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**Rough-terrain trucks — Safety  
requirements and verification —**

**Part 1:  
Variable-reach trucks**

*Chariots tout-terrain — Exigences de sécurité et vérification —  
Partie 1: Chariots à portée variable*

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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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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](http://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](http://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 of 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

This document was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 4, *Rough-terrain trucks*.

This second edition cancels and replaces the first edition (ISO 10896-1:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the document has been aligned with regional standards;
- a new steering test has been added;
- new requirements for the hydraulic circuit have been introduced.

A list of all parts in the ISO 10896 series can be found on the ISO website.

## Introduction

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e. g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers)

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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 type-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.

This document has been developed in order to align as far as possible its requirements to those of the applicable regional standards in Australia, EU, USA.

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# Rough-terrain trucks — Safety requirements and verification —

## Part 1: Variable-reach trucks

### 1 Scope

This document specifies general safety requirements for non-slewing, rough-terrain variable-reach trucks (referred to as trucks), with rigid chassis and equipped with a telescopic lifting means (pivoting boom) on which a load-handling device such as a carriage with fork arms is typically fitted. Fork arms and other integrated attachments are considered to be parts of the truck.

NOTE These trucks are also known as telehandlers, or telescopic handlers.

For the purpose of this document, trucks are designed to transport, lift and place loads and can be driven on unimproved terrain. They can also be equipped with a variety of attachments or interchangeable equipment (e.g. fork arms, bale spikes, mowers, sweepers) which can be both load-carrying and non-load-carrying.

Other standards, in addition to the relevant provisions of this document, can apply to the attachments.

This document is not applicable to the following:

- a) industrial variable-reach trucks covered by ISO 3691-2;
- b) machines designed primarily for earth moving, such as loaders, even if their buckets are replaced by fork arms (see ISO 20474-3);
- c) trucks with articulated chassis;
- d) machines designed primarily with variable-length load suspension elements (e.g. chain, ropes) from which the load can swing freely in all directions (mobile cranes);
- e) trucks fitted with personnel/work platforms, designed to move persons to elevated working positions;
- f) trucks designed primarily for container handling.

The significant hazards covered by this document are listed in [Annex A](#). This document does not address hazards that can occur:

- during manufacture;
- when handling suspended loads, which can swing freely (see ISO 10896-4);
- when using trucks on public roads;
- when operating in potentially explosive atmospheres;
- with a battery, LPG or hybrid as the primary power source.

## 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 2330, *Fork-lift trucks — Fork arms — Technical characteristics and testing*

ISO 2860, *Earth-moving machinery — Minimum access dimensions*

ISO 2867:2011, *Earth-moving machinery — Access systems*

ISO 3449, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements*

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

ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements*

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-2, *Graphical symbols — Safety colours and safety signs — Part 2: Design principles for product safety labels*

ISO 5053-1, *Industrial trucks — Terminology and classification — Part 1: Types of industrial trucks*

ISO 5353, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

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

ISO 6292:2020, *Powered industrial trucks and tractors — Brake performance and component strength*

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

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

ISO 7000, *Graphical symbols for use on equipment — Registered symbol*

ISO 7096, *Earth-moving machinery — Laboratory evaluation of operator seat vibration*

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

ISO 10263-3, *Earth-moving machinery — Operator enclosure environment — Part 3: Pressurization test method*

ISO 10263-4, *Earth-moving machinery — Operator enclosure environment — Part 4: Heating, ventilating and air conditioning (HVAC) test method and performance*

ISO 10896-6, *Rough-terrain trucks — Safety requirements and verification — Part 6: Tilting operator's cabs*

ISO 10896-7, *Rough-terrain trucks — Safety requirements and verification — Part 7: Longitudinal load moment systems*

ISO 11112, *Earth-moving machinery — Operator's seat — Dimensions and requirements*

- ISO 12508, *Earth-moving machinery — Operator station and maintenance areas — Bluntness of edges*
- ISO 13284, *Fork-lift trucks — Fork-arm extensions and telescopic fork arms — Technical characteristics and strength requirements*
- ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*
- ISO 13766-1, *Earth-moving and building construction machinery — Electromagnetic compatibility (EMC) of machines with internal electrical power supply — Part 1: General EMC requirements under typical electromagnetic environmental conditions*
- ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*
- ISO 13850, *Safety of machinery — Emergency stop function — Principles for design*
- ISO 15817, *Earth-moving machinery — Safety requirements for remote operator control systems*
- ISO 15818, *Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements*
- ISO 18063-1, *Rough-terrain trucks — Visibility test methods and their verification — Part 1: Variable-reach trucks*
- ISO 21507, *Earth-moving machinery — Performance requirements for non-metallic fuel tanks*
- ISO 22915-10, *Industrial trucks — Verification of stability — Part 10: Additional stability test for trucks operating in the special condition of stacking with load laterally displaced by powered devices*
- ISO 22915-14, *Industrial trucks — Verification of stability — Part 14: Rough-terrain variable-reach trucks*
- ISO 22915-20, *Industrial trucks — Verification of stability — Part 20: Additional stability test for trucks operating in the special condition of offset load, offset by utilization*
- ISO 19014-1, *Earth-moving machinery — Functional safety — Part 1: Methodology to determine safety-related parts of the control system and performance requirements*
- ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*
- ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*
- ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*
- IEC 60529, *Degrees of protection provided by enclosures (IP Code)*
- EN 12053, *Safety of industrial trucks — Test methods for measuring noise emissions*
- EN 12895, *Industrial trucks — Electromagnetic compatibility*
- ANSI B56.11.5, *Measurement of Sound Emitted by Low Lift, High Lift, and Rough Terrain Powered Industrial Trucks*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5053-1 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org>

— ISO Online browsing platform: available at <http://www.iso.org/obp>

**3.1**  
**rough-terrain truck**  
truck designed for operation on unimproved natural terrain as well as the disturbed terrain of work sites

**3.2**  
**compact truck**  
truck having a maximum height in normal travel mode not exceeding 2 150 mm, a maximum operating mass according to ISO 6016 not exceeding 6 000 kg, and a maximum width in normal travel mode not exceeding 1 850 mm

**3.3**  
**rated capacity**  
 $Q_1$   
<truck> maximum load permitted by the manufacturer at the standard load centre distance that the truck is capable of lifting and transporting on *fork arms* (3.13) in normal conditions with the *boom* (3.14) fully retracted

Note 1 to entry: See [Figure 1](#).

**3.4**  
**rated capacity**  
<attachment> maximum load that the *attachment* (3.17) is permitted by its manufacturer to handle in normal operation under specified conditions

Note 1 to entry: The rated capacity of the *attachment* (3.17) can be associated with the load centre distance. See [Table 1](#).

**3.5**  
**actual capacity**  
maximum load at a specified load centre distance, established by the manufacturer based on component strength and truck stability, that the truck can carry, lift and stack to a specified *lift height* (3.7) and *reach* (3.6), in normal operation

Note 1 to entry: See [Figure 1](#).

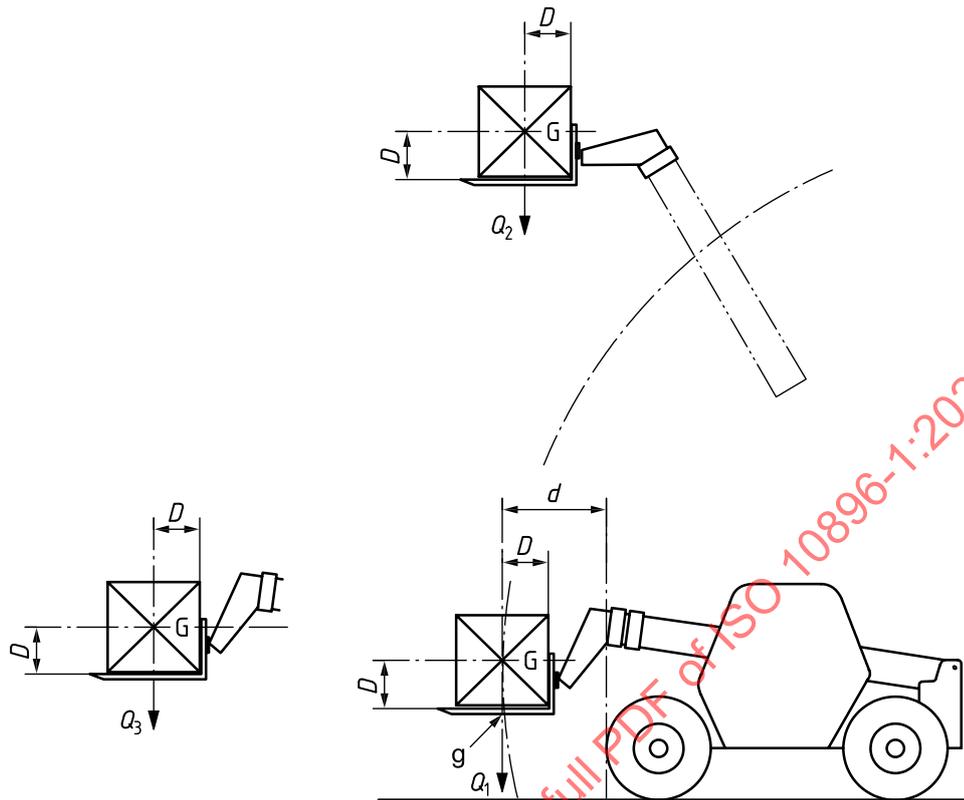
Note 2 to entry: The actual capacity depends on the configuration of the truck in respect of variables including lift height, the reach of the *boom* (3.14), the actual load centre, load-handling devices and *stabilizing devices* (3.11).

Note 3 to entry: It defines the load-handling ability of the particular truck as equipped. Different actual capacity with removable *attachments* (3.17), where permitted, may also be established by the appropriate stability test or by calculation verified by empirical data.

