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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

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 10896-1 was prepared by Technical Committee ISO/TC 110, *Industrial trucks, Subcommittee SC 4, Rough-terrain trucks*.

ISO 10896 consists of the following parts, under the general title *Rough-terrain trucks — Safety requirements and verification*:

— *Part 1: Variable-reach trucks*

Slewing trucks, lorry-mounted trucks, freely swinging loads and straight-masted trucks are to form the subjects of future parts 2, 3, 4 and 5.

Introduction

Variable-reach trucks are known by a variety of terms, including “telehandlers” and “multi-purpose handlers”.

The variable-reach rough-terrain trucks covered by this part of ISO 10896 are designed to transport loads to and place them on elevated work areas and can be driven on unimproved or disturbed terrain.

They can also be equipped with a variety of attachments (e.g. fork arms, bale spikes) and interchangeable equipment (e.g. mowers, sweepers).

Rough-terrain trucks — Safety requirements and verification —

Part 1: Variable-reach trucks

1 Scope

This part of ISO 10896 specifies general safety requirements for non-slewing, variable-reach rough-terrain trucks (hereafter known as “trucks”), with an articulated or 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.

Other standards, in addition to the relevant provisions of this part of ISO 10896, can apply to the attachments.

This part of ISO 10896 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);

c) trucks designed primarily with variable-length load suspension elements (e.g. chain, ropes) from which the load may swing freely in all directions (mobile cranes)[1)];

d) trucks fitted with personnel/work platforms, designed to move persons to elevated working positions[2];

e) trucks designed primarily for container handling.

The significant hazards covered by this part of ISO 10896 are listed in Annex A. This part of ISO 10896 does not address hazards that can occur

— during manufacture,

— when handling suspended loads, which may swing freely,

— when using trucks on public roads,

— when operating in potentially explosive atmospheres, or

— with a battery, LPG or hybrid as the primary power source.

2 Normative references

The following referenced documents are indispensable for the application 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 2867:2011, *Earth-moving machinery — Access systems*

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

1) Additional requirements for trucks intended for freely swinging load applications, their lifting devices and attachments, and personnel/work platform applications on trucks, are being developed by ISO/TC 110/SC4.

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

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, *Powered industrial trucks — Terminology*

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

ISO 6016:2008, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

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 symbols*[2)]

ISO 7096:2000, *Earth-moving machinery — Laboratory evaluation of operator seat vibration*

ISO 9244, *Earth-moving machinery — Machinery safety labels — General principles*

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 10570, *Earth-moving machinery — Articulated frame lock — Performance requirements*

ISO 11112:1995, *Earth-moving machinery — Operator's seat — Dimensions and requirements.* Amended by ISO 11112:1995/Amd 1:2001

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 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

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

ISO 15817, *Earth-moving machinery — Safety requirements for remote operator control*

ISO 16528-1:2007, *Boilers and pressure vessels — Part 1: Performance requirements*

ISO 16528-2, *Boilers and pressure vessels — Part 2: Procedures for fulfilling the requirements of ISO 16528-1*

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2) The database on Graphical Symbols for Use on Equipment contains the complete set of graphical symbols included in IEC 60417 and ISO 7000: http://www.graphical-symbols.info/

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*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

3 Terms and definitions

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

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 of 2 150 mm, a maximum operating mass according to ISO 6016 of 6 000 kg, and/or a maximum width in normal travel mode of 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 fully retracted

SEE: Figure 1.

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

Note to entry The rated capacity of the attachment 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 and *reach* (3.6), in normal operation

SEE: Figure 1.

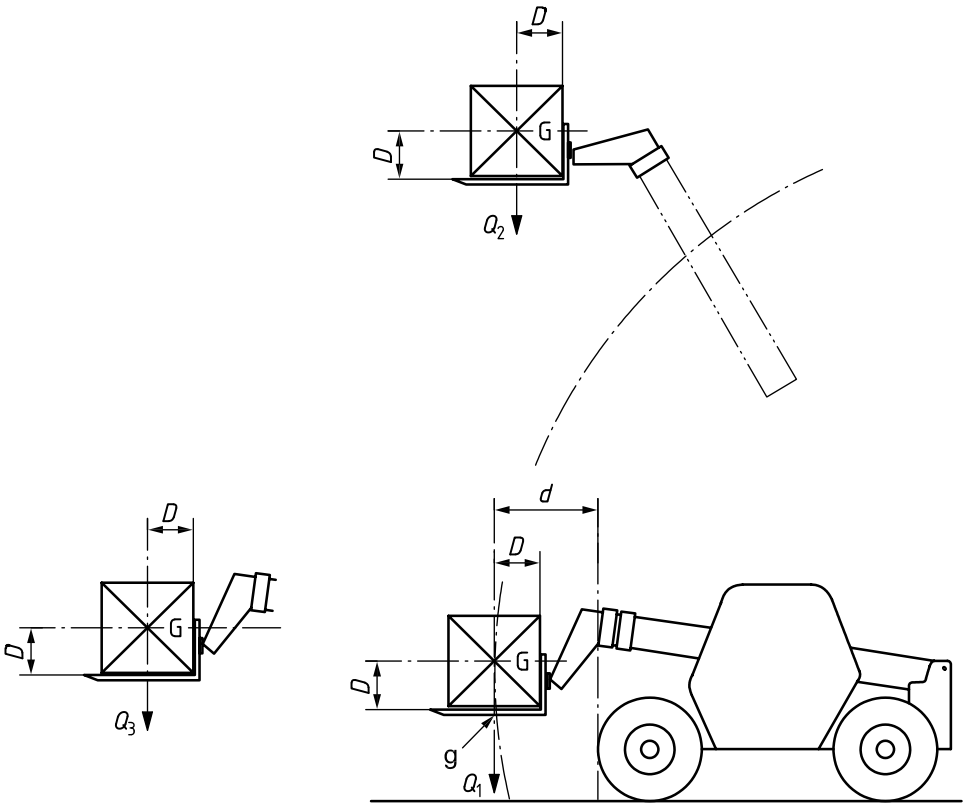
Note 1 to entry The actual capacity depends on the configuration of the truck in respect of variables including lift height, the reach of the boom, the actual load centre, load-handling devices and stabilizing devices.

Note 2 to entry It defines the load-handling ability of the particular truck as equipped. Additional actual capacity with removable attachments, 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

SEE: Figure 1.

NOTE 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)

SEE: Figure 1.

