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Rough-terrain variable reach trucks — Visibility — Test methods and verification

National foreword

This British Standard is the UK implementation of EN 15830:2012.

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Rough-terrain variable reach trucks - Visibility - Test methods and verification

Chariots à portée variable tout-terrain - Visibilité - Méthodes d'essai et vérification

Geländegängige Flurförderzeuge mit veränderlicher Reichweite - Sichtverhältnisse - Prüfverfahren und Verifizierung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 15830:2012) has been prepared by Technical Committee CEN/TC 150 “Industrial trucks - Safety”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2012, and conflicting national standards shall be withdrawn at the latest by November 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is a type-C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this standard.

Where there are provisions of this type-C standard which are different from those which are stated in type A or B standards, the provisions of this type-C standard take precedence over the provisions of the other standards, but only for machines that have been designed and built in accordance with the provisions of this type-C standard.

The purpose of this standard is to address the operator's visibility in such a manner that the operator can see around the rough-terrain variable reach truck to enable proper, effective and safe operation that can be quantified in objective engineering terms. This standard includes a test method that uses two lights placed at the location of the operator’s eyes. The masking due to the truck, its components and attachments and a standard test load are determined around the truck, starting at a boundary line 1 m away from the smallest rectangle that encompasses the truck out to the visibility test circle. The radius of the circle is 12 m. The method used does not capture all of the aspects of the operator’s visibility, but provides information to assist in determining the acceptability of visibility from the truck. Criteria are included in this standard to provide guidance for designers as to the extent of visibility masking that are acceptable.

Due to the operator’s capability and the operation mode of the truck, the test method divides the area around the truck into six sectors: the front (sector A), to the front sides (sectors B and C), to the rear sides (sectors D and E), and to the rear (sector F).

For each of the sectors, the operator has physical characteristics that are considered. Besides the eye spacing of 65 mm (the nominal binocular eye spacing of the 50th percentile operator), additional adjustments (up to the limits specified in Tables 2 and 3) can be made considering that the operator has the capability to turn the head and move the body torso side to side. The eye spacings used are less than the maximum permitted values based on the ergonomics of the operator. This is done to maintain the current state-of-the-art of trucks.

Standard test loads are carried on or suspended from, devices on the truck during the visibility tests. They are intended to be dimensionally representative of typical loads carried by rough-terrain variable reach trucks and are used to determine their masking effects and to define representative boom geometry of the truck in normal uses.

The established visibility performance criteria are based on the physical aspects of the human operators and ground personnel using various representative dimensions and the design of trucks that have provided acceptable visibility. To establish the visibility criteria, a combination of the eye spacings and masking widths are used. Multiple masking in sectors are acceptable where there is adequate spacing between the individual masking. Where the direct visibility is considered inadequate, additional devices for indirect visibility [mirrors or closed circuit television cameras (CCTV)], can be used to achieve acceptable visibility. For the rectangular 1 m boundary (RB) additional devices for indirect visibility (mirrors or CCTV) are preferred. Other aids (see ISO 16001) can be used exceptionally.

1 Scope

This European Standard applies to rough-terrain variable reach trucks (herein-after referred to as 'trucks') that have a specific seated operator's position, on the left hand side of the boom, or centre position (excluding operator position on the right side of the boom).

This European Standard specifies a static test method for determining and evaluating the operator's visibility on a rectangular 1 m boundary close around the rough-terrain variable reach truck and on a 12 m visibility test circle. Performance requirements for visibility are specified in this standard.

This European Standard does not apply to rough-terrain variable reach trucks designed to handle freight containers (rough-terrain reach stackers).

It applies to trucks for operation on work sites.

2 Normative references

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

EN 1459:1998+A2:2010, *Safety of industrial trucks—Self-propelled variable reach trucks*

EN 13545:2002, *Pallet superstructures - Pallet collars - Test methods and performance requirements*

EN 13698-2:2003, *Pallet production specification - Part 2: Construction specification for 1000 mm x 1200 mm flat wooden pallets*

EN ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope (ISO 3411:2007)*

EN ISO 21898:2005, *Packaging - Flexible intermediate bulk containers (FIBCs) for non-dangerous goods (ISO 21898:2004)*

EN ISO 5353:1998, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point* (ISO 5353:1995)

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and EN 1459:1998+A2:2010 and the following apply.

3.1 trucks

3.1.1
variable reach truck
counterbalanced lift truck used for stacking loads with an articulated boom

Note 1 to entry: The boom may be telescopic or not, non-slewing or have a slewing movement of no more than 5° either side of the longitudinal axis of the truck.

3.1.2
rough-terrain variable reach truck
variable reach truck designed for operation on unimproved natural or disturbed terrain or areas

3.1.3
compact truck
truck having a maximum height in normal travel mode of 2 150 mm and:

— 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

Note 1 to entry: These dimensions do not include equipments such as working lights, mirrors, etc.

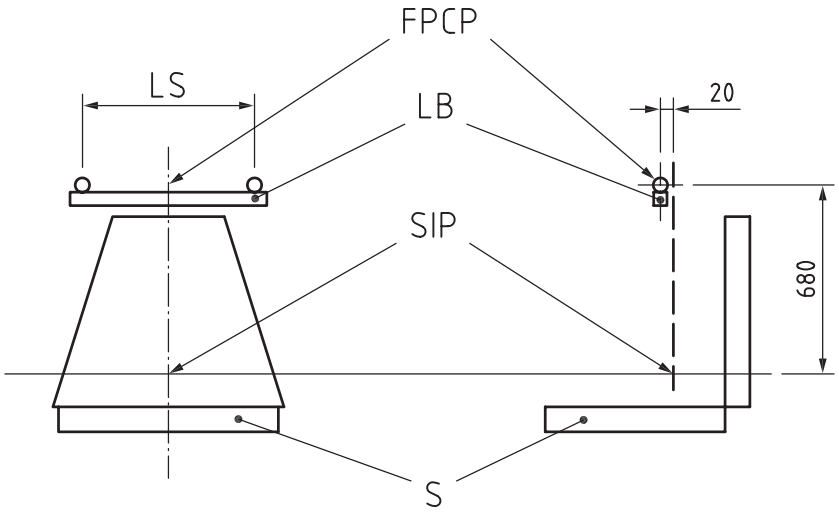
3.1.4
rigid-frame truck
rough terrain variable reach truck having a rigid frame and wheel steering