**3.6**  
**reach**  
 $d$   
distance between two vertical parallel planes, one plane being tangent to the front of the outside diameter of the front tyres or tracks, the other plane being tangent to the curve described by the centre of gravity of the load moving from its highest position to its lowest position

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: In practice, the reach can be measured by referring to a point,  $g$ , corresponding to the vertical projection of the centre of gravity,  $G$ , of the load onto the plane of the top surface of the *fork arms* (3.13), as shown in [Figure 1](#).

**Key**

- $d$  reach
- $D$  standard load centre distance
- $G$  centre of gravity of the load
- $g$  point corresponding to vertical projection of  $G$
- $Q_1$  rated capacity
- $Q_2$  actual capacity at maximum lift height
- $Q_3$  actual capacity at maximum reach

**Figure 1 — Parameters for determining actual capacity of a truck with fork arms**

**3.7****lift height**

height from the ground to the upper face of the fork arms or underside of the load, whichever is the lower

**3.8****standard load centre distance**

$D$

distance from the centre of gravity of the load, horizontally rearwards to the front of the fork shanks and vertically downwards to the upper faces of the *fork arms* (3.13)

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: [Table 1](#) gives standard load centre distances in relation to their rated capacities.

**Table 1 — Standard load centre distances and rated capacities**

Rated capacity		Standard load centre distance				
$Q_1$ kg		$D$ mm				
		400	500	600	900	1 200
0	<1 000	X		X <sup>a</sup>		
≥1 000	<5 000		X <sup>c</sup>	X <sup>b</sup>		
≥5 000	<10 000			X		
≥10 000	<20 000			X	X	X
≥20 000	<25 000				X	X
≥25 000						X

NOTE Trucks can be rated for special applications with load centres related to those applications.

<sup>a</sup> 600 mm is typically used in the USA.

<sup>b</sup> 600 mm is typically used in Asia, Australia and the USA.

<sup>c</sup> 500 mm is typically used in Europe.

**3.9  
lost load distance**

$l_L$   
effective thickness

$d_E$   
horizontal shift in the standard load centre that can occur when removable *attachments* (3.17) are added to a truck

**3.10  
axle oscillation locking-mechanism**

mechanism designed to lock oscillation of an axle to improve truck stability

**3.11  
stabilizing device**

extendable or pivoting mechanical support used to improve the stability of a truck when stationary

**3.12  
lateral levelling**

change in the lateral inclination angle between the chassis and the ground made to ensure that the *boom* (3.14) operates in a vertical plane even when the truck is positioned on a side slope

**3.13  
fork arms**

device comprising two or more solid fork arms, each consisting of a shank (vertical portion) and a blade, which is hook- or shaft-mounted, fitted on the carriage and usually adjusted manually

**3.14  
boom**

pivoting support member that permits horizontal and vertical placement of the load or *attachment* (3.17)

**3.15  
crab steering mode**

steering mode where all wheels of the truck steer in the same direction

**3.16****normal operating position**

position specified by the manufacturer in which the operator is able to control the truck operations, including load-handling functions

Note 1 to entry: Other positions can be necessary if it is not possible to control all the functions of the truck from a single position.

**3.17****attachment**

interchangeable equipment

component or assembly of components which can be mounted on the *attachment bracket* (3.18) for a specific use

**3.18****attachment bracket**

device fitted at the end of the *boom* (3.14) to connect and lock interchangeable *attachment(s)* (3.17) without the use of a tool to facilitate quick interchange of *attachment(s)* (3.17)

**3.19****non-slewing**

slewing movement not greater than  $5^\circ$  to either side of the longitudinal axis of the truck

Note 1 to entry: See [Figure 2](#).

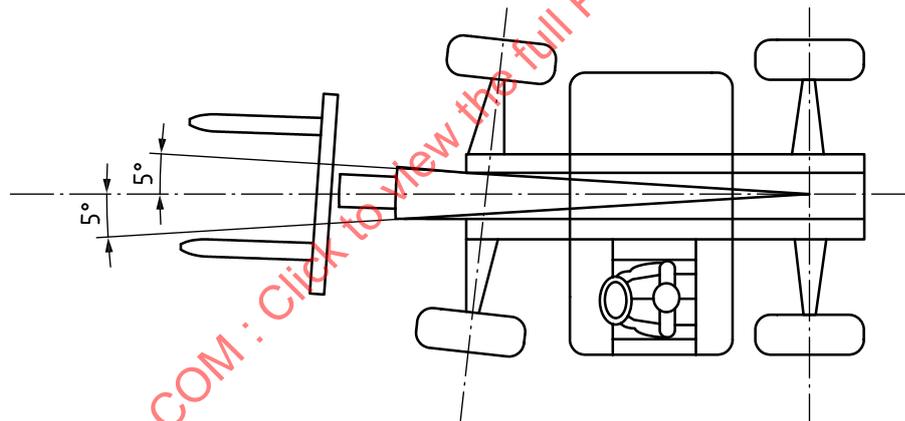


Figure 2 — Non-slewing movement

**3.20****boom float**

control mode that uses gravity to allow an *attachment* (3.17) at the end of the *boom* (3.14) to follow a contour (e.g. the ground)

**3.21****maximum working pressure**

highest pressure at which a hydraulic circuit is intended to operate in steady-state operating conditions

[SOURCE: ISO 5598:2020, 3.2.429, modified — In the definition, “system or sub-system” has been replaced by “hydraulic circuit”.]

**3.22****level ground**

ground with a gradient of  $(0 \pm 2) \%$

**3.23****hybrid**

truck powered using two or more distinct power sources

**3.24**

**rough-terrain variable-reach truck**

rough-terrain truck fitted with one or more articulated arms, telescopic or not, non-slewing or having a slewing movement of not more than 5° either side of the longitudinal axis of the truck used for stacking loads

**3.25**

**technically permissible maximum operating mass**

operating mass without the forks and including the heaviest attachment approved by the truck manufacturer without load

**4 Safety requirements and/or protective/risk reduction measures**

**4.1 General**

**4.1.1 General**

Rough-terrain variable-reach trucks, as defined in 3.24, shall comply with the safety requirements and/or protective measures/risk reduction of this clause. In addition, the truck shall be designed according to the principles of ISO 12100 for relevant but not significant hazards, which are not dealt with by this document.

**4.1.2 Sharp edges and acute angles**

Sharp edges and acute angles shall meet the requirements specified in ISO 12508 in areas to which the operator can be exposed during operation, access, egress and daily maintenance.

**4.1.3 Stored energy components**

Components that store energy and can cause a risk of injury during removal or disassembly, e.g. hydraulic accumulators and spring-applied brakes, shall be provided with a means to release the energy before removal or disassembly and shall be visibly marked according to 6.2.8.

**4.2 Starting/moving and stopping**

**4.2.1 Unauthorized starting**

All trucks shall be provided with a device (e.g. key, key pad, magnetic card) within the zone of reach of the operator at their normal operating position as defined in ISO 6682 that prevents starting without the use of such device.

**4.2.2 Stopping system**

The truck shall be provided with a stopping device (e.g. a key) within the zone of reach of the operator at their normal operating position as defined in ISO 6682.

The normal stop control device shall be clearly identifiable, and clearly visible.

**4.2.3 Unintended movement**

Trucks shall be designed such that the engine cannot be started while the drive system is engaged.

When the drive system direction control is in neutral position, a means shall be provided to maintain it in its neutral position.

#### 4.2.4 Uncontrolled motion

The truck shall not move from rest, on level ground, until the drive system has been engaged.

#### 4.2.5 Powered travel movement

Means shall be provided to prevent powered travel when the operator is not in the normal operating position.

Powered travel shall not occur automatically when the operator returns to the normal operating position without an additional operation, e.g. reset of the direction control to neutral.

Application of the parking brake shall shift the transmission into neutral, except on trucks with hydro-static transmission.

The release of parking brake shall not engage the transmission automatically.

NOTE On trucks with hydro-static transmission, the transmission system achieves the same objective.

#### 4.2.6 Non-activation of the parking brake

A clear warning (audible or visual) shall be activated when the operator is not at the normal operating position and the parking brake is not applied.

#### 4.2.7 Brakes

Trucks shall be equipped with service brake(s) and parking brake systems, complying with ISO 6292 and with the following requirements.

If the manufacturer can demonstrate that service brakes performance in reverse is the same as in forward direction, testing of stopping distance according to ISO 6292 may be performed in forward direction only.

The stopping distance test in ISO 6292:2020, 6.3.1, shall be carried out only with the truck in the configuration giving the technically permissible maximum operating mass.

Where electromechanical brake systems are fitted, they shall be applied mechanically and released electrically.

Where hydromechanical parking brakes are fitted, they shall be applied mechanically and released hydraulically.

When the operator manually releases the parking brake from the normal operating position, it shall not disable the service brakes.

NOTE Local road regulations can apply when trucks are used on roads.

### 4.3 Electrical and electronic systems

#### 4.3.1 General

##### 4.3.1.1 Protection of circuits

Control and auxiliary circuits shall be fuse protected against short circuit conditions and dangerous excess current. Several auxiliary circuits in parallel, with combined rated current not exceeding 12 A, may be protected by a single device.

#### 4.3.1.2 Protection of wiring, conductors and electrical components

Any live part not connected to the truck frame shall be insulated and, where necessary, protected against thermal and mechanical damage.

#### 4.3.1.3 Specification

Copper conductors external to enclosures (excluding short connections between electric or electronic components and wires that are an integral part of a proprietary component) shall be:

- a) flexible;
- b) of cross-sectional area not less than:
  - 1) for control wiring: 0,5 mm<sup>2</sup>;
  - 2) for signal wiring: 0,3 mm<sup>2</sup>;
  - 3) for data communication wiring and for conductors of adequately supported copper multicore cables and wiring harnesses: 0,08 mm<sup>2</sup>;
- c) of cross-sectional area not less than 1,0 mm<sup>2</sup> for single wires not incorporated into a harness or extending from the harness more than 250 mm.