Note 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 Q_1 kg		Standard load centre distance D mm				
		400	**500**	**600**	**900**	**1 200**
0	< 1 000	X		X [a]		
≥ 1 000	< 5 000		X [c]	X [b]		
≥ 5 000	< 10 000			X		
≥ 10 000	< 20 000			X	X	X
≥ 20 000	< 25 000				X	X
≥ 25 000						X

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

[a] 600 mm is used in the USA.

[b] 600 mm is used in Asia, Australia and the USA.

[c] 500 mm is typically used in Europe.

3.9
lost load centre
LL
effective thickness
ET
horizontal shift in the standard load centre that may occur when removable attachments 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 devices
extendable and/or pivoting mechanical supports 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 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 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 to entry Other positions may be necessary if it is not possible to control all the functions of the truck from a single position.

3.17
attachment
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 to connect and lock interchangeable *attachments* (3.17) without the use of a tool to facilitate quick interchange of attachments

3.19
non-slewing
slewing movement not greater than 5° to either side of the longitudinal axis of the truck

SEE: Figure 2.

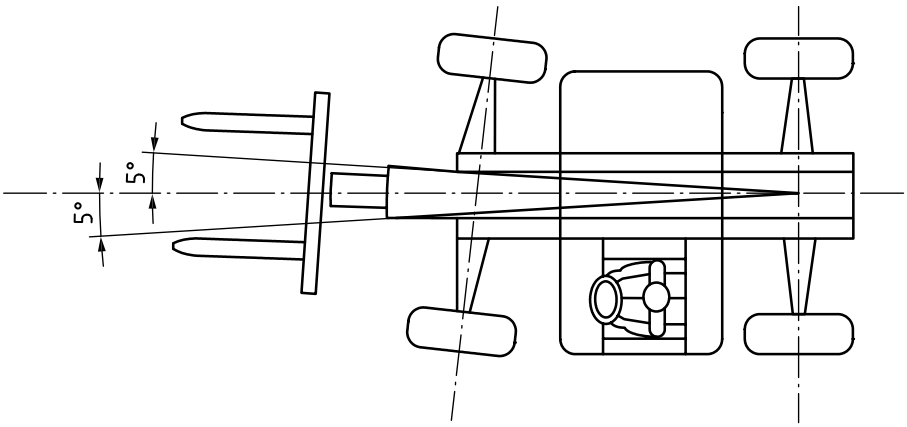


Figure 2 — Non-slewing movement

3.20
boom float
control mode that uses gravity to allow an *attachment* (3.17) at the end of the boom to follow a contour (e.g. the ground)

3.21
maximum working pressure
highest pressure at which a hydraulic circuit is intended to operate under normal operating conditions

3.22
articulated truck
truck in which steering is achieved by displacement of the front and rear frames around a central pivot

3.23
level ground
ground with a gradient of (0 ± 2) %

3.24
hybrid
truck powered using of two or more distinct power sources

4 Requirements

4.1 General

4.1.1 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.

4.1.2 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 clearly marked.

4.2 Starting/moving

4.2.1 Unauthorized starting

All trucks shall be provided with a device (e.g. key, key pad, magnetic card) that prevents starting without the use of such device.

4.2.2 Unintended movement

Trucks shall be fitted with a device which prevents the engine being started while the drive system is engaged.

When the drive system direction control is in neutral, provisions shall be made to locate and maintain it in its neutral position.

4.2.3 Uncontrolled motion

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

4.2.4 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. by reset of the direction control to neutral.

Application of the parking brake shall apply neutral travel control.

4.2.5 Non-activation of the parking brake

Means shall be provided to warn the operator, if he/she leaves the operating position when the parking brake is not applied.

4.2.6 Inching pedal

If an inching pedal is fitted, it shall be depressed to modulate the transmission and may apply the service brake. 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.

4.3 Brakes

4.3.1 General

Trucks shall be equipped with service brake(s), secondary brake(s) and parking brake systems, complying with the following requirements for wheeled trucks, as specified in ISO 3450.

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

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.

4.3.2 Failure of energy supply

Failure of the energy supply shall not result in loss of braking for automatically applied brakes.

4.4 Electrical and electronic systems

4.4.1 General

Electrical components and conductors shall be installed in such a way as to minimize damage from exposure to environmental conditions (corresponding to the use of the truck intended by the manufacturer) that can cause deterioration.

Electrical component insulation shall have flame-retardant properties. Means to prevent abrasion of electrical component insulation shall be provided, e.g. when routed through frames and bulkheads.

Electrical wires/cables not protected by over-current devices shall not be routed such that they are in contact with pipes and hoses containing fuel.

For safety-related functions of control system(s), the principles outlined in ISO 13849-1 shall be followed, or methods providing similar protection shall be applied.

4.4.2 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 IP55 (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.

4.4.3 Electrical connections

Electric wires and cables used to connect components in electric circuits shall be marked and identified, using ISO 9247 as guidance.

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

4.4.4 Over-current protective devices

Electric equipment, except the starter motor, alternator and combustion pre-heater, shall be protected by an over-current device (e.g. fuse) or other device giving the same protection.

4.4.5 Batteries

Batteries shall be securely mounted in a ventilated location that provides access for maintenance.

Batteries and/or battery locations shall be designed and built or covered to minimize any hazard to the operator caused by battery acid or acid vapours in the event of overturning the truck.

Electrically energized wires and cables (not connected to the frame) and connectors shall be covered with insulation material.

4.4.6 Battery disconnection

It shall be possible to disconnect batteries quickly, e.g. by a quick coupling or an accessible isolator switch.

Symbol 2063 of ISO 7000 may be used for identification.

4.5 Controls

4.5.1 General

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

a) easy to access from the operator's position;

b) clearly identified, indelible and visible in the operator's station; if appropriate, graphical symbols in accordance with ISO 7000 may be used and shall be described in the operator's manual (see 6.2);

c) designed such that movement of the controls to activate the functions and indicators corresponds to the intended effect or common practice whenever possible.

For safety-related functions of the control system(s), the principles outlined in ISO 13849-1 shall be followed, or methods providing similar protection shall be applied. See also 4.4.1.

Remote-operator-controlled systems fitted to the truck shall comply with the relevant provisions of ISO 15817, using ISO 6682 and ISO 10968 as guidance.

4.5.1.1 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, which shall be operable from all active operating positions.

The emergency stop shall comply with ISO 13850.

4.5.1.2 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).

4.5.1.3 Inadvertent activation

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

4.5.2 Differential locking

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.

4.5.3 Steering controls

4.5.3.1 Steering direction

4.5.3.1.1 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.

4.5.3.1.2 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.

4.5.3.1.3 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.