3.1.5
articulated-frame truck
rough terrain variable reach truck with an articulated frame which accomplishes the steering of the truck

3.2
test surface
area of compacted earth or firm surface that forms the ground reference plane for the visibility measurements, with a gradient of no more than 3 % in any direction

3.3
filament position centre point (FPCP)
centre at the midpoint of the line between the light-bulb filaments, located 680 mm above and 20 mm in front of the seat index point (SIP) as described in ISO 5353 (see Figure 1)

Dimensions in mm



Key

LB light bar
LS light bulb spacing
SIP seat index point
S seat
FPCP filament position centre point

Figure 1 — Light source apparatus

3.4 visibility-test locations

3.4.1
visibility test circle (VTC)
circle with 12 m radius located on the ground reference plane with its centre vertically below the filament position centre point. Circle is divided into six visibility sectors (see Figure 2)

3.4.2
rectangular 1 m boundary (RB)
line on the ground reference plane located at 1 m distance from the outside machine rectangular boundary (see Figure 4, Figure 5 and Figure 7)

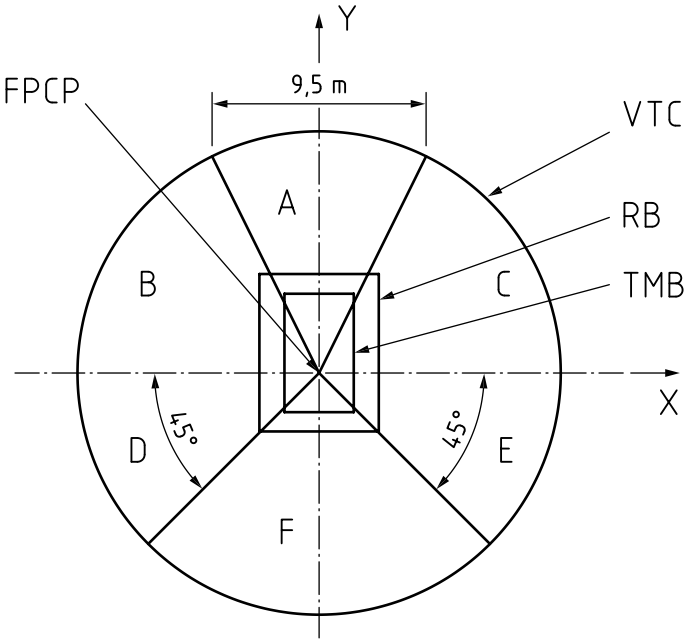
3.4.3
sector of vision A
segment of the visibility test surface to the front of the truck, defined by a 9,5 m chord length for the 12 m radius that is perpendicular to the longitudinal plane passing through the filament position centre point with the chord length bisected by the longitudinal plane (see Figure 2)

3.4.4
sectors of vision B and C
segments of the visibility test surface to the front of the truck outside sector A and bounded by the transverse plane through the filament position centre point (see Figure 2)

3.4.5
sectors of vision D and E
segments of the visibility test surface to the rear defined by an angle of 45° to both the right and left sides of the longitudinal plane passing through the filament position centre point (see Figure 2)

3.4.6
sector of vision F
segment of the visibility test circle to the rear between sectors D and E (see Figure 2)

Dimensions in m



Key

VTC	visibility test circle
FPCP	filament position centre point
RB	rectangular 1m boundary
TMB	test machine boundary
Y	forward direction of the truck
A, B, C, D, E, F	sectors of vision

Figure 2 — Visibility test boundary

3.5
masking
shadow on the 12 m visibility test circle or on the rectangular 1 m boundary created because parts of the base truck and/or its equipment and/or the test load block the light rays from both of the light bulb filaments

Note 1 to entry: Parts that can cause masking include, e.g. rollover protective structures (ROPS), window and door frames, exhaust pipes, the engine hood and equipment or attachment, such as bucket, boom, test load.

3.6
light source apparatus
test unit intended to simulate the position of the operator eyes, and the possible movements of their head

(See Figure 1)

3.7
light bulb spacing
distance between the vertical centre axis of the considered light-bulb filaments

(See Figure 1)

3.8
light bar
rigid support on which the light-bulbs are fixed and aligned

(See Figure 1)

3.9
visibility performance criteria
criteria for the design of rough-terrain variable reach trucks to enable an operator to see objects in the area around the truck during truck operation and specified as maximum allowed masking at the 12 m visibility test circle or at the rectangular 1 m boundary

3.10
test load
simulated load used for the purpose of visibility tests intended to be dimensionally representative of typical loads which might be carried by the truck in normal use

3.11 direct and indirect visibility

3.11.1
direct visibility
visibility by direct line to the light source

3.11.2
indirect visibility
visibility with the aid of mirrors or with other aids (e.g. CCTV) fitted to the truck

3.12
derivative truck
truck modified or fitted with equipment and/or attachments that influence visibility (see also 7.5)

4 Basic dimensions

4.1 Light bulb spacing dimensions

The light bulb spacing shall conform to Annex A.

4.2 Masking dimensions

Maximum masking dimensions for each test are given in Tables 2 and 3.

4.3 Reference dimensions for the measurement

This standard specifies the following three reference dimensions for measurement:

a) 1 m, the distance used in conjunction with the rectangular 1 m boundary line around the truck and test load to describe the near field (closest distance) around the truck.

b) 1,5 m, the maximum height above the ground reference plane on which a visibility observation in the near field is made, based on the height of 5 % of the truck operators.

c) 12 m, the radius of the visibility test circle on a horizontal surface measured from the filament position centre-point.

5 Test apparatus

5.1 Test load

Test loads shall have characteristics according to Table 1:

Table 1 – Test load characteristics

Truck rated capacity (kg)	Test load dimensions (height x width x depth) (mm)	
	Fork mounted test load	Suspended test load
≤5 000	825 x 1 200 x 1 000 [(a)]	1 000 x 1 000 x 1 000[(b)]
>5 000	1 200 x 1 200 x 1 200	1 000 x 1 000 x 1 000[(b)]
(a) simulating an EN 13698-2:2003 pallet with 4 x 200 mm high EN 13545:2002 pallet collars (b) the dimensions of the test load and height carried beneath forks (6.3.3) approximate to a typical filled 'Flexible Intermediate Bulk Container' (FBIC) as described in EN ISO 21898:2005		

The test loads shall not permit transmission of light through their surfaces which could affect the visibility test results.