If conductors of other materials are used, they shall be selected and sized to give equivalent performance.

#### 4.3.1.4 Protection of wiring and electrical components against fuel leakage

Wiring and electrical components shall be designed, placed or protected to minimize hazards arising from leakage from the fuel system, such as contamination and fire.

#### 4.3.1.5 Mechanical protection

Where wiring passes through metal parts of the frame or enclosures, the holes shall be fitted with insulating bushes or the wiring shall be protected by some other equivalent means.

#### 4.3.1.6 Wiring that flexes

Wiring that flexes during normal operation of the truck functions shall be relieved of mechanical strain at their electrical termination.

#### 4.3.2 Degree of protection

Depending on the location/installation of electrical and electronic components, the following degrees of protection are required:

- a) all components installed on the truck's exterior or directly exposed to the environment shall have a minimum degree of protection corresponding to IP56 according to IEC 60529;
- b) for all components installed in the operator's enclosed cab or protected against the environment, the protection shall be designed and executed so as to safeguard the intended function under expected and intended conditions.

#### 4.3.3 Electrical connections

Wires, cables, terminals, etc., shall be identified by codings in accordance with the electrical diagram included in the service instructions.

This requirement does not apply to electrical circuits used for anti-theft systems, where fitted.

#### 4.3.4 Batteries

Batteries shall be restrained to prevent movement which can give rise to a hazard, and be mounted in a ventilated location that provides access for maintenance.

Batteries shall be designed, located or protected to minimize any hazard to the operator caused by battery acid or acid vapours in the event of overturning of the truck.

The truck shall be designed and constructed so that the battery can be electrically disconnected with the aid of an easily accessible device, e.g. a switch or connector. Disconnectable battery terminals satisfy this requirement provided the terminals are accessible without the use of a key or tool.

For marking, see [6.3](#).

#### 4.4 Controls

##### 4.4.1 General

The controls (hand levers, joysticks, pedals, switches, etc.) and indicators of the truck and attachment shall be as follows:

- easy to reach from the normal operating position, according to ISO 6682;
- clearly identified with an indelible means and visible in the operator's station. If appropriate, graphical symbols in accordance with ISO 7000 shall be used and described in the operator's manual (see [6.2](#));
- designed such that movement of the controls to activate the functions and indicators corresponds to the intended effect or common practice whenever possible. For guidance, see [Table 2](#).

**Table 2 — Load handling controls**

Function	Direction of motion		
	of load or equipment	predominant motion of the operator's hand	
Main functions	Reach	Retract Extend	Rearward or to left Forward or to right
	Lift	Up Down	Rearward Forward
	Tilt (mast/fork)	Rearward Forward	Rearward or to left Forward or to right
	Frame level	Clockwise Counter-clockwise	Right Left
	Stabilizer	Raise Lower	Rearward or up Forward or down
	Side shift	Right Left	Rearward or to right Forward or to left
	Push-pull	Push-pull	Rearward Forward
Rotate laterally		Clockwise Counter-clockwise	Rearward, up or to right Forward, down, or to left
Rotate longitudinally		Rearward Forward	Rearward or up Forward or down
Load stabilizer		Down	Rearward or up

Table 2 (continued)

Function		Direction of motion	
		of load or equipment	predominant motion of the operator's hand
Auxiliary functions		Up	Forward or down
	Swing	Right	Rearward, up or to right
		Left	Forward, down, or to left
	Slope	Clockwise	Rearward, up or to right
		Counter-clockwise	Forward, down, or to left
	Fork position	Together	Rearward or up
		Apart	Forward or down
	Trip	Engage	Rearward or up
Release		Forward or down	
Grip	Engage	Rearward or up	
	Release	Forward or down	
Clamp	Clamp	Rearward or up	
	Release	Forward or down	

Control fitted to the truck should be designed using ISO 10968 as guidance.

The surface of a rotary control device should move in the same sense of direction as a lever.

For safety-related functions of the control system(s), Table 3 applies, or similar analysis shall be done by the manufacturer according to ISO 19014-1 or ISO 13849-1 or equivalent methods.

Table 3 — PLr and SIL for controls

Subclause in this document	PLr (ISO 13849-1)	SIL (EN 62061)
<a href="#">4.2.3</a>	b	1
<a href="#">4.2.4</a>	b	1
<a href="#">4.2.5</a> Means shall be provided to prevent powered travel when the operator is not in the normal operating position.	c	1
<a href="#">4.2.5</a> Powered travel shall not occur automatically when the operator returns to the normal operating position without an additional operation, e.g. by reset of the direction control to neutral.	b	1
<a href="#">4.2.5</a> Application of the parking brake shall engage transmission in neutral, except on trucks with hydro-static transmission.	c	1
<a href="#">4.2.6</a>	b	1
<a href="#">4.4.2</a> the use of the controls at one operator's position shall preclude the use of the controls at other operator's positions.	c	1
<a href="#">4.4.4</a> (only when the deactivation device is provided)	b	1
<a href="#">4.4.7.2.1</a>	b	1
<a href="#">4.4.7.2.2</a>	c	1
<a href="#">4.4.5</a> , second paragraph Visual indication shall be provided to inform the operator of the selected mode(s) of operation.	b	1
<a href="#">4.4.8</a> If the truck is equipped with an automatic axle oscillation locking-mechanism, it shall comply with <a href="#">Table 3</a> .	b	1

Table 3 (continued)

Subclause in this document	PLr (ISO 13849-1)	SIL (EN 62061)
4.6, first indent They shall be fitted with locking devices, e.g. load holding valves, to keep them in position in case of hose failure or oil leakage.	b	1
4.6, second indent Means shall be provided so that the operator is able to verify that the stabilizing devices are positioned in a safe travelling position when moving the truck.	b	1
4.6, fourth indent Means shall be provided so that the operator is able to verify that each stabilizing device is deployed to support the truck in conformity with the load chart(s).	b	1

Remote-operator-controlled systems fitted to the truck shall comply with ISO 15817.

#### 4.4.2 Multiple operating positions

If more than one operating position is fitted, the use of the controls at one operating position shall preclude the use of the controls at others, except for the emergency stop if fitted, which shall be operable from all active operating positions.

If fitted, the emergency stop shall comply with ISO 13850. In case of remote control, compliance with ISO 15817:2012 4.5, fulfils this requirement.

#### 4.4.3 Controls of trucks accessible from ground level

Where controls are accessible from the ground, means shall be provided to minimize the possibility of actuating them from the ground (e.g. protection by door, guard or by interlocking devices).

#### 4.4.4 Inadvertent activation

Controls that can cause a hazard due to inadvertent activation shall be arranged, deactivated or guarded so as to minimize the risk. A deactivation device shall either be self-acting or acting by compulsory activation of the relevant device.

#### 4.4.5 Travel controls

4.4.5.1 Service brakes, if foot operated, shall be applied by depressing a pedal located to allow right-foot operation.

Operation of the service brake pedal shall not be hindered by the simultaneous use of other controls.

The pedal layout and construction shall ensure a comfortable position for the operator and moderate operating efforts, taking ergonomic principles into consideration.

The pedal layout shall be as follows (see [Figure 3](#)):

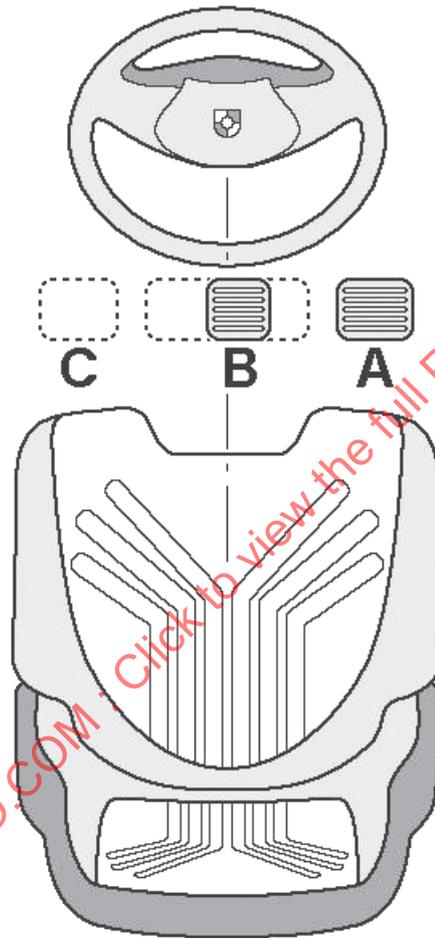
- the accelerator pedal shall be positioned on the right;
- the service brake pedal shall be located at the accelerator pedal's left;
- the clutch pedal, if fitted, shall be positioned in such a way to be operated by the operator's left foot; it shall be on the left of the two other pedals.

4.4.5.2 The parking brake control shall be located convenient to the operator in the normal operating position.

4.4.5.3 Clutch pedal, if fitted, shall disengage the clutch by depressing the pedal.

4.4.5.4 Accelerator pedal shall increase travel speed by depressing the pedal. When released, the accelerator pedal shall:

- return to neutral position; and
- provide reduction of travel speed.



**Key**

- A accelerator pedal
- B service brake pedal; or  
inching + service brake pedal
- C clutch pedal;  
inching pedal; or  
inching + service brake pedal if service brake pedal is also in B

The dotted lines indicate:

- optional clutch pedal C;
- brake pedals B which can extend partly to the left of the seat longitudinal axis.

**Figure 3 — Pedal layout**

NOTE The shape of the pedals sketched above are only for illustrative purposes.

**4.4.5.5** If an inching pedal is fitted, it shall be designed so that when it is depressed, it modulates the transmission. When full application disengages the transmission, it also applies the service brakes. It shall be capable of being operated by the operator's left foot. If there is no separate means of applying the service brake, the inching pedal shall be a single pedal capable of being operated equally by either foot.

