



BSI Standards Publication

## Railway applications — Driver's cabs

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Part 5: External visibility for tram vehicles

EUROPEAN STANDARD

**EN 16186-5**

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## Railway applications - Driver's cabs - Part 5: External visibility for tram vehicles

Applications ferroviaires - Cabines de conduite - Partie  
5 : Visibilité extérieure depuis la cabine de tramways

Bahnanwendungen - Führerraum - Teil 5:  
Sichtbedingungen nach außen bei  
Straßenbahnfahrzeugen

This European Standard was approved by CEN on 21 June 2021.

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## European foreword

This document (EN 16186-5:2021) has been prepared by Technical Committee CEN/TC 256 “Railway applications”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by February 2022, and conflicting national standards shall be withdrawn at the latest by February 2022.

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

EN 16186 *Railway applications — Driver’s cab* consists of the following parts:

- *Part 1: Anthropometric data and visibility;*
- *Part 2: Integration of displays, controls and indicators;*
- *Part 3: Design of displays;*
- *Part 4: Layout and access;*
- *Part 5: External visibility for tram vehicles;*
- *Part 6: Integration of displays, controls and indicators for tram vehicles<sup>1</sup>;*
- *Part 7: Design of displays for tram vehicles<sup>1</sup>;*
- *Part 8: Tram vehicle layout and access<sup>1</sup>.*

NOTE Part 1 to 4 above-mentioned standard are only applicable for heavy rail vehicles.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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<sup>1</sup> Under development.



## 1 Scope

This document specifies the external front and rear visibility conditions from cabs of tram vehicles and the associated assessment method.

This document applies to vehicles operating on tram networks.

This document does not apply to driver's auxiliary desks.

This document is not intended to be applied for tram train.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 15152:2019, *Railway applications - Windscreens for trains*

EN 15227, *Railway applications - Crashworthiness requirements for rail vehicles*

EN 15663, *Railway applications - Vehicle reference masses*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

### 3.1

#### **auxiliary desk**

#### **<tram vehicle>**

additional control desk with limited functionality generally located in the passenger area

### 3.2

#### **windscreen**

glazing in front of a driver through which the track ahead can be observed

[SOURCE: EN 15152:2019, 3.2, modified — “or passengers” is removed.]

### 3.3

#### **sagittal plane**

XZ plane passing in the middle of the dummy

Note 1 to entry: The XZ directions are defined in EN 15227.

### 3.4

#### **side windscreen**

additional glazing positioned at the side of a windscreen that is predominately positioned transversely to the running direction

[SOURCE: EN 15152:2019, 3.2.2]

### 3.5

#### **tram network**

urban rail network with its own right of way or shared with road traffic

Note 1 to entry: Typically line of sight operation.

Note 2 to entry: A tram network can be linked to other rail networks.

### 3.6

#### **tram vehicle**

rail vehicle operated within line of sight and designed to run on a tram network

Note 1 to entry: An assembly of one or more coupled tram vehicles is usually called a tram.

### 3.7

#### **primary vision area**

area of the windscreen through which track and signals are visible from the driving position

Note 1 to entry: Defined as “vision area A” by EN 16186-1:2014+A1:2018, 3.1.3.

[SOURCE: EN 15152:2019, 3.3, modified — The current Note 1 to entry was added.]

### 3.8

#### **secondary vision area**

area of the windscreen outside the primary vision area, through which the driver can also look from the driving position

Note 1 to entry: Defined as “vision area B” by EN 16186-1:2014+A1:2018, 3.1.4.

[SOURCE: EN 15152:2019, 3.4, modified — The current Note 1 to entry was added. “May” has been replaced with “can”]

### 3.9

#### **driver dummies**

models referring to the min and max anthropometric data

Note 1 to entry: The anthropometric data are provided in Clause 4.

4 Driver's anthropometric data

4.1 General

This Clause defines the anthropometric data on which the requirements in this document are based.  
The background on these anthropometric data are provided in CEN/TR 16823.

4.2 Data

Figure 1 and Figure 2 give the body size measures.