5.2 Light source apparatus

The light source apparatus is capable of positioning a light bar horizontally with two halogen light bulbs (e.g. H5-type 60 W or equivalent) mounted with the bulbs vertically. Each light bulb shall be horizontally movable on the light bar from 32,5 mm up to 202,5 mm on each side of the filament position centre-point. It shall be possible to rotate the light bar through 360° around the filament position centre point. The filament position centre point shall be located 680 mm above and 20 mm in front of the seat index point (SIP) as described by ISO 5353 (see Figure 1).

5.3 Vertical test object

The vertical test object is 1,5 m high, 100 mm wide, used to evaluate the masking on the rectangular 1 m boundary. It is considered as a 2 dimensional object, without depth. It shall be maintained substantially perpendicular to the test surface throughout the tests.

5.4 Observation mirror

To determine the masking on the visibility test circle or the rectangular 1 m boundary, a hand held mirror can be used to detect the line-of-sight between the light source and the ground reference plane or vertical test object. The observation mirror shall have a maximum size of 100 mm x 150 mm.

NOTE Other apparatus giving equivalent results is acceptable.

6 Truck test configuration

6.1 Equipment of the truck

The truck shall be equipped with standard fork arms and equipment according to the manufacturer's standard specification.

6.2 Openings

All truck openings, such as doors and windows, shall be closed.

6.3 Position of the truck and load handling attachment

6.3.1 General

The truck shall be positioned on the test surface with the filament position centre point vertically above the visibility test circle centre point. The front side of the truck shall be directed to sector A.

6.3.2 Tests in normal travel mode

6.3.2.1 Test with fork mounted load

The test load shall be positioned centrally (laterally) and rearwards (longitudinally) on the fork.

The boom shall be fully retracted and its height adjusted so that dimension A (see Figure 4) is respected with the upper face of the fork above and substantially parallel to the test surface.

Where:

— RB = Rectangular 1 m boundary

— A = (300 ± 50) mm for compact trucks

— A = (500 ± 50) mm for other trucks

A rearward tilt of the fork of < 5 ° is acceptable.

NOTE The test load may be lifted on a pallet.

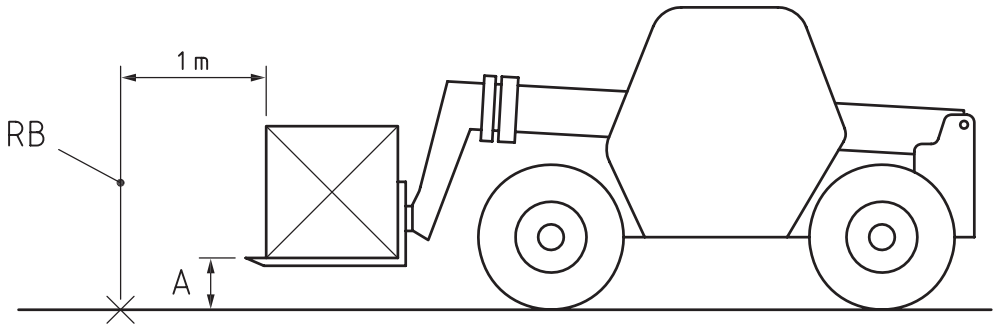


Figure 3 – Test with fork mounted load – Boom and load position

6.3.2.2 Test without load

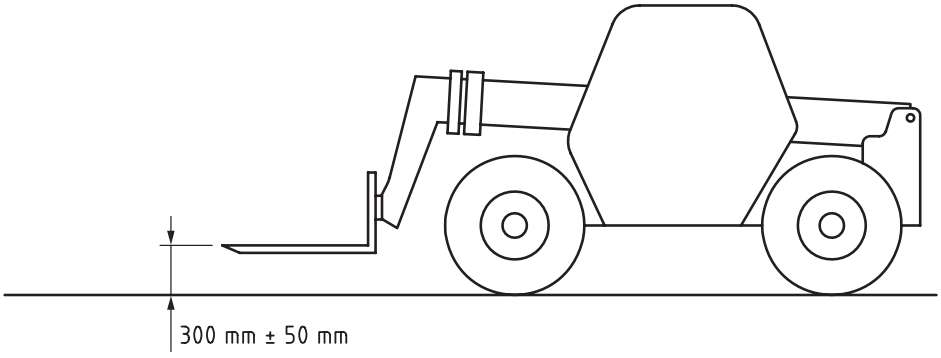


Figure 4 — Test without load - boom position

The boom shall be fully retracted and its height adjusted so that the upper face of the fork above and substantially parallel to the test surface is (300 ± 50) mm. A rearward tilt of the fork of <5 ° is acceptable. See Figure 4.

6.3.3 Tests with suspended load

The test load as specified in 5.1 shall be located so that the forward edge is (1 000 ± 50) mm from the test machine boundary described by the test with fork mounted load (6.3.2.1 and 7.1.4).

The boom shall be adjusted so that dimension B is set with the upper face of the forks above and substantially parallel to the test surface and the heel of the forks vertically above the rear face of the test load.

Where:

- RB = Rectangular 1 m boundary
- B = (2 000 ± 50) mm for compact trucks
- B = (2 200 ± 50) mm for other trucks

The test load shall be positioned (600 ± 50) mm below and, centrally (laterally) with respect of the raised forks (see Figure 5).

A rearward tilt of the fork carriage or fork arms of less than 5° is acceptable.

NOTE The test load may be positioned on a frame on the floor or suspended from the forks. The frame or straps should be designed so that they do not significantly affect the visibility test.