**4.4.5.6** Pedals, except for the parking brake pedal if equipped, shall be designed such that the pedal automatically returns to its original position when the operator removes their foot from the pedal.

**4.4.5.7** The pedals shall have a slip-resistant surface and be easy to clean.

#### **4.4.6 Differential locking**

If a manual differential lock is fitted, the control shall allow the operator to activate the disengagement of the differential lock when travelling.

If the truck is equipped with a pedal-operated differential lock, depressing the pedal shall lock the differential.

If the truck is equipped with a differential lock that is engaged by other means (e.g. switch or hand lever), the engaged and disengaged positions shall be clearly marked.

#### **4.4.7 Steering controls**

##### **4.4.7.1 Response to movement**

The steering mechanism shall be designed to ensure a proportional response to movement of the control.

##### **4.4.7.2 Steering direction**

**4.4.7.2.1** On trucks with a steering wheel control, clockwise rotation of a steering wheel shall steer the truck to the right when the truck is travelling in the forward direction.

**4.4.7.2.2** On trucks with a crab steering mode, clockwise rotation of the steering wheel shall move the truck to the right when the truck is travelling in the forward direction and to the left when it is travelling in the reverse direction.

**4.4.7.2.3** On trucks on which the steering is controlled by means of a single lever control, moving the lever to the right shall cause the truck to be steered to the right when the truck is travelling in the forward direction.

**4.4.7.2.4** On trucks with reversible control unit or dual controls, the requirements of [4.4.7.2.1](#) and [4.4.7.2.2](#) shall be met when the operator is facing in the intended direction of forward travel.

##### **4.4.7.3 Failure of power supply**

In the event of an interruption of the power supplied to the steering system (including a stalled engine), the truck shall be capable of steering a path. The truck shall be tested according to the following conditions and shall meet the following requirements:

- the truck shall be loaded to its technically permissible maximum operating mass; tyre pressures and mass distribution between the axles shall conform to the manufacturer's instructions given in the instruction handbook;
- the boom shall be in the transport position as defined by the manufacturer;
- interrupt the power supply to the steering system before starting the spiral movement;

- the truck shall describe a spiral movement at a speed of  $(10 \pm 2)$  km/h, starting from the straight-ahead position, on a dry, flat road surface offering good tyre adhesion;
- the maximum steering effort on the steering control shall be measured from the straight-ahead position after interruption of the power supply, until the truck enters and negotiates a turning circle of 12 m radius measured at the outermost steered wheel;
- the duration of the manoeuvre (time between the moment when the steering control is first operated and the moment when the truck enters a turning circle of 12 m radius) shall not exceed 8 s;
- one manoeuvre shall be made to the left and one to the right;
- the emergency steering effort required to achieve a turning circle of 12 m radius, starting from the straight-ahead position, shall not exceed 600 N. Higher transient steer efforts of less than 0,5 s duration are permitted.

#### 4.4.7.4 Strength of components

The steering control and its support members shall be capable of withstanding a force of 900 N in any direction at the actuating means (e.g. steering wheel) without any functional damage or permanent deformation.

#### 4.4.7.5 Steering knobs

Where steering can be accomplished with either hand and the steering mechanism is of a type (power assisted steering or equivalent) that prevents road reactions from causing the handwheel to spin, steering knobs may be fitted. If fitted, steering knobs shall be of a type that can be engaged by the operator's hand from the top and shall be within the periphery of the steering handwheel.

Steering knobs shall meet the requirements of [4.4.7.4](#).

#### 4.4.8 Load-handling controls

##### 4.4.8.1 General

Controls shall return to neutral when released and shall stop load movements, except where otherwise specified in this document.

Controls shall preferably be located for right-hand operation.

The controls for the load-handling functions shall be separate from the driving controls, except the travel direction control, gear control, or both, which can be separate or not.

##### 4.4.8.2 Controls with detents or maintained engagement

###### 4.4.8.2.1 General

The boom float control and the auxiliary hydraulic control(s) for operating attachments (e.g. for concrete mixers, brooms, augers) may be equipped with detents or other devices to maintain engagement of the function.

These controls shall comply with [Table 3](#) or similar analysis shall be done by the manufacturer according to ISO 19014-1, ISO 13849-1 or equivalent methods.

A visual indication that the detent is activated shall be provided to the operator.

The detent mode shall either:

- a) be automatically deactivated when the truck is switched off and not be automatically activated when the truck is switched on; or

b) prevent the truck from being restarted until the detent mode is deactivated.

#### 4.4.8.2.2 Boom float control

On trucks equipped with boom float control, protection shall be provided against unintended lowering of the boom.

In addition to the provisions of 4.4.8.2.1, the boom float control mode shall be automatically deactivated when the boom-raising/lowering control is operated.

This control shall comply with Table 3 or similar analysis shall be done by the manufacturer according to ISO 19014-1, ISO 13849-1 or equivalent methods.

#### 4.4.9 Multi-function controls

If a control is designed to perform more than one function, each separate function shall be clearly identified in accordance with ISO 7000 in the operator's station and explained in the operator's manual (see 6.2).

Visual indication shall be provided to inform the operator of the selected mode(s) of operation.

Means to fulfil this requirement shall comply with Table 3 or similar analysis shall be done by the manufacturer according to ISO 19014-1, ISO 13849-1 or equivalent methods.

#### 4.4.10 Stabilizing device control

Where independent or selectable controls for stabilizing devices are provided, the left control shall operate the left stabilizing device, and the right control shall operate the right stabilizing device.

If selectable controls are provided, a single position may operate both stabilizing devices.

#### 4.4.11 Sway/levelling control

On trucks equipped with operator-controlled lateral levelling, operating the control to the left shall cause the truck to sway to the left, and operating the control to the right shall cause the truck to sway to the right.

#### 4.4.12 Axle oscillation locking-mechanism control

If the truck is equipped with an automatic axle oscillation locking-mechanism, the control shall comply with Table 3 or similar analysis shall be done by the manufacturer according to ISO 19014-1 or ISO 13849-1 or equivalent methods.

#### 4.4.13 Hand throttle control

A hand throttle control may be provided to set the engine speed. If provided, the travel speed shall be controlled by the accelerator pedal and travel shall not be initiated without the accelerator pedal being operated.

When the direction of motion of a hand throttle control is in a plane parallel to the longitudinal axis of the truck, the direction of motion shall be generally forward or upward to increase engine speed.

### 4.5 Power systems and accessories

#### 4.5.1 Exhaust systems

Exhaust systems shall be designed to direct engine exhaust emissions away from the normal operating position(s) and any passenger position(s). Materials used in the vicinity of an exhaust system shall be chosen and protected so that they are not adversely affected by heat from the exhaust system.

## 4.5.2 Cooling systems

Cooling systems shall be designed to prevent air flow through the system from being directed at the operator and any passenger position(s), or so that the operator and passenger(s) are shielded from airflow through the system (see also 4.9.3 and 4.11.1).

## 4.5.3 Tanks and pressure vessels

### 4.5.3.1 General

Fuel and hydraulic tanks shall be provided with fluid level indicators. Pressure in the tanks exceeding the pressure specified by the manufacturer shall be automatically compensated by a suitable device (vent, safety valve, etc.).

### 4.5.3.2 Filler openings

Filler openings of tanks (except window washer and brake fluid reservoirs) shall be located outside the operator's station.

### 4.5.3.3 Fuel tanks

Fuel tanks shall be securely mounted. The installation arrangement and construction shall ensure that any fuel leaking from the tank, its filler or its connections shall not collect in pools without a passive means for drainage and shall not drain onto unprotected electrical or hot parts.

If the tank is to contain gasoline, the tank installation shall be designed and installed in the truck such that any ignition hazard due to static electricity is avoided.

If the filler is located on the side of the truck, the filler cap shall not, when closed, project beyond the external envelope of the truck.

Fuel tanks shall withstand an internal pressure of 0,03 MPa gauge (0,3 bar gauge)<sup>1)</sup> without permanent deformation or leakage.

Fuel spillage shall not be possible during normal operating conditions, as specified by the manufacturer, excluding refuelling and fuel filter replacement.

If constructed with non-metallic materials, the fuel tank shall comply with ISO 21507.

### 4.5.3.4 Pressure vessels

Pressure vessels shall be designed in order to minimize risks for any exposed person.

## 4.6 Stabilizing devices

When stabilizing devices are provided:

- a) they shall be fitted with locking devices, e.g. load holding valves, to keep them in position in case of hose failure or oil leakage;
- b) means (e.g. visual indication) shall be provided so that the operator is able to verify that the stabilizing devices are positioned in a safe travelling position when moving the truck;
- c) each stabilizing device shall be equipped with a footplate that is self-aligning in at least one plane; and
- d) means (e.g. visual indication) shall be provided so that the operator is able to verify that each stabilizing device is deployed to support the truck in conformity with the load chart(s).

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1) 1 bar = 0,1 MPa = 0,1 N/mm<sup>2</sup> = 10<sup>5</sup> N/m<sup>2</sup>.

Means other than visual indication to fulfil these requirements shall comply with [Table 3](#) or similar analysis shall be done by the manufacturer according to ISO 19014-1, ISO 13849-1 or equivalent methods.

## 4.7 Design requirements for maintenance purposes

### 4.7.1 General

Trucks shall be designed such that routine lubrication and maintenance operations can be performed safely, using ISO 11525-1 as guidance on the safe maintenance of trucks. ISO 2860 shall apply for openings intended for maintenance purposes.

Where the maintenance procedures described in the operator's manual can only be performed with a component (e.g. boom, tiltable cab) in a position that can cause injury, the component shall be mechanically secured with a device(s) designed to withstand at least 1,5 times the mass of the elements that have to be supported according to the instructions handbook, provided with, and permanently affixed to, the truck, or stored in a secure place on the truck.

The boom support device, excluding the attaching parts, shall be red or yellow contrasting with the colour of the truck.

