that is engaged.

For machines with a rotating upper structure, the road travel position shall be identified on the machine.

The steering system of track-laying machines with a design speed (forward or reverse) >20 km/h shall be gradual.

4.7 Brake systems

Machines shall be equipped with a service brake system, a secondary brake system, and a parking brake system, suitable, under the manufacturer's intended conditions of service, load, speed, terrain, and slope, for driving on the road.

The equipment shall be able to resist corrosion and ageing phenomena which could lead to a sudden loss of braking efficiency.

Brake systems of crawler machines with a maximum machine speed <20km/h shall comply with ISO 10265.

Brake systems of all wheeled machines shall comply with ISO 3450. Rubber-tracked crawler machines with a maximum machine speed ≥20km/h shall comply with ISO 3450.

Wheeled machines shall have a braking capacity of equal nominal rating on each wheel of a braked axle.

4.8 Trailer connections

4.8.1 Coupling devices

If fitted, mechanical coupling devices enabling the connection of a trailer shall be so designed that safety according to the state of the art is provided. The connections and their locking mechanisms shall ensure that under normal operating conditions, no unintentional unlatching can occur. Sufficient angular movement shall be ascertained.

Coupling devices should be in accordance with ISO 6489-3.

Other devices, such as those covered in ISO 6489-1,[5] ISO 6489-2,[6] ISO 6489-3,[7] ISO 6489-4,[8] ISO 6489-5,[9] ISO 24347[14] and ECE R55,[20] and national trailer couplings are acceptable according to customer requirements.

4.8.2 Braking

The requirements given in ISO 3450:2011, 4.11, for machines designed for the connection of a trailer shall be met.

Machines designed and equipped to tow a trailer at more than 20 km/h and where the sum of the trailed axle loads is more than 3 500 kg shall be equipped with a trailer braking circuit according to ISO 5676.

The parking brake system of the machine shall be capable of holding the machine combination, machine and an un-braked trailer of 3 500 kg mass (or less if the permissible, un-braked towable mass, as specified by the machine manufacturer, is less), stationary on a 15 % upwards or downwards gradient.

4.8.3 Lighting socket

Machines designed and equipped to tow a trailer shall be equipped with a lighting socket (e.g. according to ISO 1724[1] or ISO 11446-1[10]). If this is a 24 V lighting socket (e.g. according to ISO 12098), a label shall be fitted in proximity to the socket.

4.9 Operator's station

4.9.1 Visibility

In order that the operator has sufficient visibility from the operator's station, in relation to the travel areas of the machine necessary for travel on the road

— earth-moving machines shall comply with ISO 5006, and

— rough-terrain variable-reach trucks shall comply with ISO 10896-1:2012, 4.14

4.9.2 Mirrors

Machines shall be equipped with rear-view mirrors in accordance with ISO 14401-1 and ISO 14401-2.

Rough-terrain trucks shall meet the requirements as specified for wheel loaders.

Mirrors should be of an approved type, e.g. ECE R46.[19]

4.9.3 Restraint system

Machines fitted with an operator protective structure (ROPS, TOPS, etc.) shall have an operator restraint system that meets the requirements specified in ISO 6683.

4.9.4 Additional seating positions

If for the purpose of carrying of a co-worker(s), additional seats (e.g. ISO 13459) are fitted, these shall also be equipped with a restraint system meeting the requirements specified in ISO 6683. The place for the co-worker shall be arranged such that

— a sufficient number of handholds are provided,

— intrusion into the operator's space envelope is minimized, and

— protection against inadvertent contact with controls is provided (see also 4.11.2).

4.9.5 Wiper systems

If equipped with a front window, this shall be fitted with motorized windscreen wiper(s) and washer(s). The area swept by the wiper(s) shall be such that it corresponds to a chord of the semi-circle of vision at least 8 000 mm long within sector A as described in ISO 5006. The wiper(s) shall have a frequency of ≥20 cycles/min at their maximum frequency setting.

If debris build up on a rear screen is foreseen to cause impaired visibility while the machine is being driven on the road, the rear window should also be fitted with a motorized wiper and washer.

The tank of the window washer(s) shall be easily accessible. The system shall function in the temperature range of –18 °C to +65 °C. The function shall not decrease if the solution (water and washer fluid) contains up to 50 % methyl or isopropyl alcohol (or equivalent) washer fluid.

4.9.6 Doors and windows

Doors and windows (if equipped) shall be securely held in their functional positions; measures shall be taken for preventing inadvertent opening. Doors shall be retained at their intended operating position(s) by a positive engagement device.