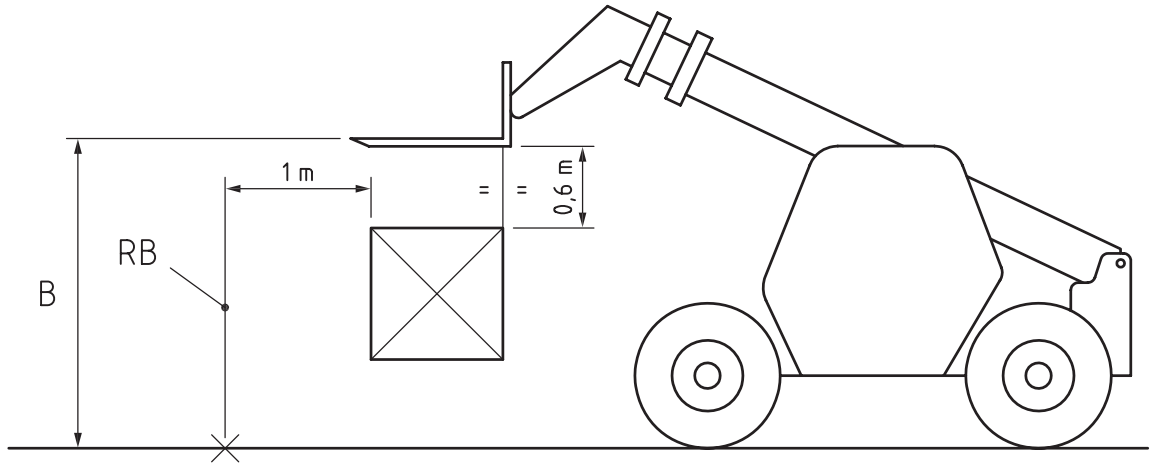


Figure 5 – Test with suspended load – boom and load position

6.3.4 Lorry trailer loading condition

The boom shall be fully retracted and its height adjusted so that the upper face of the forks above and substantially parallel to the test surface is (1 000 ± 50) mm (see Figure 6). A rearward tilt of the fork carriage or fork arms of less than 5° is acceptable.

NOTE The test load is not required for this test as the risks during lorry trailer loading are principally in the rearward direction during the reversing part of the manoeuvre before the boom is lowered.

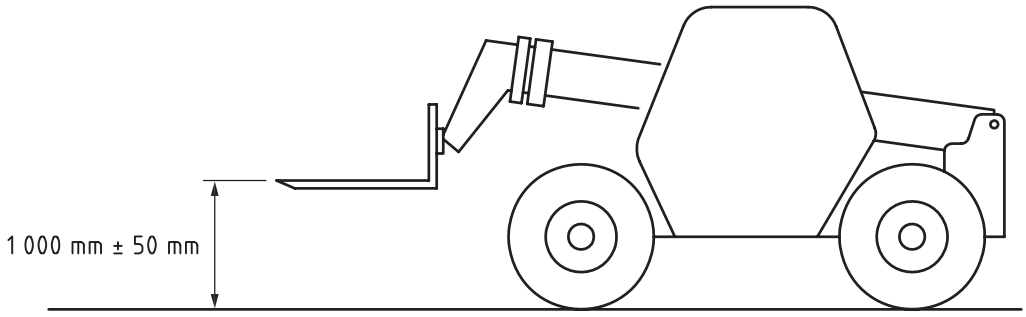


Figure 6 – Test in lorry trailer loading condition – boom and forks position

7 Measurement procedure

7.1 Test-surface marking and truck location on the test surface

7.1.1 Mark a visibility test circle of 12 m radius on the test surface with the two centrelines as shown in Figure 2. Mark the centre point of the visibility test circle to enable accurate alignment of the truck (see 6.3.1).

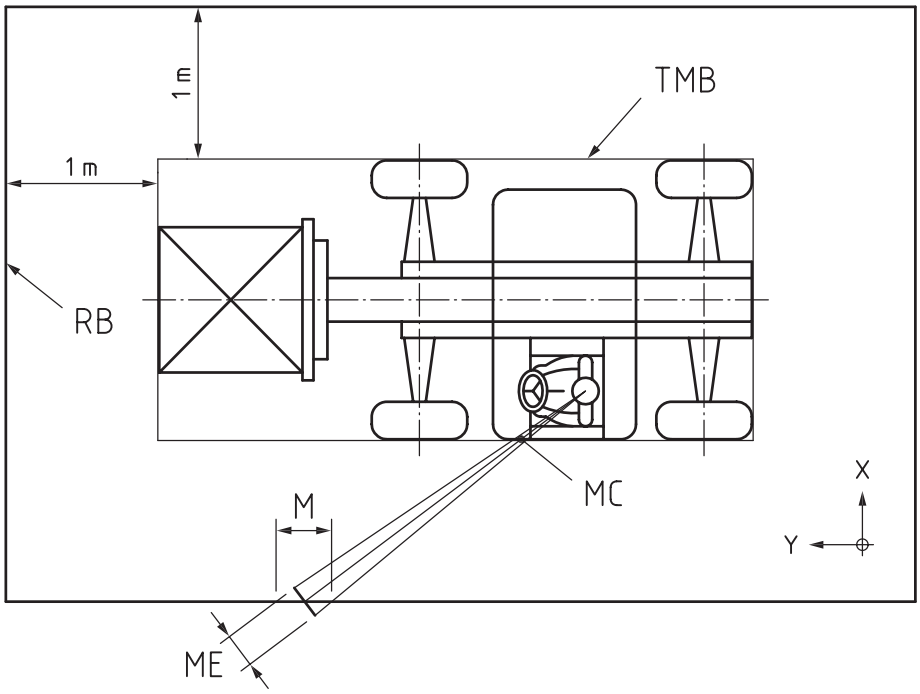
7.1.2 Mark where the sectors A, B, C, D, E and F intersect the line of the circle on the test surface as shown in Figure 2.

7.1.3 Position the fork mounted load and adjust the boom and forks as defined in 6.3.2.1.

NOTE RB remains the same for all tests and is measured and set as illustrated in Figure 4 and Figure 7.

7.1.4 Mark the test machine boundary (TMB) as the smallest rectangle that can be placed around the vertical projection of the truck and test load as shown in Figure 7.

Mark the rectangular 1 m boundary (RB) on the test surface at a distance of 1 m from the test machine boundary, as shown in Figure 7.