### 4.7.2 Tiltable cab support device

If a cab is designed to be tilted for maintenance, servicing or other non-operational purpose, a means of locking the controls shall be provided. If daily maintenance is required below a tilted cab, an automatically acting support device shall be provided.

## 4.8 Systems for lifting, tilting and reaching

### 4.8.1 Chains and wire ropes

#### 4.8.1.1 Chains

When the lifting or reaching mechanism includes one or more chains, the truck manufacturer shall use only leaf or roller chains. These chains shall provide a factor,  $K_1$ , with the minimum values specified in [Table 4](#).  $K_1$  is calculated according to [Formula \(1\)](#).

$$K_1 = \frac{(L_c \times n)}{(Q + w)} \quad (1)$$

where

$L_c$  is the minimum breaking load for new chain;

$n$  is the number of chains;

$Q$  is the maximum static load (rated capacity and dead weight of the lifting mechanism) that would exist in a single or more than one equally loaded chain when the truck and boom are stationary in the least favourable position assuming no friction in the boom structure or lifting/reaching mechanism;

$w$  is the friction load in lifting/telescoping mechanism carried by the chains;

and where  $L_c$ ,  $Q$  and  $w$  are expressed using the same unit.

Pulley diameters shall follow the chain manufacturer's recommendations.

Table 4 — Factor  $K_1$

Trucks <10 000 kg rated capacity	$K_1 \geq 5$
Trucks $\geq 10\ 000$ kg rated capacity	$K_1 \geq 5 - 0,2 (Q_1 - 10)$
$K_1$ shall never be less than 4.	
$Q_1$ is expressed in tonnes (t).	

4.8.1.2 Wire ropes

When the lifting or reaching mechanism includes one or more wire ropes, the truck manufacturer shall use only wire ropes with a factor,  $K_2$ , of at least 6.  $K_2$  is calculated according to [Formula \(2\)](#).

$$K_2 = \frac{(L_{wr} \times n)}{(Q + w)} \tag{2}$$

where

$L_{wr}$  is the minimum breaking load for new wire rope;

$n$  is the number of wire ropes;

$Q$  is the maximum static load (rated capacity and dead weight of the lifting mechanism) that would exist in a single or in equally loaded wire ropes when the truck and boom are stationary in the least favourable position, assuming no friction in the boom structure and in the lifting/reaching mechanism;

$w$  is the friction load in lifting/telescoping mechanism carried by the wire ropes;

and where  $L_{wr}$ ,  $Q$  and  $w$  are expressed using the same unit.

Pulley diameters shall follow the wire rope manufacturer’s recommendations.

4.8.2 Hydraulic system

4.8.2.1 Hydraulic circuit

Hydraulic circuit shall comply with ISO 4413:2010, except for 5.3.2.3, 5.3.2.5.2, 5.4.6.2, 5.4.7.4.3, 7.4.2.1 and 7.4.5.

Hoses, piping and connections subject to internal pressure shall be capable of withstanding, without bursting or permanent deformation, a pressure equal to at least three times the maximum working pressure. Pipes and hoses shall be located and restrained so as to minimize deterioration, sharp edges and other damage-causing sources. The hydraulic system shall be designed and installed such that its performance and reliability are not reduced or its components damaged as a result of external stresses, vibration or movements of the truck or its components.

Each hose assembly in the hydraulic system shall be identified.

When needed to allow correct connections, maintenance and troubleshooting, hydraulic components in the hydraulic system shall be identified.

4.8.2.2 Pressure control

Hydraulic systems shall include devices that prevent the pressures in the systems from exceeding pre-set levels. The devices shall be designed and fitted so that unintentional loosening or adjustment is avoided and a tool or key is required to alter the pressure setting.

#### 4.8.2.3 Oil purification

The hydraulic system(s) shall be continuously protected against the risk of contamination of the hydraulic oil, e.g. by means of filter(s).

#### 4.8.2.4 Load holding

Means shall be provided to maintain the load in the event of leakage, a fault or interruption of the power supply, failure in the hydraulic circuit of the load lifting, tilting, reaching, stabilizing or lateral levelling systems.

The test to be used for verifying this requirement is given in [5.4](#).

#### 4.8.3 Maximum load-lowering speed

The maximum permissible lowering speed shall be such that in the event of a sudden stop of the lowering means, at the maximum reach for any load zone with the specified load, the rear wheels of the truck are only able to leave the ground momentarily and return to the ground unassisted.

The test to be used for verifying this requirement is given in [5.5](#).

#### 4.8.4 Limitation of stroke

Any mechanism on the truck with movement requiring limits to prevent over-travel (for example structural disassembling) shall be provided with mechanical stops. Hydraulic cylinders can fulfil this requirement if designed for that purpose.

#### 4.8.5 Fork arms, attachments and attachment brackets

Fork arms, attachments and attachment brackets shall be in accordance with [Annex B](#).

### 4.9 Operator's station

#### 4.9.1 General requirements

The normal operating position shall have space available for the operator to minimize the potential for interior impact during normal operation, using ISO 3411 as guidance.

Means shall be provided to prevent crushing of the operator between the descending boom and other parts of the truck.

#### 4.9.2 Storage of operator's manual

A means shall be provided inside the operator's station to store the operator's manual and other instructions. If the operator's station is not equipped with an enclosed cab, such means shall protect the manual(s) from climatic conditions (e.g. sunlight, rain, snow).

#### 4.9.3 Hot parts

All parts of the truck within the zones of comfort and reach of controls, as defined in ISO 6682, or within the reach of the operator when entering or exiting the normal operating position, shall be designed in accordance with ISO 13732-1.

The temperature of the air at the heater outlet, where fitted, shall not exceed 60 °C.

#### 4.9.4 Pipes and hoses

Pipes and hoses located within 1 m of the DLV (deflection limiting volume, see ISO 3164) and having a pressure exceeding 5 MPa or a temperature of 60 °C shall be guarded in accordance with ISO 3457.

Guards (including flexible hose coverings) shall be sufficiently sturdy to stop, disperse or divert a fluid stream in case of hose, pipe or component failure.

Any part or component that diverts a fluid stream can be regarded as a sufficient protection device.

An enclosed cab may be considered as a guard when hoses are located outside the enclosed cab, provided it meets the above requirement.

NOTE Enclosed cab doors or windows able to be opened during truck operations do not satisfy this requirement.

If possible, pipes and hoses should be placed outside the enclosed cab.

#### 4.9.5 Operator's station equipped with enclosed cab

##### 4.9.5.1 Climatic conditions

Provisions shall be made to accommodate a ventilation system, an adjustable heating system and a system for defrosting windows.

##### 4.9.5.2 Heating system

If a heating system is fitted, it shall either:

- a) comply with ISO 10263-4; or
- b) have the capability of increasing the temperature of the air inside the enclosed cab and of maintaining a temperature of 18 °C at the minimum ambient temperature in which the truck is intended to operate, with the minimum capacity of the heating system having a temperature variation,  $\Delta T$ , of 25 °C within 30 min.

The test shall be run starting with the engine at working temperature, as specified by the manufacturer. Measurement of the system capacity shall be made at three points located in a vertical plane through the seat index point (SIP) and parallel to the longitudinal axis of the truck (see [Figure 4](#)) as follows:

- 660 mm above the SIP and 20 mm in front of it;
- at the SIP, as defined by ISO 5353;
- 100 mm above the floor plate and 600 mm in front of the SIP.

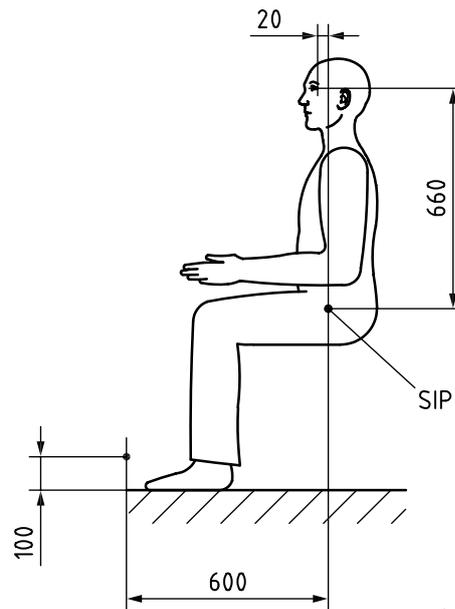


Figure 4 — Location of measuring points

Alternatively, the heating capacity can be determined by calculation.

NOTE Filter element selection depends on the intended operating environmental conditions.

#### 4.9.5.3 Demisting and defrosting systems

Trucks with an enclosed cab shall be provided with facilities for demisting and defrosting the front and rear window(s) — for example, by means of a heating system or particular defrosting device.

NOTE A method for testing windscreen defrosting system is given in ISO 10263-5.

#### 4.9.5.4 Air conditioning

If air conditioning is fitted, it shall comply with ISO 10263-4.

#### 4.9.5.5 Wipers and washers

The front and rear window(s) shall be fitted with motorized window wiper(s) and washer(s).

Wiper(s) and washer(s) shall be provided for the roof window if it is necessary for the operator to view the attachment or load through the roof window.

Wiper(s) shall clear a sufficient area to allow the operator to view the attachment or load through the entire lift zone.

The tank of the window washer(s) shall be easily accessible.

#### 4.9.5.6 Pressurization system

Where an enclosed cab is provided with a pressurization system, it shall be tested according to ISO 10263-3 and shall provide an interior relative pressure of at least 50 Pa.

#### 4.9.5.7 Doors and windows

Doors, windows and flaps shall be securely held in their intended operating positions; measures shall be taken for preventing inadvertent opening. Doors shall be retained in their intended operating position(s) by a positive engagement device. The door-open locking device for the primary opening shall be releasable from the operator's station.

It shall only be possible to open the boom side window if additional protection is provided to prevent the operator being injured by the boom and/or the opening is small enough to prevent the operator accessing this area from the cab.

If such protection depends solely on the glass, the truck shall be designed so that, in the event of a missing or broken boom side window, the operator is not at risk of injury.