4.5.3.1.4 On trucks with reversible control unit or dual controls, the requirements of 4.5.3.1.1 and 4.5.3.1.2 shall be met when the operator is facing in the intended direction of forward travel.

4.5.3.2 Failure of power supply

For trucks with a maximum speed of ≤20 km/h, in the event of an interruption of the power supplied to the steering system (including a dead engine), it shall be possible to maintain the path being steered until the truck is brought to a stop.

Trucks with a maximum speed greater than 20 km/h shall meet the following requirements.

a) 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.

b) In order to verify compliance with the requirement in a), the truck shall describe a spiral movement at a speed of 10 km/h, starting from the straight ahead position, on a dry, flat road surface offering good tyre adhesion. The steering effort on the steering control shall be noted until it reaches the position corresponding to the truck entering a turning circle of 12 m radius. The duration of the manoeuvre (time between the moment when the steering control is first operated and the moment when it reaches the position where the measurements are taken) shall not exceed 8 s. One manoeuvre shall be made to the left and one to the right. The truck shall be tested at its operating mass according to ISO 6016:2008, 3.2.1, with the attachment approved by the manufacturer that produces the greatest load on the steered axle(s).

4.5.3.3 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.

4.5.3.4 Steering knobs

Steering knobs (if installed) shall be capable of being reached by the operator's hand from the top, and shall be within the periphery of the steering wheel.

Steering knobs shall meet the requirements of 4.5.3.3.

4.5.4 Load-handling controls

4.5.4.1 General

Controls shall return to neutral when released and shall stop load movements, except where otherwise specified in this part of ISO 10896.

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

4.5.4.2 Controls with detents or maintained engagement

4.5.4.2.1 General

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

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.

4.5.4.2.2 Boom float control

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

In addition to the provisions of 4.5.4.2.1, the boom float control mode shall be automatically deactivated when the boom-raising/-lowering control is operated.

4.5.5 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.

4.5.6 Stabilizing device control

On trucks equipped with stabilizing devices, controls for deployment and retraction of such devices shall be clearly marked in accordance with ISO 7000.

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 middle position may operate both stabilizing devices.

4.5.7 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.

4.5.8 Axle oscillation lock control

On trucks equipped with a manual axle oscillation lock, the lock/unlock control(s) shall be clearly marked in accordance with ISO 7000.

4.5.9 Auxiliary hydraulic control

On trucks equipped with auxiliary hydraulic control, this control shall be clearly marked in accordance with ISO 7000.

The control may be equipped with a detent or other device to maintain engagement of the function. See 4.5.4.2.

4.6 Power systems and accessories

4.6.1 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 non-flammable and shall be chosen and protected so that they are not adversely affected by heat from the exhaust system.

4.6.2 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. The surface temperature of any shielding shall not exceed 60 °C adjacent to the operator and passenger position(s).

4.6.3 Tanks and pressure vessels

4.6.3.1 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.).

4.6.3.2 Filler openings

Filler openings of tanks (except window washer and brake fluid reservoirs) shall

a) have provisions for lockable filler caps (filler caps located inside lockable compartments, e.g. the engine compartment, or those caps that can only be opened with a special tool, do not require a lockable provision), and

b) be located outside the operator's station.

4.6.3.3 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 (0,3 bar)[3] 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.

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3) 1 bar = 0,1 MPa = 0,1 N/mm^2 = 105 N/m^2.

4.6.3.4 Air pressure vessels

Simple air pressure vessels shall be designed and tested in accordance with ISO 16528-1 and ISO 16528-2.

4.7 Stabilizing devices

When stabilizing devices are provided,

a) they shall be fitted with interlocking devices, e.g. load holding valves, to keep them in position in case of hose failure or oil leakage,

b) means shall be provided to the operator to ensure 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) an indication shall be given to the operator (sensors, painted marks, etc.) when each horizontally extendable stabilizing device is extended to level and/or supports the truck in conformity with the load chart(s).

4.8 Design requirements for maintenance purposes

4.8.1 General

Trucks shall be designed such that routine lubrication and maintenance operations can be performed safely, using ISO 11525 as guidance on the safe maintenance of trucks and ISO 2860 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 could cause injury, the component shall be mechanically secured with a device(s) provided with, and permanently affixed to, the truck, or stored in a secure place on the truck.

4.8.2 Tiltable cab support device

When 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.

4.9 Systems for lifting, tilting and reaching

4.9.1 Chains and wire ropes

4.9.1.1 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 2. The calculation of K_1 shall be related to the maximum static load, Q, 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.

$$K_1 = \frac{L_c \times n}{Q + w}$$

where

L_c is the minimum breaking load for new chain;

n is the number of chains;

Q is the maximum static load in chains;

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 2 — Factor K_1

Trucks < 10 000 kg rated capacity	$K_1 \geq 5$
Trucks > 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).	

4.9.1.2 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. The calculation of K_2 shall be related to the maximum static load, Q, 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.

$$K_2 = \frac{L_{wr} \times n}{Q + w}$$

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 in wire ropes;

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.

4.9.2 Hydraulic system

4.9.2.1 Hydraulic circuit

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 so located and restrained 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.

4.9.2.2 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.

4.9.2.3 Oil purification

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

4.9.2.4 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 descent of the rated load in its least favourable position shall not exceed 150 mm in 10 min with the oil in the hydraulic system at normal working temperature.

The average forward tilting of fork carriage speed with the rated load shall not exceed 0,5° per min.

4.9.3 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 will return to the ground unassisted.

The test to be used for verifying this requirement is given in 5.4.

4.9.4 Limitation of stroke

Any mechanism on the truck with movement requiring limits to prevent over-travel shall be provided with means for positive stops. Hydraulic cylinders can fulfil this requirement if designed for that purpose.

4.9.5 Fork arms, attachments and attachment brackets

Fork arms, attachments and attachment brackets shall be in accordance with Annex B.

4.10 Operator's station

4.10.1 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.

4.10.2 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 manuals from climatic conditions (e.g. sunlight, rain, snow).

4.10.3 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 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.

4.10.4 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.

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.

4.10.5 Operator's station equipped with enclosed cab

4.10.5.1 Climatic conditions

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

4.10.5.2 Heating and ventilation 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 of ΔT 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 3) 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.