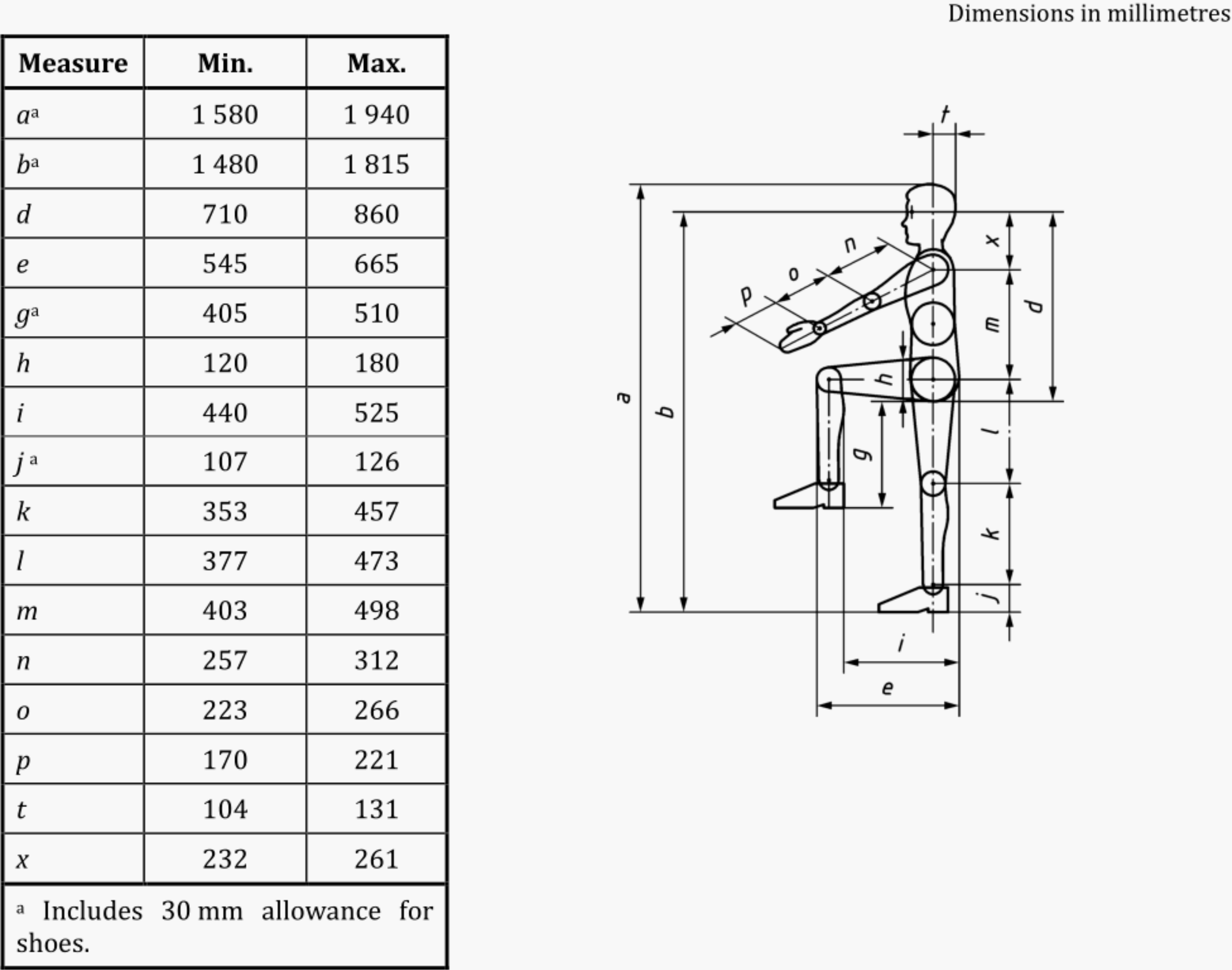


Figure 1 — Principal body size measures



Dimensions in millimetres

	Min.	Max.
d	see Figure 1	
f <sup>a</sup>	510	635
l	see Figure 1	
q	78	90
r	75	101
s	105	121
t	see Figure 1	
u	295	387
v	450 to 550	600 to 700
w	390 to 405	470 to 510
x	see Figure 1	
z	220	290
<sup>a</sup> Includes 30 mm allowance for shoes.		

Key

- a) sitting upright
- b) sitting inclined
- 1 hip point
- 2 seat reference point
- 3 heel point (lowest rear point of the heel)
- z/4 non-flexible part of the shoe pad