Windows shall be made of safety glass or other material that provides similar safety performance (see, for example, ECE R43).

#### 4.9.5.8 Interior lighting system

The enclosed cab shall be fitted with a fixed inner lighting system. This system shall be able to function with the engine stopped, making it possible to illuminate the operator's station so that the operator's manual can be read.

#### 4.9.6 Operator's seat

##### 4.9.6.1 General

Trucks shall be fitted with an adjustable seat that supports the operator in a position that allows the operator to control the truck under the intended operating conditions.

All seat adjustments shall be possible without the use of tools and shall be clearly described in the operator's manual.

The seat dimensions and adjustments shall comply with ISO 11112. For compact trucks only, the fore and aft adjustment (see ISO 11112:1995, Table 1,  $l_2$ ) shall be at least an adjustment of 70 mm in total, and the vertical adjustment (ISO 11112:1995, Table 1,  $h_1$ ) is not required.

The operator's seat shall meet the following requirements:

- a) if a weight-adjustable seat is fitted, the adjustment shall accommodate a minimum range of operator weights, from 55 kg to 110 kg;
- b) swivelling seats shall be provided with a mechanism (e.g. spring or latch) to lock the seat in position, and the swivel shall be possible in all positions of adjustment;
- c) the seat mounting shall be able to withstand the forces that can occur during operation, e.g. braking.

##### 4.9.6.2 Suspension seat vibration

An operator's seat fitted with suspension shall meet the requirements of the following input spectral classes, according to ISO 7096, with regard to its ability to reduce the vibration transmitted to the operator:

- for trucks with an operating mass greater than 4 500 kg, EM 3;
- for trucks with an operating mass less than or equal to 4 500 kg, EM 8.

##### 4.9.6.3 Operator restraint

The truck shall have an operator restraint system according to ISO 6683.

#### 4.9.7 Control panels and symbols on displays

##### 4.9.7.1 Control panels

The operator shall be able to see, from the normal operating position, in daylight and in darkness, the indicators necessary in order to be able to check the proper functioning of the truck. Glare shall be minimized.

##### 4.9.7.2 Symbols on displays

Symbols for use on displays shall be in accordance with ISO 7000.

#### 4.9.8 Other indicating devices

##### 4.9.8.1 Longitudinal stability indications

Means shall be provided to indicate to the operator that the maximum limits of longitudinal stability determined by the longitudinal stability tests described in [4.12](#), have not been exceeded.

Load charts associated with boom angle indicator (e.g. pendulum), extension indicator (e.g. markings on the boom) and a longitudinal chassis inclinometer may be used to satisfy this requirement.

Longitudinal load moment indicator as specified in ISO 10896-7 can also be used to satisfy this requirement.

##### 4.9.8.2 Lateral slope indication

A lateral slope inclinometer (e.g. a bubble gauge) shall be fitted at the operating position.

#### 4.10 Operator access

##### 4.10.1 General requirements

Access system(s) shall be provided to the normal operating position and areas requiring routine maintenance as described in the operator's manual. Access system shall be in accordance with ISO 2867, except that the first step shall not be more than 550 mm above the ground (measured with the truck on tyres) and successive steps shall not be more than 350 mm apart. The values specified in ISO 2867 are to be considered with the wheels on the ground.

NOTE It is preferable to space successive steps evenly.

Effect of mud on the means of access shall be minimized by adequate design.

##### 4.10.2 Enclosed cab openings

###### 4.10.2.1 Primary opening

A primary access shall be provided. The dimensions shall be in accordance with ISO 2867:2011, Table 1.

It shall be possible to open the door from the inside without any tool or key.

###### 4.10.2.2 Alternative opening (emergency exit)

An alternative opening shall be provided on a side other than that of the primary opening. The dimensions shall comply with ISO 2867:2011, 5.3.2.

In order to be acceptable for use as an alternative opening, a window panel or another door shall be easy to open or remove without the use of keys or tools.

Latches may be used if they can be opened from the inside without the use of keys or tools.

The breaking of a suitably sized window panel is considered equivalent to an alternative opening, if the necessary hammer (or equivalent), immediately accessible to the operator in the enclosed cab, is provided. The hammer shall be secured to prevent accidental loss.

When a window is used as an emergency exit, it shall bear an appropriate marking (see, for example, IEC 61310-1:1995, Figure 8).

### 4.11 Protective measures and devices

#### 4.11.1 Hot parts

Parts that are hot due to the truck operation shall be designed, positioned or provided with a thermal guard to minimize the risk of contact with such parts and surfaces in close proximity to the primary opening, normal operating position or daily routine maintenance areas.

NOTE ISO 13732-1 gives guidance for cases where it is necessary to specify temperature limit values for hot surfaces, but does not set surface temperature limit values.

#### 4.11.2 Protection against crushing, shearing and trapping

Parts that move relative to one another and are within reach of the operator in the normal operating position shall be:

- positioned at distances in accordance with ISO 13857; or
- provided with guards in accordance with [4.11.3](#).

If hazards still exist, they shall be identified on the truck in accordance with [6.2.1](#).

#### 4.11.3 Guards

Guards shall be designed to be securely held in place and prevent access to dangerous areas and parts where a hazard exists.

Movable guards shall, if possible, remain attached to the truck when open. When unintentional closure can cause injury, movable guards and engine panels shall be fitted with a support system (e.g. springs, gas strut) to secure them in an open position for a wind speed up to 8 m/s.

Guards shall comply with ISO 3457.

Fixed guards shall be fitted where no daily maintenance is needed.

#### 4.11.4 Engine compartment

Engine compartment cover shall comply with [4.11.3](#).

Engine compartment cover shall be protected against unauthorized access if it provides a guarding function, for example, with:

- a lock that requires the use of a tool or key;
- a latch inside a lockable enclosed compartment (e.g. enclosed cab).

Where it is necessary to perform maintenance with the engine cover open, the moving elements (e.g. fans, rotating shafts) shall be protected either by a fixed guard or safety distances in accordance with ISO 13857.

#### 4.11.5 Fenders

If the risk exists, the operator in the normal operating position and the critical information displays shall be protected from debris thrown up by the tyres or tracks, in any steered position, for example, by means of fenders.

#### 4.11.6 Roll-over protective structures (ROPS) and falling object protective structures (FOPS)

Trucks shall be equipped with:

- ROPs in accordance with ISO 3471:2008, Table 1, third list item; and
- FOPs in accordance with ISO 3449 level I for compact trucks and level II for other trucks. Openings in the top of the overhead guard shall not exceed 150 mm in one of the two dimensions, i.e. width or length.

#### 4.11.7 Elevating and/or tiltable operator's station

Elevating operator's station shall comply with [Annex C](#). Tiltable operator's station shall comply with ISO 10896-6.

#### 4.11.8 Audible warning devices

Trucks shall be equipped with an audible warning device (horn), operable from the operator's station, and complying with ISO 9533.

If a truck is equipped with a reverse audible alarm, it shall comply with ISO 9533.

### 4.12 Stability

#### 4.12.1 Stability tests on tilting platform

Trucks shall meet the requirements of ISO 22915-14.

For specific operating conditions foreseen by the manufacturer, the additional stability test of ISO 22915-10 (e.g. trucks intended to be fitted with an attachment for stacking with load laterally displaced by power) and/or ISO 22915-20 (e.g. trucks intended to be fitted with a bucket) shall apply.

#### 4.12.2 Longitudinal load moment control

When fitted, longitudinal load moment control shall comply with ISO 10896-7. When a longitudinal load moment control is fitted, a longitudinal load moment indicator in accordance with ISO 10896-7 shall be fitted.

### 4.13 Visibility

Trucks shall meet the requirements of ISO 18063-1.

### 4.14 External lighting devices

Work lights shall be provided;

All lighting devices shall comply with the relevant clauses of ISO 12509.

## 4.15 Fire protection

### 4.15.1 Fire resistance

The interior, upholstery and insulation of the operator's station shall be made of flame-retardant materials, the burning rate of which shall not exceed 200 mm/min, as tested in accordance with ISO 3795.

### 4.15.2 Fire extinguisher

Space shall be provided for installation of fire extinguisher(s) and shall be accessible to the operator or trucks shall have a built-in extinguishing system.

## 4.16 Retrieval, transportation, lifting and towing

### 4.16.1 General

Attachment points for tying-down, lifting, retrieval and towing of the truck, and their correct use shall be described in the operator's manual.

If a pin is part of the retrieval, tie-down, lifting or towing device, the securing device for the pin (if needed) shall not be detachable from the pin.

### 4.16.2 Retrieval

Retrieval points shall be provided at the front and/or rear of the truck and shall be clearly identified on the truck (see [6.2.4](#))

The capacity of the retrieval point shall be equal to 1,5 times the machine mass.

The retrieval point shall withstand the above capacity at the maximum pull angle.

### 4.16.3 Tie-down

Tie-down points shall be provided in accordance with ISO 15818 and shall be clearly identified on the truck (see [6.2.3](#)).

### 4.16.4 Lifting

When the truck is designed to be lifted, lifting attachment points shall be provided in accordance with ISO 15818 and shall be clearly identified on trucks and subassemblies that are to be lifted separately (see [6.2.2](#)).

When trucks are not designed to be lifted, it shall be clearly stated in the operator's manual.

### 4.16.5 Towing

Trucks with provision for towing shall be fitted with towing or coupling devices designed and arranged to ensure easy and safe connection and disconnection, and to prevent accidental disconnection during use.

NOTE Specific road and agricultural requirements can apply (see, for example, ISO 6489).

## 4.17 Noise

### 4.17.1 Noise emission measurement

The emission sound pressure level at the operator's station and the emission sound power level in the environment shall be measured according to EN 12053 or ANSI B56.11.5.

## 4.18 Electromagnetic compatibility

Trucks shall be tested according to at least one of the following EMC standards: ISO 13766-1 or EN 12895.