Dimensions in millimetres

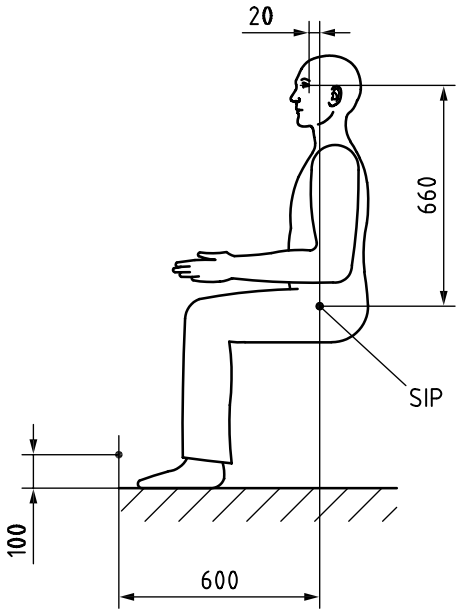

Figure 3 — Location of measuring points

Alternatively, the heating capacity may be determined by calculation.

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

4.10.5.3 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.

4.10.5.4 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.

4.10.5.5 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.

4.10.5.6 Doors and windows

Doors, windows and flaps shall be securely held in their functional 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 normal 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 upon the glass, the truck shall be so designed 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).

4.10.5.7 Interior lighting system

When the truck is intended and equipped to operate in darkness, 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.

4.10.6 Operator's seat

4.10.6.1 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.

4.10.6.2 Suspension seat vibration

An operator's seat fitted with suspension shall meet the requirements of the following input spectral classes, according to ISO 7096:2000, 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.

4.10.6.3 Operator restraint

Trucks shall have an operator restraint system that is in accordance with ISO 6683.

4.10.7 Control panels and symbols on displays

4.10.7.1 Control panels

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

4.10.7.2 Symbols on displays

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

NOTE Other International Standards dealing with symbols on machines are ISO 3287, ISO 3767-1, and ISO 6405-1 and ISO 6405-2.

4.10.7.3 Longitudinal stability indications

Means shall be provided to indicate to the operator that the maximum limits of longitudinal stability specified in the longitudinal stability tests have been reached.

NOTE Load charts associated with boom angle indicator (e.g. pendulum) and extension indicator (e.g. markings on the boom) can be used to satisfy this requirement.

4.11 Operator access

4.11.1 General requirements

An access system shall be provided for access to the operator's station and areas where routine maintenance has to be performed. This shall be in 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.

4.11.2 Access to articulated trucks

On trucks with articulated frames, in the fully articulated steering position a minimum clearance of 150 mm for the lower limbs shall be provided between firm structures or components, with relative movement in the path of the systems for access to the operator's station, as illustrated by Figure 4.

Dimensions in millimetres

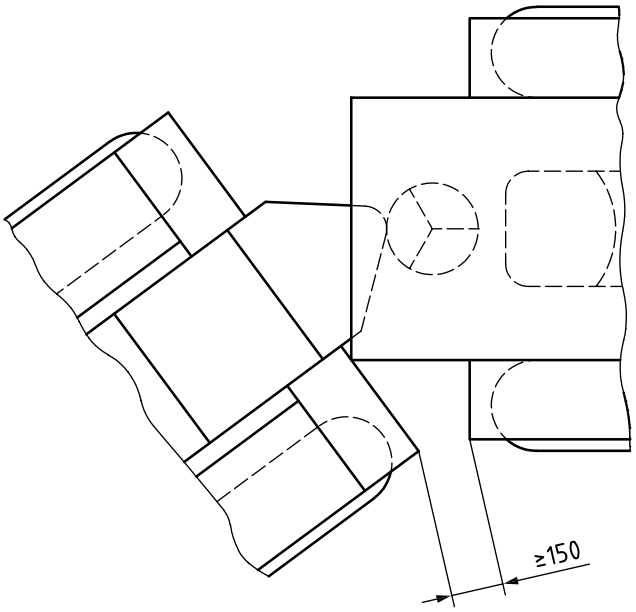

Figure 4 — Minimum clearance of lower limb for access to operator's cab on machines with articulated steering

4.11.3 Enclosed cab openings

4.11.3.1 Normal access opening

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

4.11.3.2 Alternative opening (emergency exit)

An alternative opening shall be provided on a side other than that of the normal 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 pane hammer, immediately accessible to the operator in the enclosed cab, is provided.

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

4.12 Protective measures and devices

4.12.1 Hot parts

Parts that are hot in 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 normal opening, normal operating position or daily routine maintenance areas, according to ISO 13732-1.

4.12.2 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 designed, positioned or provided with protective devices, thereby minimizing the risk of crushing, shearing and trapping.

Distances shall be in accordance with ISO 3457.

If hazards still exist, they shall be identified on the truck in accordance with 4.12.4.

4.12.3 Guards

Guards, in accordance with ISO 3457, shall be designed to be securely held in place, restricting 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 could 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.

4.12.4 Safety signs

Safety signs shall be affixed to the truck and attachments in accordance with ISO 15870 or ISO 9244.

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

4.12.5 Engine compartment

The engine compartment shall be protected against unauthorized access by means including either

a) locking,

b) installation requiring the use of a tool or key, or

c) a latch inside a lockable compartment (e.g. enclosed cab).

4.12.6 Articulated frame lock

Articulated trucks shall be equipped with an articulated frame lock in accordance with ISO 10570.

4.12.7 Fenders

The operator in the normal operating position and the critical information displays shall be protected from debris ejected by the tyres or tracks, if the risk exists, in any steered position.

4.12.8 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, and with openings in the top of the overhead guard not exceeding 150 mm in one of the two dimensions, i.e. width or length.

4.12.9 Elevating and/or tiltable operator's station

See Annex C.

4.12.10 Audible warning devices

Trucks shall be equipped with an audible warning device (horn), operable from the operator's station, and the A-weighted sound pressure level of which shall be greater than or equal to 93 dB. This value shall be measured 7 m from the foremost point of the truck with fork arms in their travel position, as defined by the manufacturer.

The test procedure shall be in accordance with ISO 9533.

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

4.13 Stability

Trucks shall meet the requirements of ISO 22915-14 and ISO 22915-20.

Additionally, for trucks fitted with power devices having the capability of stacking laterally displaced loads, the stability test of ISO 22915-10 shall also apply.

4.14 Visibility

Operator visibility during travel and manoeuvring shall be taken into consideration during the truck design.

NOTE A project specifying visibility test requirements for rough-terrain trucks is under development.

4.15 External lighting devices

Trucks designed for utilization on roads shall be equipped with lighting devices, using ISO 12509 as guidance in the case of wheel loaders.

4.16 Fire protection

4.16.1 Fire resistance

The interior, upholstery and insulation of the enclosed cab, and other parts of the truck where insulation materials are used, 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.