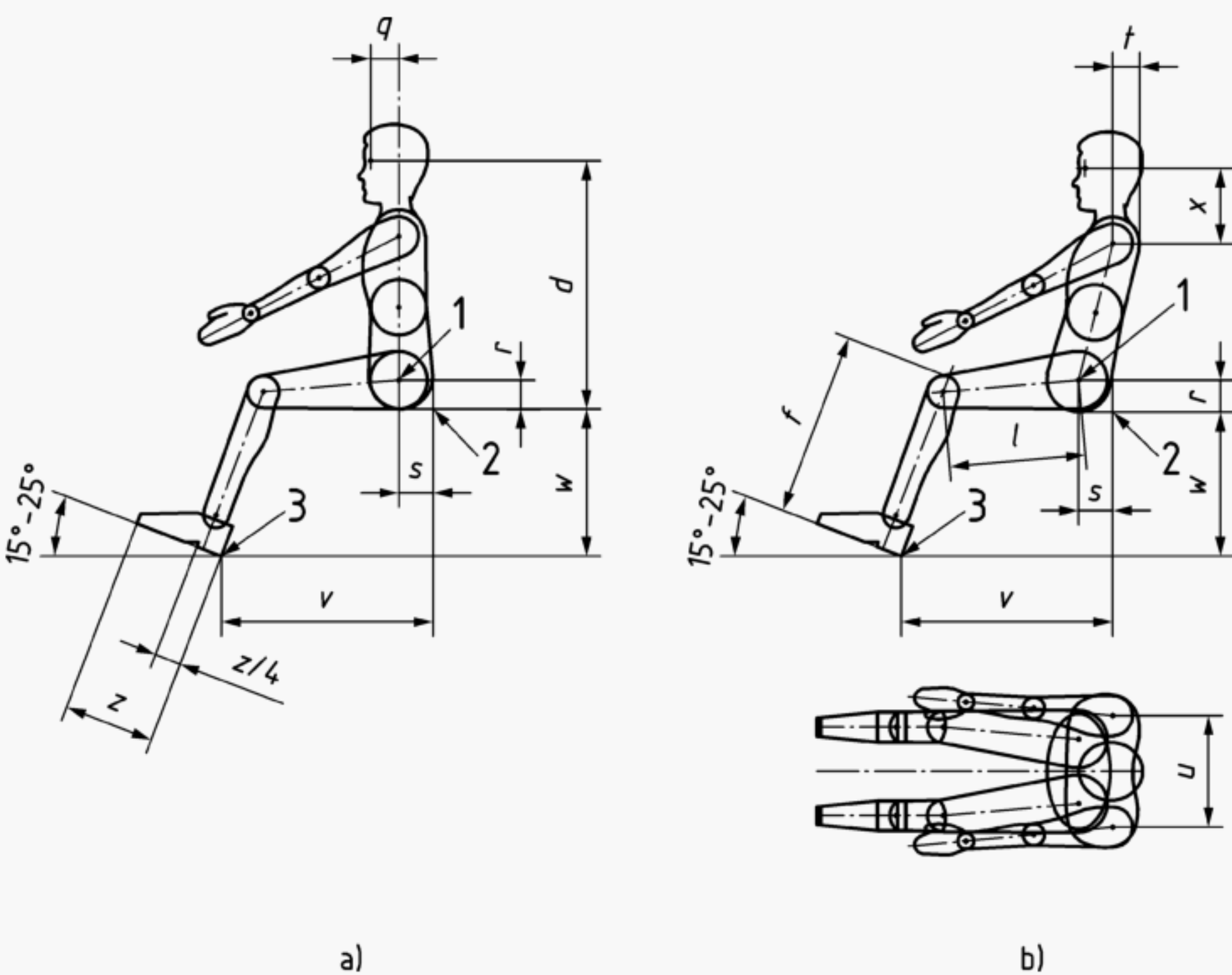


Figure 2 — Additional body size measures

The minimum distance between the eyes is 53 mm and the maximum distance between the eyes is 70 mm.

The minimum dimensions shall be used together with the minimum requirements listed in Figure 2.

The maximum dimensions shall be used together with the maximum requirements listed in Figure 2.



## 5 Forward visibility

### 5.1 General

For the seated driving position, the forward visibility requirements of 5.2.1 shall be ensured (see also Annex A and Annex B, Figure B.1).

The horizontal distance from the driver's eye to the windscreen in seated position shall be a minimum of 500 mm and an absolute maximum of 1 715 mm.

The sightlines as defined in 5.2 shall not be infringed by any permanent equipment of the rolling stock (except for the wiper), whether inside or outside the cab.

All visibility criteria shall be applied using both dummies defined in 4.2.

The visibility criteria do not apply to driver instructor locations.

### 5.2 Forward visibility requirements

#### 5.2.1 Objectives

A good outside field of vision enables the driver to anticipate hazardous situations, taking into account the exterior environment when the tram vehicle is moving. The cab design shall enable all drivers:

- to see the track (free from obstacles, track elements in the correct position);
- to see and recognize the signals intended for them in an adequate sighting distance;
- to anticipate and detect hazard by having a large field of vision taking account of the technical constraints and the physiological data (use of the binocular field of vision);
- to detect a hazard by limiting the hidden areas: e.g. detection of a pedestrian of 6 years of age or over when the tram vehicle starts moving in area used by pedestrians (in particular stations).

These objectives are met if the requirements listed below are fulfilled.