Key

TMB test machine boundary
MC masking component
M masking
ME masking effective length perpendicular to light source
RB rectangular boundary

Figure 7 – Test machine boundary and rectangular 1 m boundary

7.2 Positioning of the test apparatus

7.2.1 Mount the light source apparatus with the FPCP as described in 5.2.

7.2.2 For the sector of vision being evaluated, the light bulb spacing shall be in accordance with Table 2 and Table 3 and shall be symmetrical to the FPCP. Where using 205 mm or 405 mm spacing, in order to minimize the masking affects, these do not need to be symmetrical to the FPCP, provided that each bulb is between 102,5 mm and 202,5 mm (in accordance with Tables 2 and 3) from the FPCP.

NOTE For truck research and development purposes, the 65 mm light bulb spacing can be used to provide a more detailed evaluation of the masking around a truck and is recommended for such work.

7.2.3 A masking shall be evaluated (for the light bulb spacing and against the criteria defined in Tables 2 and 3) with respect to the relevant sector in which the centre of the masking lies. To determine the sector in which the centre of the masking lies (see Figure 7), a straight line from the FPCP to the centre of the masking (parallel to the surface) shall be drawn. The sector where this line crosses the VTC is the sector that applies.

To take measurements, rotate the light bar so that the line between the two light sources is perpendicular to

the line between the filament position centre point and the edge of the visibility masking component. This first point denotes the start of the masking. Continue to rotate the light bar to the next edge of the visibility masking component i.e. where the masking ceases to occur.

7.3 Measurement of the masking

7.3.1 General

As a first step, all measurements shall be made considering the direct visibility.

As a second step, additional devices like mirrors or CCTV may be incorporated in the measurements to conform to the visibility performance criteria if required. If when having incorporated additional devices a direct visibility masking is broken into two or more parts, the remaining masking portions shall be re-evaluated with respect of the relevant sector in which the centre of remaining masking lies. See 9.3.

For defining the indirect visibility for mirrors, use the same measurement procedure as for direct visibility to measure and record the reflection of the light source in the mirrors to the visibility test circle and the rectangular 1 m boundary. Use the same light bulb spacing as specified in 7.3.2 for the visibility test circle and in 7.3.3 for the rectangular 1 m boundary for the sectors where the mirror is located.

The measurements shall be made for each of the test configurations specified in 6.3.2, 6.3.3 and 6.3.4.

Where a mirror is used to take measurements, the masking points on the visibility test circle and rectangular 1m boundary shall be marked where the light source is cut off at the centre of the mirror.

7.3.2 Measurement at the visibility test circle

Adjust the light bulb spacing as specified in Table 2 for the relevant sector. Position the light source as described in 7.2.2 and 7.2.3.

Record the masking at the visibility test circle on the ground reference plane, so that the cord length of the masking on the visibility test circle can be determined.

When a truck has two or more vertical components that are near each other, a light bulb spacing less than the maximum specified for the sector may be used to determine the minimum masking (see also 7.2.2).

The requirements for a minimum spacing between two adjacent masking as specified in 9.1 shall be considered.

If a masking exists at the visibility test circle in sectors A and C, record the measurements. If the masking disappears within a vertical distance of 750 mm from the test surface at the 12 m radius, record the height at which the masking meets the criteria of Table 2.

NOTE 1 This information is required for the operator's handbook.

Do not record a masking that has a width of less than 100 mm.

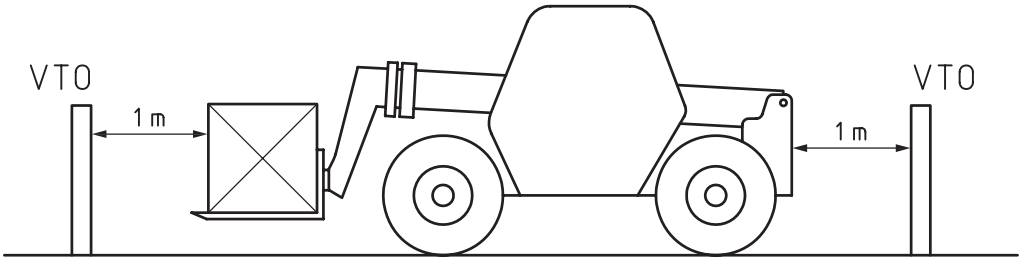
NOTE 2 The test can be carried out in a dark environment where the shadows of truck components can be directly noted on the visibility test circle, or a mirror located on the test surface or the vertical test object can be used to develop a line of sight to the filament to determine the point where masking occurs.

7.3.3 Measurement at the rectangular 1 m boundary

The measurement shall be made with light bulb spacing up to 405 mm on the RB perpendicular to the masking for determination of the actual masking in the near field vision area. Use the vertical test object as specified in 5.3 and check along the rectangular 1 m boundary as illustrated in Figure 7 and Figure 8. Mark on the rectangular 1 m boundary where the direct view to the light source is masked by truck parts. Record the masking with their x and y coordinate. If the masking width (M) exceeds 300 mm on the RB, measure the

width ME (masking effective length, see figure 7) of the masking perpendicular to the light source; see Figure 7. Record ME as the width of the masking.

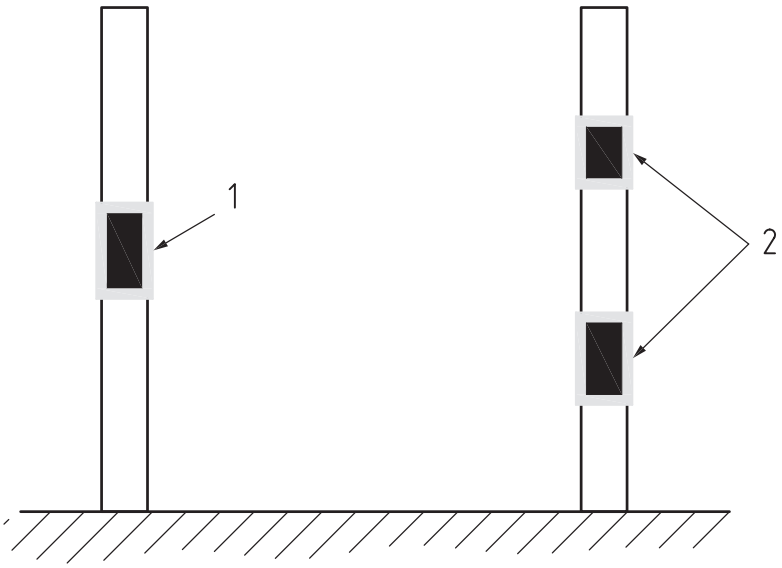
If the top of the surface of the vertical test object is masked, then the vertical test object may be considered visible if the observation mirror (or equivalent) can direct the light source for a continuous 200 mm height of the vertical test object (see Figure 9).