4.16.2 Fire extinguisher

Trucks shall have space for installation of fire extinguisher(s), easily accessible to the operator, or a built-in extinguishing system to permit the operator safe exit from the truck.

4.17 Retrieval, transportation, lifting and towing

4.17.1 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.

These attachment points may be the same if allowed by the manufacturer.

If a pin is part of the retrieval, tie-down, lifting or towing device, provision shall be made to retain the pin in place during use and to prevent it from being lost when not in use.

4.17.2 Retrieval

Retrieval points shall be provided at the front and/or rear of the truck.

The capacity of the retrieval point, expressed in newtons, shall be equal to 1,5 times the machine mass multiplied by the acceleration due to gravity.

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

4.17.3 Tie-down

Tie-down points shall be provided and shall be clearly identified on the truck.

4.17.4 Lifting

When provided, lifting attachment points shall be clearly identified on trucks and subassemblies that are to be lifted separately.

4.17.5 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.

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

NOTE Specific road and agricultural requirements may apply. See, for example, ISO 6489.

4.18 Noise

Noise reduction shall be an integral part of the design process for trucks, specifically taking into account technical progress and measurements at source.

Some major sound sources of trucks are power generation and transmission equipment such as combustion engines, and cooling, electric-drive and hydraulic systems.

Measures for noise reduction include enclosing power generation, transmission and hydraulic equipment, capsulated cooling systems and exhaust silencers.

NOTE ISO/TR 11688-1 and ISO/TR 11688-2 give further information on noise generation mechanisms in machinery.

5 Verification of requirements and safety measures

5.1 General

The manufacturer shall verify that each individual requirement of this International Standard 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 it is able to perform the tasks for which it was designed, e.g. travelling, braking, steering, load-handling, warning, safety, lighting (if any) and remote control (if fitted).

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 may 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

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

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.

At the maximum engine speed specified by the manufacturer,

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 Maximum load-lowering speed verification

5.4.1 General

Compliance with 4.9.3 shall be checked, on level ground, in respect of Q_1 and Q_2, as follows:

— Q_1 at the fully retracted and maximum lifted position;

— Q_2 at the maximum lift height.

5.4.2 Test procedure

With the engine at maximum speed, attain full lowering speed, then quickly release the control when the load reaches the maximum reach for the relevant load zone.

6 Information for use

6.1 General

Manual(s) shall be supplied with each truck and include information for use and information for routine maintenance.

6.2 Operator's and maintenance manuals

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

a) intended and prohibited uses of the truck;

b) list of approved attachments;

c) climatic conditions for which the truck is designed;

d) instructions on the protective measures to be taken by the user, including, where appropriate, the personal protective equipment (PPE) to be provided;

e) conditions in which the truck meets the requirement for stability during use and transportation;

f) operating method to be followed in the event of breakdown;

g) prohibition of operation in hazardous atmospheres for which the truck is not designed.

6.2.2 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 authorized tyres (including solid, foam, and water-filled), information on their required size, design and inflation pressures;

e) capacity of, and performance data on, the truck and the combination of truck and related attachments;

f) truck weight, dimensions and turning radii;

g) adjustment of the operator's seat and use of the seat belt.

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

a) required competencies of the operator;

b) measures necessary to control residual risks;

c) ground-bearing pressure (wheels and stabilizing devices) unloaded and loaded in static position;

d) daily checks before operating the truck;

e) instructions for access and egress;

f) operating controls and operating displays;

g) starting, driving and braking of the truck;

h) handling of loads and use of the different attachments, and warning about the hazards due to the action of wind forces;

i) information on possible displacement of the centre of gravity;

j) lift height for travelling;

k) travelling on gradients;

l) safe parking of the truck;

m) instructions for de-energizing stored energy components;

n) use when the operator's direct visibility is limited;

o) instructions for towing with the truck.

6.2.4 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.

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

a) loading and unloading of trucks;

b) restraint of the truck during transport using tie-down points;

c) towing the truck and moving inoperative trucks;

d) storage of trucks for extended periods of time;

e) instructions for transport in the operator's manual.

6.2.6 The following Information covering inspection and routine maintenance:

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 to be performed by a competent person;

d) type and frequency of inspections and maintenance operations, with particular attention to the replacement and durability of wear 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 to 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. overload indicators, and the frequency of these checks, if fitted by the manufacturer or authorized representative;

o) instructions for changing wheels.

6.3 Marking

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

a) business name and full address of the manufacturer or authorized representative;

b) designation of series or type;

c) serial number;

d) year of construction;

e) rated capacity;

f) net power of engine expressed in kilowatts (kW);

g) mass of the unladen truck, fully fuelled and serviced, without the operator and without the mass of any removable attachment;

h) if necessary, the maximum vertical force and the drawbar pull on the tow-hook in newtons (N).

i) a warning, visible to the operator in the normal operating position, stating that the truck is to be level before lifting or extending the boom.

6.4 Load charts

6.4.1 Trucks with load-carrying attachments

Where the manufacturer has authorized their use, trucks with load-carrying attachments shall be fitted with appropriate load charts related to the load-carrying attachment. The load chart shall be legible and durable, affixed in a prominent position, and easily readable by the operator in the normal operating position.

See Figure 5 for an example.

The load chart shall provide information on

a) the type of attachment to which it applies,

b) applicable load centre distances,

c) actual capacities at lift heights and reach,

d) applicable limitations on the attachment use,

e) model of truck to which it applies,

f) type of tyres,

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.

Load charts may be combined with the nameplate.