Windscreens and windows shall be made of safety glass or other material which provides similar safety performance and shall be of an approved type (e.g. ECE R43,[18] 92/22/EEC,[15] 2009/144/EC,[16] FMVSS No 205,[22] ANSI Z26.1,[23] JIS R3211,[24] GB 9656[25]).

4.9.7 Sun visors

If equipped with a front windscreen, an adjustable sun visor should be fitted to minimize glare to the operator unless other parts of the operator station (e.g. roof profile, cab members) provide sufficient protection or where the fitting of a sun visor is not practicable (e.g. on compact machines due to space constraints).

4.10 Operator's station with enclosed cab

If equipped with an enclosed cab, a system shall be provided to defrost the front windscreen and rear window. The defrosting system for the windscreen shall meet the requirements specified in ISO 10263-5.

4.11 Operator's controls and indicators

4.11.1 General

The controls (hand levers, pedals, switches, etc.) and indicators for driving the machine, shall be chosen, designed, constructed, and arranged as per ISO 20474 or ISO 10896-1.

If pedals of a machine have the same function (clutch, brake, and accelerator) as on a motor vehicle, they shall be arranged in the same manner, to avoid the risk of confusion.

4.11.2 Inadvertent activation

Movement of equipment, attachments, and any functional components (e.g. stabilizers, powered access systems) which could cause hazards while driving on the road shall be minimized by protection of controls or by restraint of equipment attachments and components.

Controls are considered as being protected from inadvertent activation by the operator if one or more of the following applies:

— the control is located outside of the zone of comfort (see ISO 6682);

— the control is guarded such that it is protected from inadvertent activation by a shroud or cover sufficient to avoid inadvertent activation;

— the control is deactivated by a switch(es) for driving on the road, or provided with mechanical locks to be installed by the operator to prevent the movement of controls.

Equipment, attachments, and components are considered as being protected if restraint devices (mechanical, hydraulic, or electric) installed or activated by the operator, are provided (see also 4.17).

Where relevant, the choice of protection shall take account of the presence of co-workers being carried in the machine (see 4.9.4).

4.11.3 Operating instrumentation

Visual indicators for proper operation of the machine shall be in accordance with ISO 6011, in respect of the use of colours and related aspects. Rough-terrain trucks shall meet the requirements as specified for wheel loaders.

If the machine is equipped with a speedometer (see 4.3.2), the speedometer shall display the speed in km/h or mph in accordance with the requirements of the market in which the machine is first placed. For countries in which mph is used and in the case of an analogue display, it is permissible for the display to show speed in both mph and km/h.

On machines with a maximum speed of more than 40 km/h, there shall be the following relationship between the indicated speed, v_1, and the true speed, v_2:

Displays in km/h:

$$0 \leq v_1 - v_2 \leq \frac{v_2}{10} + 2{,}5$$

Displays in mph:

$$0 \leq v_1 - v_2 \leq \frac{v_2}{10} + 4$$

4.11.4 Symbols and signs

Where applicable, symbols used on operator controls and other displays shall comply with primarily ISO 7000 but ISO 3287 or ISO 6405-1 and ISO 6405-2 can be used .

4.12 Lighting, signalling devices, and marking lights, and reflex-reflector devices

4.12.1 General

All machines shall be equipped with lighting, signalling devices, marking lights, and reflex reflector devices, complying with lighting group II, ISO 12509.

The exception to this is that ISO 12509 shall be used as guidance on visibility angles and SMV Plate is optional.

For use of machines in snow-removal applications, the lighting devices can be installed at heights greater than those specified in ISO 12509.

If these devices impede operation of the machines or are subject to damage during the intended operation, they shall be designed in such a way they can be properly positioned for driving on the road.

Lighting, signalling and marking devices, and reflex reflectors devices can be required to be of an approved type.

4.12.2 Special markings

If warning markings are provided (permanently affixed or removable) to mark the width or length, including overhanging projections of machines, these should have a width of at least 140 mm and a minimum surface area of 120 mm^2, with red and white stripes of 100 mm width, inclined outwards from top to bottom at an angle of 45°. The uppermost stripe shall be red. If, with certain machine configurations, it is not possible to use warning markings with a width of 140 mm, the width can be reduced to not less than 70 mm.

NOTE The stripes can be required to be retroreflective. There can be restrictions on the colour of the retroreflective stripes as fitted to the front, rear, and side of the machine. These are outside the scope of this International Standard.

4.13 Plates and inscriptions

4.13.1 Rear registration plate

Machines shall have provision for mounting a registration plate at the rear. It is recommended that the space made available be a flat, rectangular surface with a length and height of 520 mm × 200 mm.