## 5 Verification of requirements and safety measures

### 5.1 General

The manufacturer shall verify that each individual requirement of this document has been met by the design and manufacture of the truck, for example by:

- a) design, e.g. verification of drawings and documents, or calculation;
- b) measurement, e.g. tests of travelling and lowering speeds and lift and tilt leakage;
- c) visual examination, e.g. no permanent deformation after tests, verification of the marking of the truck; and/or
- d) specific tests, e.g. type tests.

### 5.2 Functional verification

Functional verification shall be performed on each truck to verify that:

- the truck is able to perform the tasks for which it was designed, (for example travelling, braking, steering, load handling);
- safety devices function as intended (e.g. seat belt, load moment control if fitted);
- controls operate as intended, including remote control if fitted;
- lighting devices, etc., function correctly.

### 5.3 Structural verification

#### 5.3.1 Test loads

The test loads are:

- $Q_1$  the rated capacity of the truck;
- $Q_2$  the actual capacity at maximum lift height; and
- $Q_3$  the actual capacity at maximum reach.

See [Figure 1](#).

Two different  $Q_2$  and  $Q_3$  values can be specified: one with the truck on tyres, and the other with the truck on stabilizing devices.

#### 5.3.2 Static test

##### 5.3.2.1 Purpose

The purpose of this test is to demonstrate the overall structural integrity of the loaded truck in static conditions. It shall be applied to each representative type of truck.

### 5.3.2.2 Test procedure

**WARNING** — For this test, it is advisable to secure the truck to the ground to avoid the risk of overturning.

Trucks shall be type-tested on firm, level ground at 125 % of  $Q_1$ ,  $Q_2$  and  $Q_3$  at the corresponding positions.

### 5.3.2.3 Acceptance criteria

The truck shall be considered as complying with this test if the test load is safely supported for 10 min without permanent deformation or component failure.

## 5.3.3 Dynamic testing

### 5.3.3.1 Purpose

The purpose of this test is to demonstrate the overall structural integrity of the loaded truck in dynamic conditions. It shall be applied to each representative type of truck.

### 5.3.3.2 Test procedure

Trucks shall be tested at 100 % of each of the three capacities,  $Q_1$ ,  $Q_2$  and  $Q_3$ , in a complete operating cycle, at the maximum engine speed specified by the manufacturer, and from a stationary, fully retracted and lowered boom position to each of the positions specified below, and back again.

This test shall be conducted on level ground.

Sequence:

- a) bring  $Q_1$  to the fully retracted and maximum lifted position;
- b) bring  $Q_2$  to the fully retracted maximum lifted position and then to maximum height; and
- c) bring  $Q_3$  to maximum reach.

NOTE In order to perform this test safely, it is advisable to secure the truck to the ground.

### 5.3.3.3 Acceptance criteria

The truck shall be considered as complying with this test if the test is completed without permanent deformation or component failure.

## 5.4 Load holding verification

Compliance with [4.8.2.4](#) shall be checked on each truck as follows:

- a) the descent of the load shall be measured in the position that creates the highest pressure in the lift cylinder and shall not exceed 150 mm in 10 min with the oil in the hydraulic system at normal working temperature;
- b) the average forward tilting with  $Q_1$  of fork carriage speed shall not exceed 0,5° per min.

## 5.5 Maximum load lowering speed

Compliance with [4.8.3](#) shall be checked as defined below, unless the truck is fitted with a LLMC according to ISO 10896-7.

Trucks shall be tested at 100 % of the capacity  $Q_2$  and  $Q_3$  on level ground.

The test procedure shall start from the maximum lifting position. With the engine at maximum speed, attain full lowering speed, then quickly release the control when the angle of the boom to the horizontal is not more than 20° or the maximum reach for the relevant load zone is reached.

The truck shall not overturn and the load carrier shall not hit the ground. It is acceptable for the rear wheels to momentarily leave the ground.

The means for preventing tip-over during the test shall impose no appreciable restriction on the truck until the tip-over instance occurs.

NOTE In order to perform this test safely, it is advisable to secure the truck to the ground.

## 6 Information for use

### 6.1 Instruction handbook

#### 6.1.1 General

The manufacturer shall provide instructions complying with ISO 12100:2010, 6.4.5, using drawings or pictures and simple and clear language, avoiding specific technical terminology.

The instruction handbooks shall be made up of at least 2 volumes:

- operating and maintenance instructions;
- service instructions.

Service instructions shall be intended only for specialist service personnel and shall be separated from the operating and maintenance instructions.

#### 6.1.2 Operating and maintenance instructions

Operating and maintenance instructions shall be intended for the operator or other non-specialized personnel and shall be combined.

They shall be supplied:

- a) with the truck;
- b) in paper format. They can be supplied in electronic format in addition.

The following information covering use of the truck shall be provided:

- a) intended and prohibited uses of the truck;
- b) climatic conditions for which the truck is designed;
- c) instructions on the protective measures to be taken by the operator, including, where appropriate, the personal protective equipment (PPE) to be used;
- d) conditions in which the truck meets the requirement for stability during use and transportation;
- e) operating method to be followed in the event of breakdown;
- f) instructions on the use of the operator-restraint device, system or enclosure, and guidance on the operator's behaviour in the event of a tip-over;
- g) prohibition of operation in hazardous atmospheres for which the truck is not designed.

### 6.1.3 Instructions regarding the truck

The following information covering the truck shall be provided:

- a) business name and full address of the manufacturer or authorized representative;
- b) description of the truck and approved attachments for use with the truck;
- c) description of the safety systems and warning signs;
- d) description of the wheels and tyres:
  - 1) types of rims for the front and rear wheels;
  - 2) makes, types and size of tyres which can be used, and required inflation pressures;
  - 3) makes, types and size of solid tyres which can be used, if any;
- e) capacity of, and performance data on, the truck and the combination of truck and related attachments;
- f) truck mass, dimensions and turning radii.

### 6.1.4 Instructions regarding the operational use of the truck

The following information covering operational use of the truck shall be provided:

- a) required competencies of the operator;
- b) information on residual risks, if any;
- c) ground-bearing load under tyres and ground bearing pressure under stabilizing devices in static position, in maximum loaded and unloaded conditions;
- d) daily checks before operating the truck;
- e) instructions for access and egress;
- f) adjustment of the operator's seat and use of the seat belt;
- g) operating controls and operating displays;
- h) starting, driving and braking of the truck;
- i) handling of loads and use of the different attachments, and warning about the hazards due to the action of wind forces;
- j) an explanation on how to understand and use load charts;
- k) information on possible displacement of the centre of gravity;
- l) lift height for travelling;
- m) travelling on gradients;
- n) safe parking of the truck;
- o) use when the operator's direct visibility is limited;
- p) instructions for towing with the truck, when applicable;
- q) the operating method to be followed in the event of a malfunction or breakdown;
- r) noise level as measured in [4.17](#);

- s) the sentence: “a seat is an essential means to reduce the vibration transmitted to the operator. In case of replacement of the seat, refer to the manufacturer”;
- t) when applicable, information that the lifting of persons is prohibited;
- u) position intended for the fire-extinguisher.

#### 6.1.5 Instructions regarding internal combustion engine trucks

The following information relating to internal combustion (IC) engine trucks shall be provided:

- a) approved fuels;
- b) safe handling of fuels;
- c) refuelling operations;
- d) warning of the effect of exhaust emissions in confined spaces;
- e) warning of the effect of exhaust emissions on the operator.

#### 6.1.6 Instructions regarding transportation and storage of trucks

The following information on transportation and storage of trucks shall be provided:

- a) loading and unloading of trucks;
- b) location of tie-down points and procedure to use them, if needed;
- c) configuration for transport
- d) towing the truck and moving inoperative trucks;
- e) storage of trucks for extended periods of time.

#### 6.1.7 Instructions regarding inspection and routine maintenance

The following information covering inspection and routine maintenance shall be provided:

- a) training and competencies required for inspection and routine maintenance operations;
- b) information covering routine maintenance that can be performed by the truck operator;
- c) information covering operations which shall not be carried out by the operator, but to be performed by a competent person;
- d) type and frequency of inspections and maintenance operations required for safety reasons, with particular attention to the criteria for replacement of wearing parts;
- e) specifications of consumables and quantity required;
- f) information covering approved spare parts;
- g) filling and handling of battery, oil, diesel or other fuels, as applicable;
- h) instructions for the verification of marking;
- i) warnings of particular hazards and the correct procedure to be followed during maintenance;
- j) instructions for de-energizing stored energy components;
- k) access for inspection, service and maintenance at height, and under or in the boom;

- l) drawings, diagrams, descriptions and explanations necessary for use and routine maintenance of the truck;
- m) instructions for disposing of waste material (e.g. oils and battery);
- n) information for checking the proper functioning of any additional protective devices, e.g. load moment indicators, and the frequency of these checks, if fitted by the manufacturer or authorized representative;
- o) instructions for changing wheels.

## 6.2 Graphical symbols and warnings

### 6.2.1 Safety signs and graphical symbols

Safety signs shall be affixed to the truck and attachment in accordance with ISO 15870.

Trucks intended for lifting material only, shall bear clear and indelible marking(s) prohibiting the lifting of personnel.

Verification by visual examination.

### 6.2.2 Graphical symbols lift point

Locations of lift points, if provided, shall be clearly indicated on the truck. Graphical symbol ISO 7000-1368 shall be used (see [Figure 5](#)).

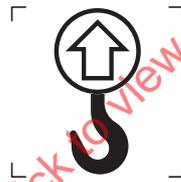


Figure 5 — Lift point

### 6.2.3 Graphical symbols tie-down point

Locations of tie-down points shall be clearly indicated on the truck. Graphical symbol ISO 7000-2069 shall be used (see [Figure 6](#)).



Figure 6 — Tie-down point

### 6.2.4 Graphical symbols of retrieval point

Location of retrieval points shall be clearly indicated on the truck. Graphical symbol ISO 7000-2686 shall be used (see [Figure 7](#)).