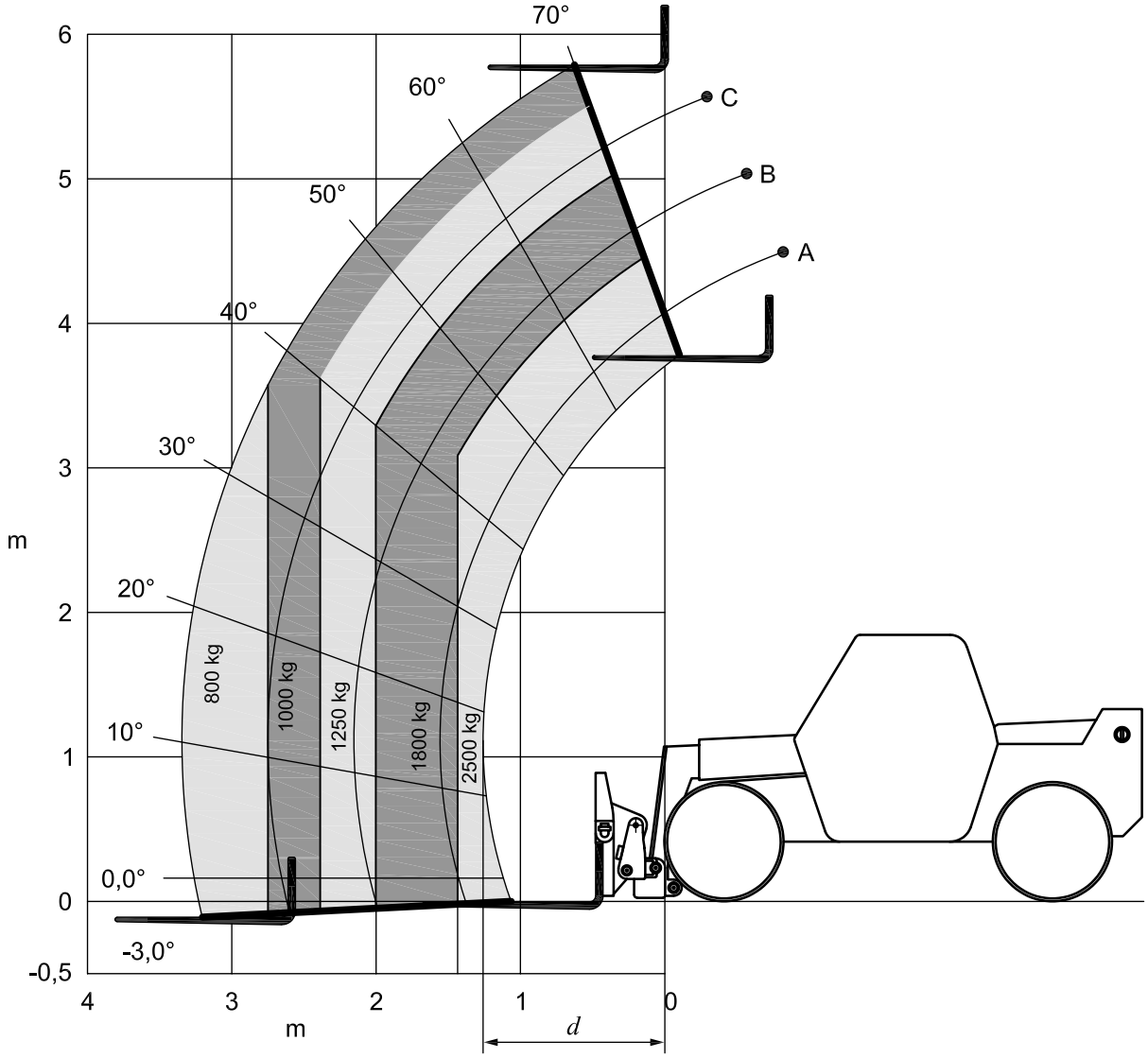

Figure 5 — Load chart

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.

Annex A
(informative)

List of significant hazards

The product should be designed such that it is fit for its purpose or function and can be adjusted and maintained without putting persons at risk when it is used under conditions foreseen by the manufacturer.

To properly design a product and cover all specific safety requirements, the manufacturer should

— identify the hazards that apply to the product and perform risk assessments, and

— design and construct the product taking into account these assessments.

The aim of this procedure is to eliminate or reduce the risk of accidents throughout the foreseeable lifetime of the machinery, including the phases of assembling and dismantling, in which the risk of accidents can also arise from foreseeable abnormal situations.

In selecting the most appropriate methods, the manufacturer should apply the following principles, in the order given:

a) eliminate or reduce risks as much as possible by design (inherently safe machinery design and construction);

b) take the necessary protection measures in relation to risks that cannot be eliminated by design;

c) inform users of the residual risks due to any shortcomings of the protection measures adopted;

d) indicate whether any particular training is required;

e) specify any need to provide personal protection equipment (PPE).

The truck should be designed to prevent abnormal use, wherever possible, if such use would engender risk. In other cases, the instructions should draw the user's attention to ways in which experience has shown the truck should not be used.

The following hazards may be applicable and could involve risks to persons if not addressed. The corresponding requirements offer guidance to limit the risk or reduce these hazards.

Table A.1 — List of significant hazards

Hazard		Related subclause of this part of ISO 10896/aspect of machine	
1	**Mechanical hazards**		
1.1	**Crushing, shearing, cutting, severing, entanglement, drawing-in, trapping hazards**	4.3	Brakes
		4.5	Controls
		4.12.5	Access to engine compartment and other compartments
		4.12.7	Fenders
		4.12.2	Protection against crushing, shearing and trapping
		4.10.6.3	Operator restraint
		4.12.8	ROPS and FOPS
		4.12.10	Audible warning device
		4.14	Visibility
		4.10.5.6	Doors and windows
		4.17	Transportation
		4.17.5	Towing
		4.1.1	Sharp edges and acute angles
		4.8	Design requirements for maintenance purposes
1.2	**Impact hazards**		
	From mechanical failure	4.9.1.1	Chains
		4.9.2	Hydraulic system
		4.9.5	Fork arms , attachments and attachment brackets
		4.8	Design requirements for maintenance purposes
	From unstable load	4.9.2.4	Load holding
		4.12.8	ROPS and FOPS
	From road debris	4.12.7	Fenders
	From lifting or transporting a truck	4.17	Retrieval, transportation, lifting and towing
1.3	**Stabbing or puncture hazards**	4.1.1	Sharp edges and acute angles
		4.8	Design requirements for maintenance purposes
1.4	**High-pressure fluid ejection or ejection hazard**	4.1.2	Stored energy components
		4.9.2	Hydraulic system
		4.9.2.2	Pressure control
2	**Thermal hazards**		
	Burns, scalds and other injuries by a possible contact of persons with an extreme high or low temperature, by flames or explosions, and by radiation from heat sources	4.6.1	Exhaust systems
		4.10.3, 4.12.1	Hot parts
		4.16	Fire protection
	Damage to health by hot or cold working environment	4.10.5.1	Climatic conditions
3	**Hazards generated by noise**	4.18	Noise
4	**Hazards generated by materials**		
	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dust	4.6.1	Exhaust systems
		4.10.5.2	Heating and ventilation system
	Fire or explosion hazard	4.6.3.3	Fuel tanks
		4.16	Fire protection