Key

VTO: vertical test object

Figure 8 — Measurement at the rectangular 1 m boundary



Key

1 Visibility ≥ 200 mm anywhere on the test object – acceptable.
2 Visibility <200 mm not adjacent – unacceptable.

Figure 9 — Observation of the vertical test object

NOTE The visibility on the vertical test object below the 1,5 m height can be checked by the use of a mirror moved up and down the test object.

When a truck has two or more vertical components that are near each other, a light bulb spacing less than the maximum may be used to determine the minimum masking (see also 7.2.2).

7.4 Fork arm visibility

Use the machine configuration described in 6.3.2.2 (without test load), using standard specification fork arms as described by the manufacturer, and the light source apparatus with light bulb spacing of up to 405 mm.

The FPCP of the light source may be moved toward the load centre by up to 300 mm and above or below by up to150 mm.

Move observation mirror (or equivalent) along upper face of fork to detect the light source.

NOTE An observation mirror is not necessary if the fork arm is directly illuminated by the light source.

7.5 Requirements for derivative trucks

The impact on visibility created by attachments authorised by the manufacturer shall be assessed. If the maskings are likely to be greater than the appropriate criteria in Tables 2 and 3 (see note 2), then the testing without load and with the attachment and boom positioned in the travel mode according to the manufacturer's specification shall be undertaken.

NOTE 1 It is sufficient to measure the truck with the most challenging standard attachment within the limits of the intended use.

NOTE 2 If the attachment is designed for suspended load only, only the criteria for suspended load need to be applied.

8 Calculation method and computer simulation

8.1 Calculation method

If calculation is used as an alternative method to the tests, it shall give equivalent results.

Annex C gives an example of calculation method for symmetrical eye spacing.

8.2 Computer simulation

Computer-simulation based on the principles specified in this standard may be used to determine the visibility masking and provide results for the test report.

9 Evaluation method and performance criteria

9.1 Visibility performance criteria on the visibility test circle

The space between any two adjacent masking on the visibility test circle shall be equal to or greater than 700 mm. If this is not the case, the two masking and the space between them shall be combined to result in one reported masking.

The truck meets the requirements of this standard if the measurement results show no masking or masking smaller than or equal to the performance criteria with direct view as specified in Table 2.

NOTE 1 The visibility performance criteria are summarized in Table 2 for the different truck types. The first column of Table 1 defines the type of truck and the class of truck based upon truck type. The maximum allowed masking widths on the visibility test circle are specified in Table 2 for each truck type.

NOTE 2 The first line of each row of Tables 2 and Table 3 define the light bulb spacing for the relevant sector. The remaining lines define the number and maximum size of masking(s) permitted for that sector. For example:

65 (1-700 and 1-1300)

Defines a bulb spacing for the sector of 65 mm and a permits 2 maskings; one of a maximum size of up to 700 mm and a second of up to 1300 mm. Alternatively it may be easier to add row headings and divider lines to Tables 2 and 3.

9.2 Visibility performance criteria for the rectangular 1 m boundary

The truck meets the requirements of this standard if the measurement results show no masking or masking smaller or equal to the acceptable masking as shown in Table 3.

Table 2 — Visibility performance criteria on visibility test circle

Dimensions in millimetres

The first row of each test configuration is the maximum allowed light bulb spacing. The second row is the allowed number and width of masking						
Test configuration	**Sector**					
	A	**B**	**C**	**D**	**E**	**F**
Test in normal travel mode without load (6.3.2.2)						
Compact trucks	205 1 – 1 500	205 0	405 1 – 1 850	205 1 – 700 and 1 – 1300	205 1 – 700 and 1 – 1300	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Other trucks, except articulated-frame trucks	205 1 – 1 500	205 0	205 1 – 1 300	205 1 – 700 and 1 – 1300	205 1 – 700 and 1 – 1300	65 (1 – 700 and 1 – 1300) or (1 – 2 000) or (3 – 700)
Articulated-frame trucks	205 1 – 1 800	205 0	205 0	205 1 – 700 and 1 – 1300	205 1 – 700 and 1 – 1300	65 (1 – 700 and 1 – 1300) or (1 – 2 000) or (3 – 700)
Test in normal travel mode with fork mounted load (6.3.2.1)						
Compact trucks	205 1 – 1 500	205 0	405 1 – 1 850	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 1 300	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Other trucks, except articulated-frame trucks	405 1 – 1 500	205 0	205 1 – 1 300	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 1 300	65 (1 – 700 and 1 – 1 300) or

						(1 – 2000) or (3 – 700)
Articulated-frame trucks	405 1 – 1 800	205 0	205 0	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 1 300	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Test with suspended load (6.3.3)						
Compact trucks	405 1 – 4 300[1]	205 0	205 1-1 300	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 3 500	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Other trucks, except articulated-frame trucks	405 1 – 2 900[1]	205 0	405 1-9 000[2]	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 3 500	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Articulated-frame trucks	405 1 – 2 900[1]	205 0	205 0	205 1 – 700 and 1 – 1 300	205 1 – 700 and 1 – 1 300	65 (1 – 700 and 1 – 1 300) or (1 – 2 000) or (3 – 700)
Test lorry trailer loading condition (6.3.4) [3]						
All truck types	405	405	405	205	205	65

[1] large masking accepted due to the load itself being the cause (if the truck was to be tested without load in this configuration the masking should not exceed 1800 mm)

[2] the masking shall be orientated towards the boundary of sectors C and E. The remaining part of sector C (towards the boundary of sectors A and C) shall not contain any masking effect

[3] for trailer lorry loading the ideal use of a rough-terrain variable reach truck is use adjustments of boom geometry and extension to place and retrieve loads from a static position. However, a more dynamic use can be foreseen and so whilst it is not practical to fit aids to overcome masking due to the position of the boom and the load (predominantly in sectors A and C, and given that movements from the lorry are rearward), the results of the specified test are to be communicated in the information for use (see 11)

Table 3 — Visibility performance criteria on rectangular 1 m boundary

The first row of each test configuration is the maximum allowed light bulb spacing. The second row is the allowed number and width of masking						
Test configuration	**Sector**					
	A	**B**	**C**	**D**	**E**	**F**
All except 6.3.4 (Lorry trailer loading condition)						
	405 No masking more than 500mm. Only one masking greater than 300 mm and up to 500 mm shall be allowed and in this case the result shall be reported in the information for use.	405 No masking more than 300 mm. A gap of minimum 300 mm is required between 2 masking				

9.3 Visibility masking that exceed the visibility performance criteria with direct view

If the direct view does not conform to the performance criteria specified in 9.1 for the visibility test circle and in 9.2 for the rectangular 1 m boundary, the visibility provided by the following additional devices shall be provided:

— indirect view provided by mirrors;

— view provided by additional visual aids, e.g. CCTV.