The space shall allow the plate to be mounted substantially vertically (±5°) in relation to the rear of the machine at a height 300 mm to 1 200 mm from the ground. If the design of the machine does not allow for installation ≤1 200 mm, the space for the plate can exceptionally be at a height up to 4 000 mm, in which case the inclination can be up to 30° downwards. It is recommended that the space for mounting be on the machine centreline or to the left.

The lighting of the space for the plate is described in ISO 12509. The light can be required to be of an approved type.

4.13.2 Manufacturer's plate

Machines shall be equipped with a manufacturer's label or plate complying with the requirements of ISO 10261:2002, Clauses 5 and 7.

Additionally, the label or plate (or a supplementary label or plate) shall indicate

— maximum permissible machine axle or track loads (see 4.2.3),

— maximum permissible operating mass for the machine in its road travel position, and

— maximum permissible towing mass and vertical load on the coupling point (where relevant).

For machines designed to carry a load on the road (e.g. dumpers), the axle loads and mass should show the capacity range from unladen to permissible laden load (mass).

4.13.3 Identification number

Machines shall bear an identification number. The number shall be marked in accordance with ISO 10261:2002, Clauses 6 and 7.

It is recommended that the identification number comply with the provision for a product identification number (PIN) given in ISO 10261:2002, Clause 4.

4.13.4 SMV Plate

A slow-moving vehicle plate, if fitted, should be of an approved type. Slow-moving vehicle plates should not be fitted to machines with a maximum speed ≥40 km/h (eg ECE R69)

4.14 Warning devices

Machines shall be equipped with a forward warning device (horn), controlled from the operator's station, which complies with the requirements of ISO 9533. The device can be required to be of an approved type.

The sound emitted shall be stable and continuous.

4.15 Protection for projections

Tools and attachments with long narrow projections (e.g. materials handling spikes and forks) should be fitted or positioned or protected in such a way as to minimize risks and damage in case of collision. If removable guards are provided as a means of protection, they shall be easily removed and installed by the operator for the machine's intended operation and road use.

4.16 Tools and equipment

If it is intended that interchangeable attachments and tools (buckets, breakers, etc.) or items such as fluids and cones, necessary for carrying out the task (intended operation) at the location to/from the machine is being driven, be carried on the machine, provision shall be made for their safe carrying so that they cannot be unintentionally dropped from the machine or cause any other hazard to other road users.

Provision shall be made for the safe carrying or tethering of non-rigid lifting attachments and accessories (e.g. freely suspended hook, winch) so that they cannot swing freely during use on the road.

NOTE There could be occasions where national and possibly local restrictions prohibit the carrying of attachments, tools, items, etc.

4.17 Uncontrolled motion

Equipment, tools, and attachments (e.g. rotating upper structure on an excavator, outriggers, excavator portion of a backhoe loader) which could protrude beyond the width of the machine laterally due to drift, creep or leakage, shall be protected mechanically or hydraulically (e.g. by safety valves) so that the risk to exposed persons due to movement from the holding position is minimized.

Equipment, tools, and attachments (e.g. dozer blades on excavators, stabilizer legs on backhoe loaders) which could come into contact with the road surface without being detected by the operator, due to drift, creep or leakage, shall be protected mechanically or hydraulically (e.g. by safety valves), so that the risk of damage to the road surface is minimized.

4.18 Fenders

Machines with a design speed >25 km/h shall be equipped with fenders according to ISO 3457 to protect the operator from debris ejected by the tread of the tyres or tracks.

4.19 Fuel tanks

Metallic and non-metallic fuel tanks shall comply with the requirements ISO 21507.

4.20 Retrieval and recovery

If machine retrieval and recovery (towing) device(s) or location points are fitted, they shall comply with ISO 10532.

5 Verification of requirements

It is necessary to verify that the requirements of this International Standard have been incorporated into the design and manufacture of a machine. Either one or a combination of the following verification means shall be used to evaluate the machine for compliance with this International Standard:

— measurement;

— visual examination;

— testing where a method is prescribed in the International Standard referenced for any particular requirement;

— assessment of the contents of the documentation required to be kept by the manufacturer (e.g. evidence that purchased components, such as windscreens, have been manufactured to the required International Standard).

A report should be created to enable demonstration of conformity with the requirements of this International Standard. The report should include the following (directly or through reference to other materials):

— an overall drawing of the machinery together with drawings of the control circuits;

— photographs (e.g. to indicate employed protection measures);

— detail drawings, accompanied by any calculation notes, test results, etc., required to check the conformity of the machinery;

— results and reports relevant to referenced International Standards;

— a copy of the operating instructions for the machinery.

6 Operating instructions

The operator's instructions shall be in accordance with ISO 6750 for earth-moving machines or ISO 10896-1, Clause 6 for RTT.