Table A.1 *(continued)*

Hazard		Related subclause of this part of ISO 10896/aspect of machine	
5	**Hazards generated by neglecting ergonomic principals in machinery design**		
	Unhealthy postures or excess effort	4.10.1	Operator station - General
		4.11	Operator access
		4.10.6	Operator's seat
		4.12.8	ROPS and FOPS
	Inadequate local lighting	4.10.5.7	Interior lighting system
	Human error, human behaviour	4.5.1	Marking of controls
		6.2	Operator's and maintenance manuals
6	**Unexpected start-up, unexpected overrun/overspeed**		
7	**Failure/disorder of the control system**	4.2.2	Unintended movement
		4.9.2	Hydraulic system
		4.9.2.4	Load holding
		4.8	Design requirements for maintenance purposes
8	**Failure of the power supply**	4.3.2	Failure of energy supply
9	**Errors of fitting**	4.1.2	Stored energy components
		4.8	Design requirements for maintenance purposes
		6.2.5	Transportation and storage of trucks
10	**Falling or ejected objects or fluids**	4.12	Protective measures and devices
		4.10.4	Pipes and hoses
11	**Loss of stability/overturning of machinery**	4.10.7.3	Tip over/overloading indicators
		4.13	Stability requirements
		6.4.1	Load chart
12	**Slips, trips and falls**	4.11	Operator access
	Additional hazards, hazardous situations and hazardous events due to mobility		
	Movement when starting the engine	4.2.2	Unintended movement
	— Layout of pedals	4.5.1	Pedal operated travel and braking controls
	— Additional operator positions	4.5.1.1	Multiple operating positions
	Movement without the driver at the driving position	4.2.4	Powered travel movement
13	**Linked to the work position on the truck**		

Table A.1 *(continued)*

Hazard		Related subclause of this part of ISO 10896/aspect of machine	
	Fall of persons during access to, at or from the work position	4.11	Operator access
	Exhaust gases/lack of oxygen at the work position	4.6.1	Exhaust system
		4.10.5.2	Heating and ventilation system
	Mechanical hazards at the work position		
	Fall of objects, penetration of objects	4.12.8	ROPS and FOPS
		4.10.4	Pipes and hoses
		4.9.5	Fork arms, attachments and attachment brackets
	Insufficient visibility from the work position	4.14	Visibility
		4.10.5.4	Wipers and washers
	Inadequate lighting	4.15	Lighting
	Inadequate seating	4.10.6	Operator's seat
	Noise at the work position	4.18	Noise reduction
	Vibration at the work position	4.10.6.2	Suspension seat vibrations
14	**Due to the control system**		
	Inadequate location of manual controls	4.5.1	Controls — General
	Inadequate design of manual controls and their mode of operation	4.5.1	Consistency with truck motions
15	**Due to the power source and the transmission of power**		
	Hazards from the engine and the batteries	4.6.1	Exhaust systems
		4.6.3.3	Fuel tanks
		4.4.5	Batteries
		6.2.4	Information covering the combustion-engine-driven trucks
	Hazards from coupling and towing	4.17.5	Towing
		6.2.3	Information covering the operational use of the truck
16	**From/to third persons**		
	Unauthorized start-ups	4.2.1	Unauthorized starting
		4.13	Stability requirements
		4.12.10	Audible warning device
		4.17.5	Towing
		4.17	Transportation
		5.2	Functional verification
		6.2.3	Information covering the operational use of the truck
Additional hazards due to lifting operation			
17	**Mechanical hazards and hazardous from load falls, collisions, machine tipping caused by**		

Table A.1 *(continued)*

Hazard		Related subclause of this part of ISO 10896/aspect of machine	
	Lack of stability	4.13	Stability requirements
	Uncontrolled loading, overloading, overturning moments exceeded	4.10.7.3	Tip-over/overloading indicators
		6.4	Load chart
		4.9.3	Maximum load-lowering speed
	Unexpected/unintended movement of loads	4.9.2.4	Load holding
		4.5.5	Multi-function controls
		4.9.2	Hydraulic system
		4.5.4	Load-handling controls
		4.9.5	Fork arms, attachments, and attachment brackets
	Insufficient mechanical strength of parts, from inadequate selection of chains, ropes, lifting and accessories, and their inadequate integration into the machine	4.9.1.1	Chains
		4.9.5	Fork-arm attachments and attachment brackets
		5.3	Structural verification
18	**Hazards generated by neglecting ergonomic principles/insufficient visibility when driving**	4.5.1	Controls — General
		4.14	Visibility
Additional hazards			
19	**Travelling of self-propelled machinery**		
	Direction of movement	4.5.2	Differential locking
		4.5.3.1	Steering direction
		4.5.5	Multi-function controls

Annex B
(normative)

Attachments and attachment brackets

B.1 Attachment

B.1.1 General

The truck manufacturer shall define the range of attachments intended to be used with the truck and establish the criteria for their safe fitting and use. Specific load chart(s) for the combination of the truck and the attachment are required, according to 6.4.

The truck manufacturer shall ensure that the attachment complies with the following:

a) the attachment (e.g. clamps, side shift carriage, bucket, sweeper) is designed and manufactured such that unintentional displacement and detachment from the truck are prevented;

b) clamping devices are designed such that clamping pressure is sustained for at least 10 min after the engine has been shut down, by means of check valves or any other effective system when the truck control mechanisms are in the neutral position;

c) in the event of a malfunction in the power supply system for the attachment, means are provided to prevent the load loosening or unintentional shifting;

d) when the truck is equipped with a load-bearing clamp (e.g. paper clamp), it features control(s) with a secondary action to prevent unintentional release of the load;

e) if the truck is equipped with quick-fastening devices for attachments, as defined in B.2, it is designed and manufactured such that the locking devices can be seen by the operator to be correctly engaged with the attachment from the normal operating position, and means are provided to prevent disengagement of the attachment in the event of system failure;

f) if the attachment has its own separate hydraulic system, the system complies with 4.9.2;

g) if the attachment has a hydraulic system connected to the truck hydraulic system, the two systems are compatible, and the combined system complies with 4.9.2.

B.1.2 Identification

The truck manufacturer shall ensure that approved attachments, excluding fork arms, fork-arm extensions (see B.3) or other interchangeable attachment components, are permanently marked with the following information:

a) manufacturer’s name and address;

b) type denomination (e.g. part no, model no.);

c) serial number (if any);

d) year of construction;

e) mass, in kilograms (kg), with those attachments having interchangeable components (such as carriages that accept different types of fork arms) specifying the mass of the attachment with the heaviest interchangeable component;

f) distance of the centre of gravity of the unladen attachment from its mounting, which may be

   1) for fork arms mounted attachments, the heel of the fork arms, or

   2) for attachments that fit on a quick interchange device, the horizontal axis about which the quick fastening device pivots and for which the centre distance shall be the maximum possible;

g) if applicable, lost load centre (LL), also known as effective thickness (ET);

h) if applicable, the maximum hydraulic operating pressure, in megapascals (MPa), as recommended by the attachment manufacturer;

i) volumetric capacity of attachment in cubic metres (m^3), if relevant;

j) rated capacity and load-centre distance of the attachment and — for those attachments such as carriages that accept different types of fork arms whose capacity can vary depending on the capacity of interchangeable components (e.g. carriages that accept different types of fork arms) — the maximum capacity of the attachment with interchangeable components;

k) a warning or equivalent pictorial noting that the rated capacity of this attachment may be reduced and to refer to the load chart for truck/attachment combination.