The truck meets the requirements of this standard if the visibility with the additional devices conforms to the performance criteria in Tables 2 and 3, and in 9.1 and 9.2.

9.4 Fork arm visibility criteria

There shall be visibility to at least the full width of one fork tip.

10 Test reports

10.1 Truck details

The test reports shall include the following information:

a) the business name and full address of the manufacturer and, where applicable, his/her authorized representative;

b) the designation of the truck (including the type of truck considered : compact, articulated, other);

c) operating (unladen) mass in accordance with ISO 6016;

d) product identification number;

e) operator enclosure and/or operator protective structure description or identification;

f) equipment installed on the truck;

g) any other information that affects the visibility measurements;

h) pictures (or illustration) of the truck configuration for the visibility test;

i) record the position dimension(s) of the equipment in its tested positions.

10.2 Drawing

For each test configuration, a drawing shall illustrate the test results including the masking (dimensions in millimetres) on the visibility test circle by the designated visibility sector with the specific light bulb spacing (see Annex D). The distance between masking and their positions shall be provided. In addition, the masking at the rectangular 1 m boundary line shall be provided.

11 Information for use

The instructions shall contain the following as a way to minimize visibility hazards:

a) recommendation that the operator survey his/her field of vision when operating the truck;

b) information regarding the position, setting, use and maintenance of mirrors or visual aids (CCTV), when provided;

c) a diagrammatic representation of the results of the test in suspended load condition (as defined in 6.3.3 and Table 2). Examples are given in Annex D;

d) a note that if a suspended load or the resulting boom geometry creates a substantial blockage that the user should consider alternative carrying means (e.g. palletised load);

e) information concerning visibility masking effects at the visibility test circle (VTC) and the rectangular 1m boundary when the truck is being used in lorry trailer loading conditions according to 6.3.4 e.g. visibility diagram (see example in Figure D.2).

f) information concerning any masking in sectors A and C which are measured above the ground reference plane (up to 750 mm) in order to meet the criteria of this standard (cf. 7.3.2);

g) information that modifications of the truck may affect the operator’s visibility.

Annex A
(normative)

Light bulb spacing dimensions

The light bulb spacing is derived from the following operator physical characteristics:

— 65 mm, the light bulb spacing that represents the binocular eye spacing of 50 % seated operators as described in ISO 3411;

— 205 mm, the light bulb spacing that represents the range of eye movement (considering body torso and head movement) of 50 % of operators as described in ISO 3411 when looking to a 45° angle to the rear (135° clockwise or anti-clockwise from straight ahead position);

— 405 mm, the light bulb spacing that represents the range of eye movement (considering body torso and head movement) of 50 % operators as described in ISO 3411 when looking to the front (90° clockwise and anti-clockwise from the straight ahead position).

Annex B
(informative)

Performance criteria for additional devices

B.1 Performance criteria for mirrors

For indirect visibility to the visibility test circle, mirrors should have at least a convex radius of curvature of 300 mm.

For indirect visibility to the rectangular 1 m boundary around the truck, mirrors should have at least a convex radius of curvature as follows:

— 200 mm radius for up to 2,5 m from filament position centre point;

— 300 mm radius for up to 3,5 m from filament position centre point;

— 400 mm radius for up to 5 m from filament position centre point.

B.2 Performance criteria for CCTV system

The CCTV system should conform to ISO 16001.

Annex C
(informative)

Procedure for the determination of masking at the visibility test circle or the rectangular 1 m boundary

The specified calculation procedure provides an alternative to the test method.

For binocular vision with an eye spacing, s, the masking, expressed in millimetres, is given by the equation (see also Figure C1):

$$x = \frac{(b - s)}{a} \times r + s$$

where

a is the distance between the component causing the masking and the light-bulb filament, in millimetres;

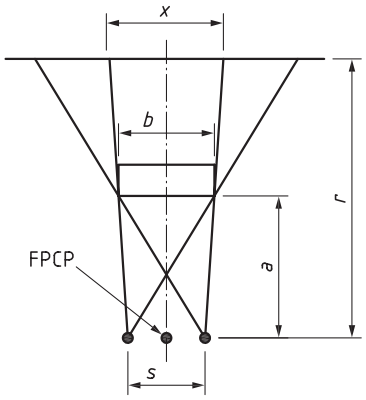
b is the width of the component causing the masking, measured horizontally, and perpendicular to the radius from the light-bulb filament position centre-point and the centre of the component, in millimetres;

r is the radius from the light-bulb filament position centre-point on the test surface to the visibility test circle on the test surface or to the rectangular 1 m boundary, in millimetres;

s is the distance between the light-bulb filaments, used to represent binocular vision with this eye spacing, in millimetres;

x is the width of the masking tangent to the visibility test circle or masking effective length on the rectangular 1 m boundary, in millimetres.

NOTE This equation is an approximate calculation of the masking and becomes less accurate as the length of the masking increases, but it provides acceptable accuracy for masking widths up to 5 m without verification by physical measurement.