The manufacturer shall, additionally, provide information on the following:

— carrying of tools and equipment where permitted by the manufacturer (see 4.16);

— identification and use of any tether points for securing non-rigid parts of the machine, e.g. hooks on winches and ropes (see 4.16);

— details of the recommended road travel position(s) of tools, attachments and working equipment (see 4.2.1);

— procedures for retrieval and recovery (towing), if applicable (see 4.20);

— setting of any mirrors for road travel (see 4.9.2);

— procedures and precautions for the towing of trailers, including any specification constraints for the trailer;

— the procedure, where relevant, for mounting any protective devices, marker plates or a slow-moving vehicle emblem (see 4.12.2 and 4.15);

— the use of any control isolation devices and restraint devices for minimizing inadvertent activation and uncontrolled motion (see 4.11.2 and 4.17);

— precautions to be taken when carrying co-workers on the machine, if permitted (see 4.9.4);

— a statement that the machine complies with this International Standard (i.e. ISO 17253);

— a notice that road traffic regulations are to be complied with and that national technical and operational (including seasonal) restrictions can apply to the use of machines on the road, for which the responsibility of identification and compliance with lies with the operator;

— a warning that speed should be such that it is within specified limits and commensurate with conditions (wind, rain, ice, snow, etc.).

Annex A
(normative)

Ground contact pressure calculation for track-laying machines

A.1 General

Annex A specifies a uniform method for calculating the average ground contact pressure, on a flat, solid road surface that does not allow for penetration in the supporting surface, of self-propelled and towed crawler (track-laying) machines. Actual ground pressure values under dynamic conditions vary depending on load, track shoe type and size, and surface conditions.

See 4.4.2 for limit values of ground contact pressure.

A.2 Calculations and requirements

A.2.1 Crawler base, *L*2

The crawler base, *L*2, according to ISO 6746-1 and as shown in Figure A.1, is the distance on the X coordinate between two X planes passing through the front idler axis and the sprocket (or rear idler) axis.

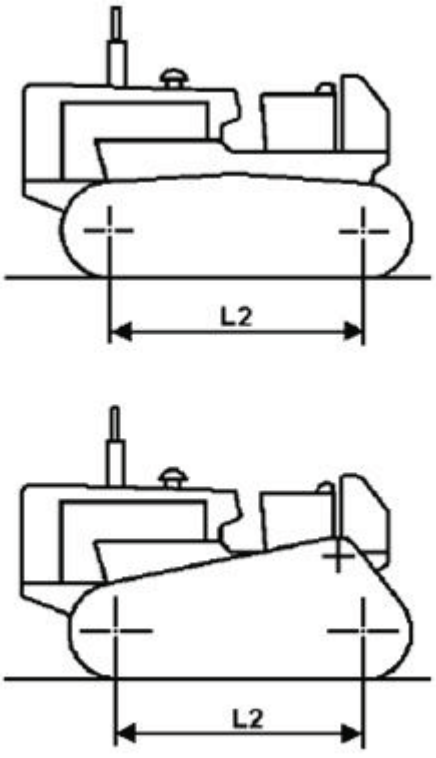


Figure A.1 — Crawler base

A.2.2 Tread contact area, T_A

The contact area, T_A, is the surface area of the tread that can be in contact with the ground and is used in Formula (A.1) to calculate average ground contact pressure.

Tread contact area varies depending on the tread profile. An example of typical track tread profile and pattern is shown in Figure A.2.

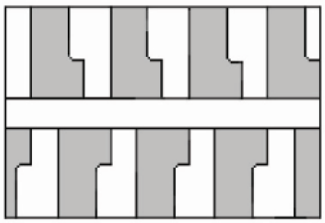


Figure A.2 — Track tread profiles

A.2.3 Calculation of average ground contact pressure — Dual-track systems

The average ground contact pressure for dual-track systems, P_G, in kilopascals, shall be determined using Formula (A.1):

$$P_G = \frac{\left(\frac{9{,}807m}{2}\right)}{n_t\left(T_A\right)} \tag{A.1}$$

where

m is the operating mass according to ISO 6016, in kg;

n_t is the number of full treads on the crawler base, L_2;

T_A is the individual tread contact area, in mm^2.

A.2.4 Calculation of average ground contact pressure — Multi-track systems

Ground contact pressure P_G for multi-track systems shall be calculated using Formula A.1 for each pair of track drives. Operating mass, m, shall be calculated for each pair of tracks based on weight distribution for the machine, e.g. 35 % to the front and 65 % to the rear. The two calculated P_G values shall be within the limits set in 4.4.2.

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