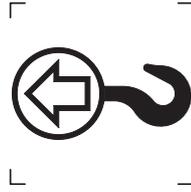


Figure 7 — Retrieval point

### 6.2.5 Graphical symbols for pneumatic tyre inflation pressures

The specified inflation pressures shall be clearly indicated on the truck. Graphical symbol ISO 7000-1435 shall be used (see [Figure 8](#)).

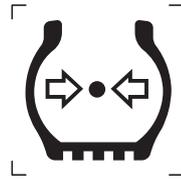


Figure 8 — Inflation pressure

### 6.2.6 Graphical symbol for fuel filling points

The location for fuel filling points shall be clearly indicated on the truck. Graphical symbol ISO 7000-0245 shall be used (see [Figure 9](#)).

NOTE Other symbols for specific fuel types are available (e.g. ISO 7000-1541 for diesel, ISO 7000-2489 for LPG).

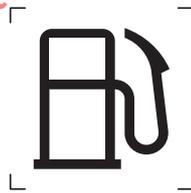


Figure 9 — Fuel filling point

### 6.2.7 Graphical symbol for hydraulic fluid filling points

The location for hydraulic fluid filling points shall be clearly indicated on the truck. Graphical symbol ISO 7000-1411 shall be used (see [Figure 10](#)).

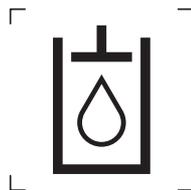
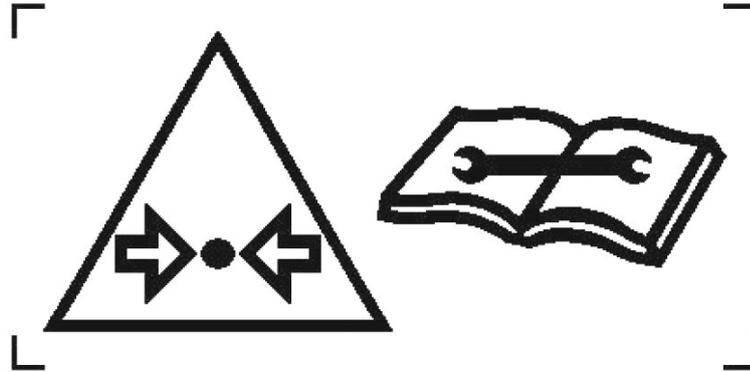


Figure 10 — Hydraulic filling point

**6.2.8 Graphical symbol for stored energy components**

A warning label and the method for removing the stored energy from such devices shall be affixed to the component. The following symbol shall be used; it's a combination of symbols ISO 7000-1701, ISO 7000-3098, and ISO 7000-1659 (see [Figure 11](#)).



**Figure 11 — Stored energy components**

Graphical symbol ISO 7000-3317 may also be used for pressurized accumulators.

**6.2.9 Graphical symbol for brake fluid filling points**

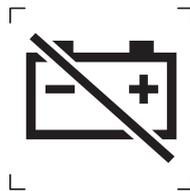
The location for brake fluid filling points shall be clearly indicated on the truck. Graphical symbol ISO 7000-1400 shall be used (see [Figure 12](#)).



**Figure 12 — Brake fluid filling point**

**6.2.10 Graphical symbol for battery disconnection**

The device for battery disconnection shall be clearly indicated on the truck. Graphical symbol ISO 7000-2063 shall be used (see [Figure 13](#)).



**Figure 13 — Battery disconnection**

**6.2.11 Warnings**

Warning devices and warning symbols as per [4.9.7](#) shall be described.

The following information shall be marked on the truck:

- a) a warning, visible to the operator in the normal operating position, stating that the truck is to be levelled to within the limits specified by the manufacturer before lifting or extending the boom;
- b) a warning, visible at the attachment carrier, stating that it is strictly forbidden to stand on the forks;
- c) a warning, visible at the attachment carrier, stating that it is strictly forbidden to stand beneath the forks, the attachment or the load.

## 6.3 Marking

### 6.3.1 Manufacturer plate(s)

Trucks shall be marked legibly and indelibly with the following minimum details. This information can be provided on one or more labels or plates:

- a) business name and full address of the manufacturer or authorized representative;
- b) designation of series or type;
- c) serial number;
- d) year of manufacture;
- e) rated capacity;
- f) net power of engine expressed in kilowatts (kW);
- g) operating mass according to ISO 6016 in kg of the unladen truck with forks (accuracy of  $\pm 5\%$ );
- h) where appropriate, the maximum vertical force and the drawbar pull provided for on the tow-hook in newtons (N).

## 6.4 Load charts

### 6.4.1 Trucks with load-carrying attachments

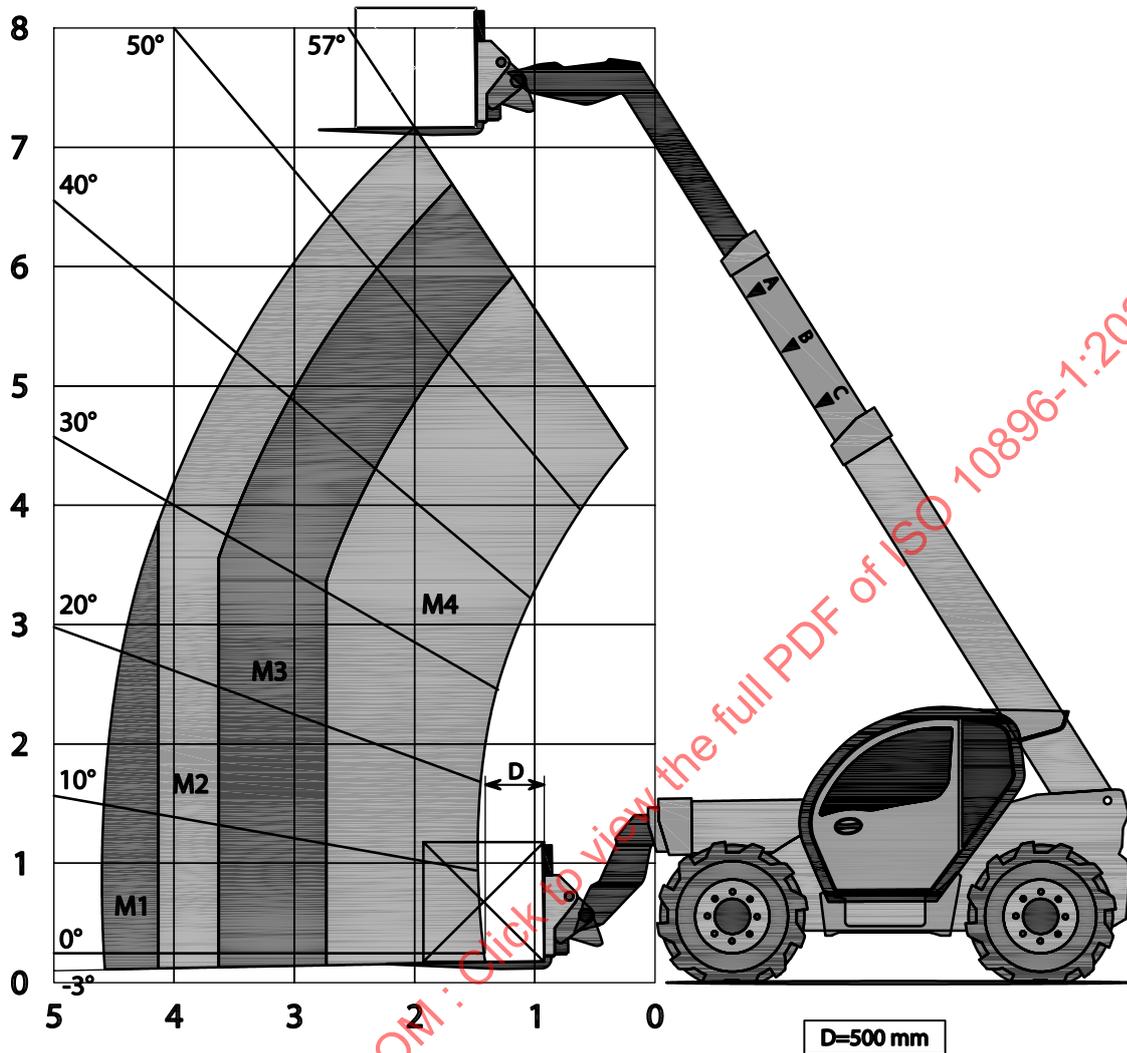
Where the manufacturer has authorized the use of load-carrying attachments, appropriate load charts shall be provided. The load chart shall be legible and durable, displayed in a prominent position, and easily readable by the operator in the normal operating position.

See [Figure 14](#) for an example.

The load chart shall provide information on:

- a) model of attachment to which it applies;
- b) applicable load centre distance(s);
- c) actual capacities at lift heights and reach;
- d) applicable limitations on the attachment use (e.g. slope);
- e) model of truck to which it applies;
- f) tyre characteristics. This can be fulfilled with a reference to the operator's manual;
- g) use with and without stabilizing device, if applicable; and
- h) use with and without ballasted tyres and optional counterweights, if applicable.

For trucks equipped with stabilizing devices, load charts shall be provided showing capacities when the stabilizing devices are deployed and when not deployed.



**Key**  
 M1, M2, M3, M4 load zones  
 D standard load centre distance  
 0,1,2,3,4,5,6,7,8 distance in metres  
 A, B, C boom length indicators

Figure 14 — Load chart

#### 6.4.2 Trucks with non-load-carrying attachments

Non-load-carrying attachments, e.g. hydraulic-breakers and brooms, which normally operate near the ground and comply with the stability criteria given in ISO 22915-14, do not require a load chart to be installed on the truck. If necessary, specific operating instructions for the limits on the attachment position, i.e. lift height or reach, shall be provided.