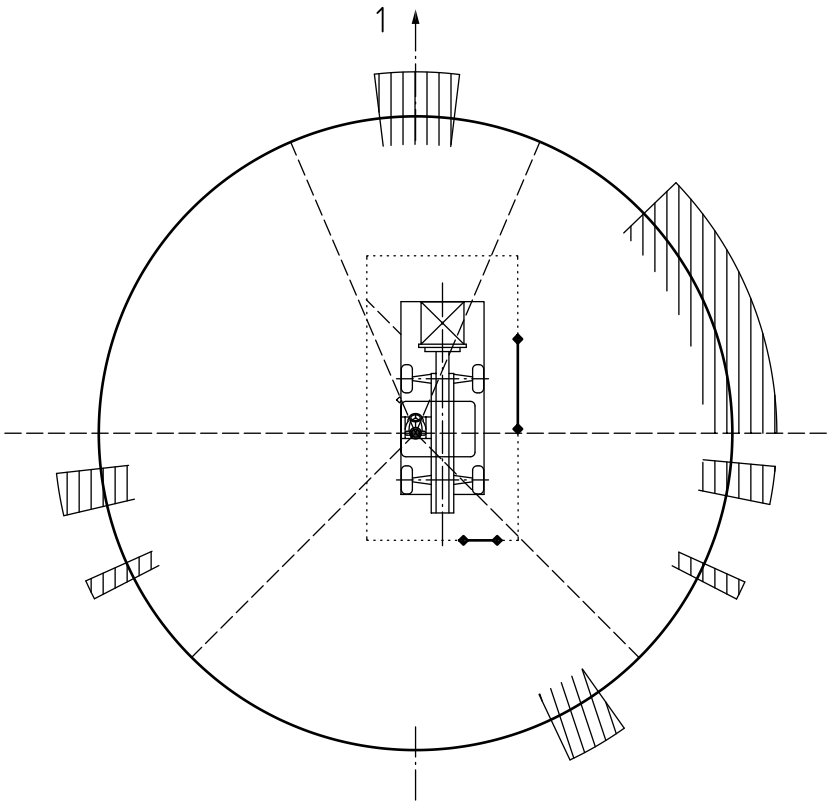


NOTE For a definition of the symbols, see the preceding equation.

Figure C.1 — Calculation method for determining masking

Annex D
(informative)

Examples of drawings for the test report



Visibility masking at 12 m radius measured at ground level

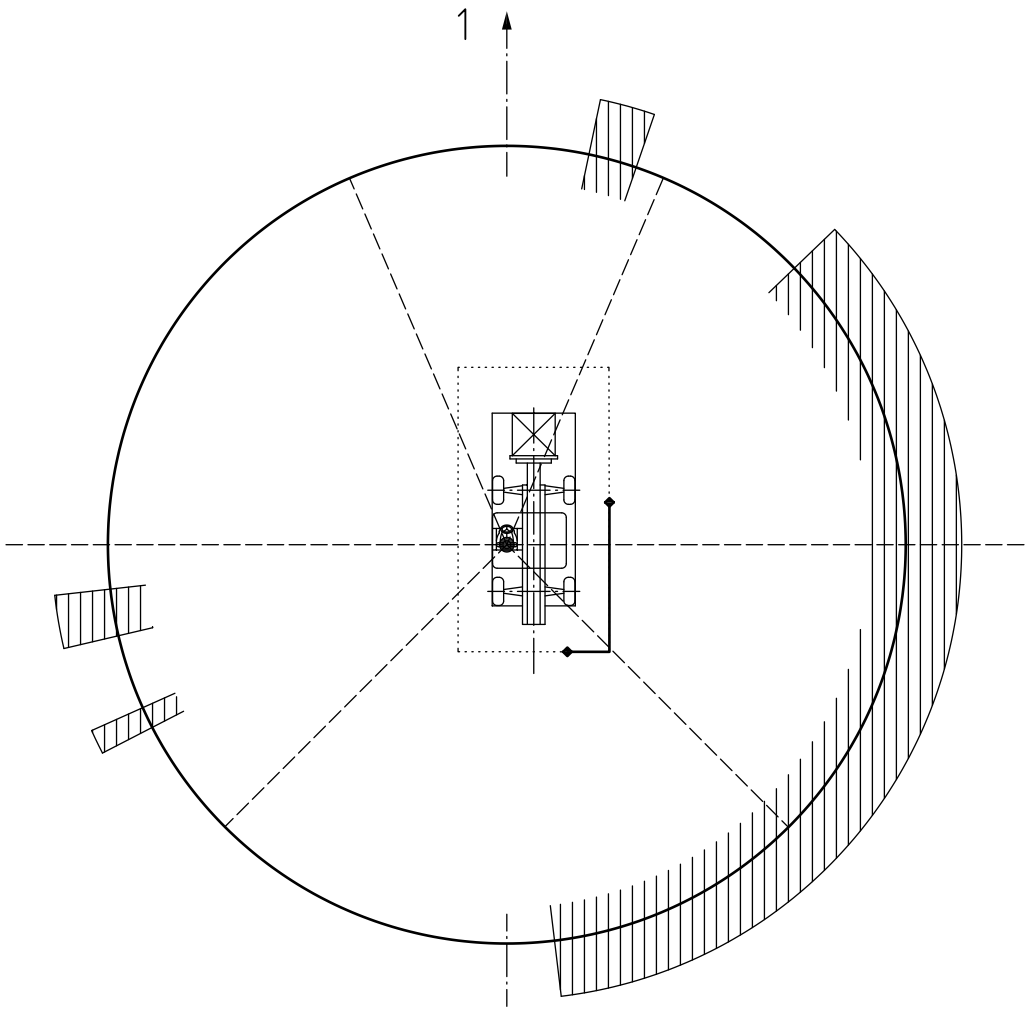
◆ Coordinates of visibility masking (>200 mm continuous height) measured at a 1,5 m height

1 m measuring line

1 - Front

Figure D.1 —Visibility masking in suspended load condition (test in accordance with EN 15830)

NOTE If a suspended load or the resulting boom/arm geometry creates a substantial blockage that the user should consider alternative carrying means.



Visibility masking at 12 m radius measured at ground level

◆ Coordinates of visibility masking (> 200 mm continuous height) measured at a 1,5 m height

1 m Measuring line

1 - Front

Figure D.2—Visibility masking in lorry trailer loading condition (test in accordance with EN 15830)

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Machinery Directive 2006/42/EC.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with paragraph 5 of Essential Requirements 1.2.2 and paragraph 1 of Essential Requirements 3.2.1 of that Directive.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] ISO 16001:2008, *Earth-moving machinery — Hazard detection systems and visual aids — Performance requirements and tests*

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