B.1.3 Instructions

The truck manufacturer shall ensure that instructions for the mounting, use and maintenance of the attachment are provided.

NOTE If attachment instructions can be provided in the form of a label on the attachment, then a dedicated operator's manual is not needed.

B.2 Attachment bracket (quick-fastening)

B.2.1 Locking

The truck manufacturer shall ensure that the attachment bracket has a locking system that meets the following requirements:

a) the locking system keeps the attachment bracket in the locked position by a positive engagement system and keeps it locked under all intended/normal operating conditions;

b) it is possible to verify the locked position of the attachment bracket from the operator's position, or from the location where the locking control is operated;

c) it is not possible that the bracket be released by malfunction or loss of engagement forces;

d) wedge-shape locking systems provide a continuous force (e.g. continuous pressure with open return, hydraulic accumulator, compressed spring) to hold the attachment in the locked position.

B.2.2 Control

The truck manufacturer shall ensure that

a) for actuation of a hydraulically operated locking and unlocking system of an attachment bracket, a separate control is provided,

b) the control is secured against inadvertent activation (see 4.5.1.3), and

c) if the actuation is integrated into a control used for functions other than locking/unlocking the attachment bracket, activation of the unlocking function is only possible by simultaneous actuation of two independent controls, both of the hold-to-run type.

B.3 Identification

The truck manufacturer shall ensure that if the bracket is not permanently integrated into the truck, markings for the attachment bracket are provided in accordance with B.1.2.

B.4 Instructions

The truck manufacturer shall ensure that the instructions for mounting, locking, inspection and the effect on the rated capacity are provided by the attachment bracket manufacturer and that the inspection procedure for locking is described in detail.

B.5 Fork arms

B.5.1 General

The truck manufacturer shall ensure that

a) fork arms are manufactured and tested in accordance with ISO 2330,

b) the total capacity of the fork arms fitted to a truck is not less than the rated capacity of the truck,

c) all fork arms fitted to a truck at a given time shall have the same capacity, and

d) if a means to prevent unintentional lateral displacement of hook-on fork arms on the fork carrier is provided, it shall conform to ISO 2328.

B.5.2 Fork arm extensions

The truck manufacturer shall ensure that fork arm extensions are designed to prevent accidental disengagement from the fork arms, and that they are in accordance with ISO 13284.

B.5.3 Fork carriers

The truck manufacturer shall ensure that

a) means are provided on the fork carrier to prevent lateral disengagement of the fork arms at the extremities, and

b) if a fork arm removal slot is provided at the bottom of the fork carrier, it is not positioned opposite a slot at the top of the fork carrier, unless means are provided to prevent the fork arms being inadvertently displaced.

B.5.4 Load retention device

The truck manufacturer shall ensure that

a) if the truck is fitted with fork arms, it is designed such that they can be equipped with load retention device(s), such as load backrest extensions,

b) if fitted with a load backrest extension, it has a height, width and strength sufficient to minimize the possibility of the load falling toward the operator when the fork arms are in a position of maximum rearward tilt, and

c) the size of the openings in the load backrest extension do not exceed 150 mm in one of the two dimensions.

Annex C
(normative)

Elevating/tiltable operator's stations

C.1 General

Trucks with an elevating or tiltable operator's station, regardless of the elevation height, shall be in accordance with 4.10. When the operator's station is in the lowest position, access shall be in accordance with 4.11.

For tiltable operator's stations, the seat shall be designed to maintain the operator in the tilted position.

The lift and descent speeds of the operator's station shall not exceed 0,6 m/s under normal working conditions; 0,4 m/s in the case of hydraulic line rupture. The tilt speed of the tiltable operator station shall not exceed 6°/s under normal working conditions; 4°/s in the case of hydraulic line rupture.

If service or maintenance work has to be done with a raised or tilted operator's station, a mechanical support device shall be provided. The device shall withstand a force equivalent to twice the mass of the operator's station.

C.2 Elevating and tilting controls

Elevating and tilting controls shall be clearly marked and protected against unintentional activation.

C.3 Emergency descent

In the event of an engine stop or of an energy source or hydraulic system failure, the operator shall be able to lower the operator's station to its lowest position or leave the operator's station safely, e.g. by steps or stairs.

In an emergency, it shall be possible for a person outside the operator's station to lower the operator's station safely. As a safety device, the control for emergency lowering shall be marked red.

C.4 Crushing hazards

The hazardous area between the truck's main frame and the bottom of an elevated/tilted operator's station shall be marked with warning signs and alternating yellow and black stripes, in compliance with ISO 3864-1 and ISO 3864-2. If the operator does not have a direct view of the hazardous area between the operator's station and the frame, means such as an exterior mirror or mirrors shall be provided to allow the operator to observe the area when lowering the operator's station.

C.5 Operator fall protection

If the truck is intended for use with the operator's station elevated/tilted with an open door, and if a fall hazard exists, a protective device (e.g. bar, chain or strap) shall be provided in the door opening 700 mm above the operator's station floor. The device shall be secured against unintentional opening.

C.6 ROPS

The ROPS (roll-over protective structure) provisions of 4.12.8 apply to elevating and tiltable operator's stations with the following exceptions:

— the ROPS for the operator's station shall be regarded as separate and independent (i.e. not connected to the truck frame);

— only the vertical load test of ISO 3471:2008, 6.3, shall be applied in all planes;

— in the case of a symmetrical design of the structure in one or more directions — front/rear, left/right and top/bottom — only one test is required for each direction;

— ISO 3471:2008, 8 h), does not apply to ROPS for elevating or tiltable operator stations.

C.7 Operator's manual

The operator's manual shall contain the specific safety instructions for elevating/tiltable operator stations relating to

— the use of a door protective device (see C.5),

— the operator's station position when travelling,

— emergency instructions, and

— use of a mechanical support device for maintenance.

Annex D
(informative)

Consistency of direction of motion for load-handling controls

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

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