#### 5.2.2 General

The visibility for the driver from the normal seated position respecting the comfort articular angles, as defined in EN 16186-8<sup>4</sup>, with the hand on the master controller, is covered by the following assessment. The assessment is based on standard reference points of the two driver dummies, on a vehicle in design mass under normal design payload conditions according to EN 15663 on a straight and level track.

Visibility to the outside shall be possible within a minimum angle of 165 °, symmetrical to the sagittal plane (see Figure 5). The forward viewing field is verified on a horizontal level at eye level.

Assessment for visibility shall at least be done with one eye point. It can be done with two eyes if needed to fulfil the criteria.

NOTE It is not necessary to do the assessment for the complete range of the different comfort angles.

### 5.2.3 Visibility of external signals

The reference points shall be:

- high reference point: positioned at a height of 6,30 m above the top of rail at a distance of 10 m from the front plane of the buffer or automatic coupler or the most external leading point of the vehicle and positioned laterally right and left from the straight track axis at a distance of 3,50 m;
- low reference point: positioned at top of rail level at a distance of 15 m from the front plane of the buffer or automatic coupler or the most external leading point of the vehicle and positioned laterally right and left from the straight track axis at a distance of 3,15 m.

The demonstration of forward visibility shall be done based on a drawing with theoretical lines of sight for both driver dummies.

It is recommended that the longitudinal distance at which low reference points are visible should be reduced.

With this assessment all effects like track curvature, track geometry and vehicle conditions are completely covered, i.e. no additional requirements resulting from those effects shall apply.

The windscreen shall enable upwards visibility of 25 ° in relation to the horizontal level at eye height in the sagittal plane for the two dummies (see Figure 3).

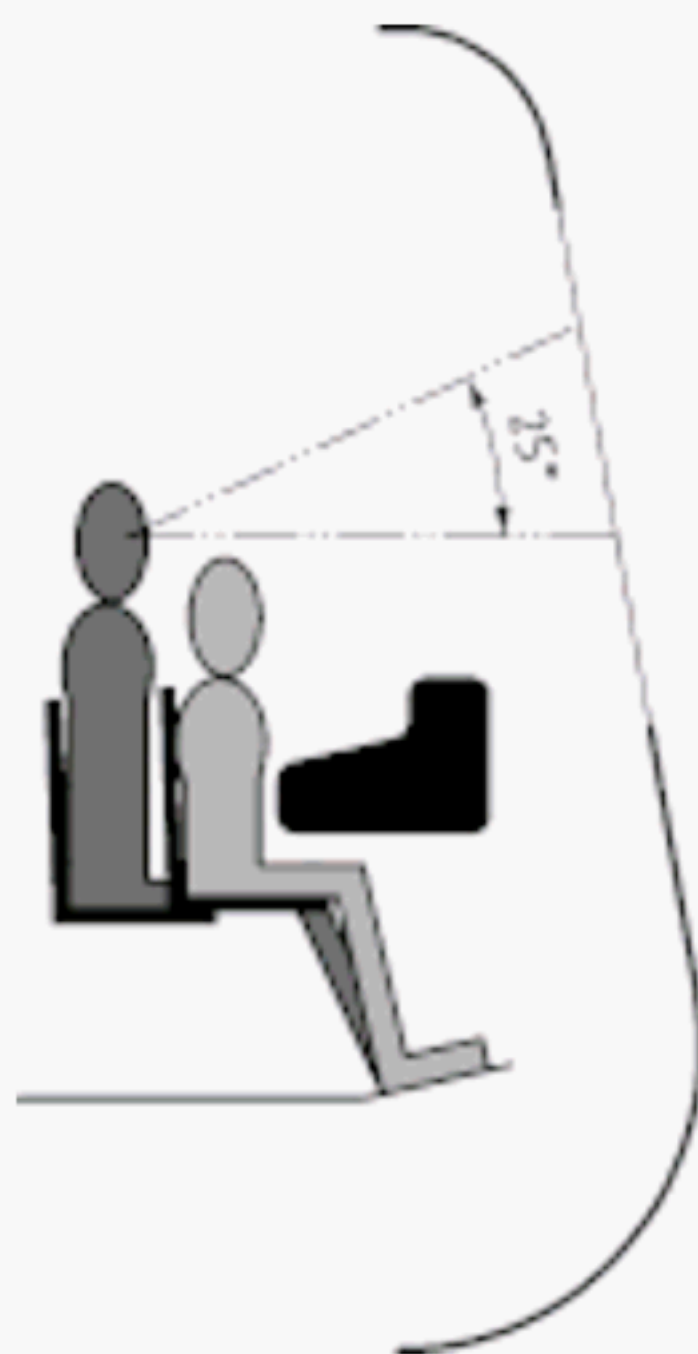


Figure 3 — Upward visibility

### 5.2.4 Close outside visibility

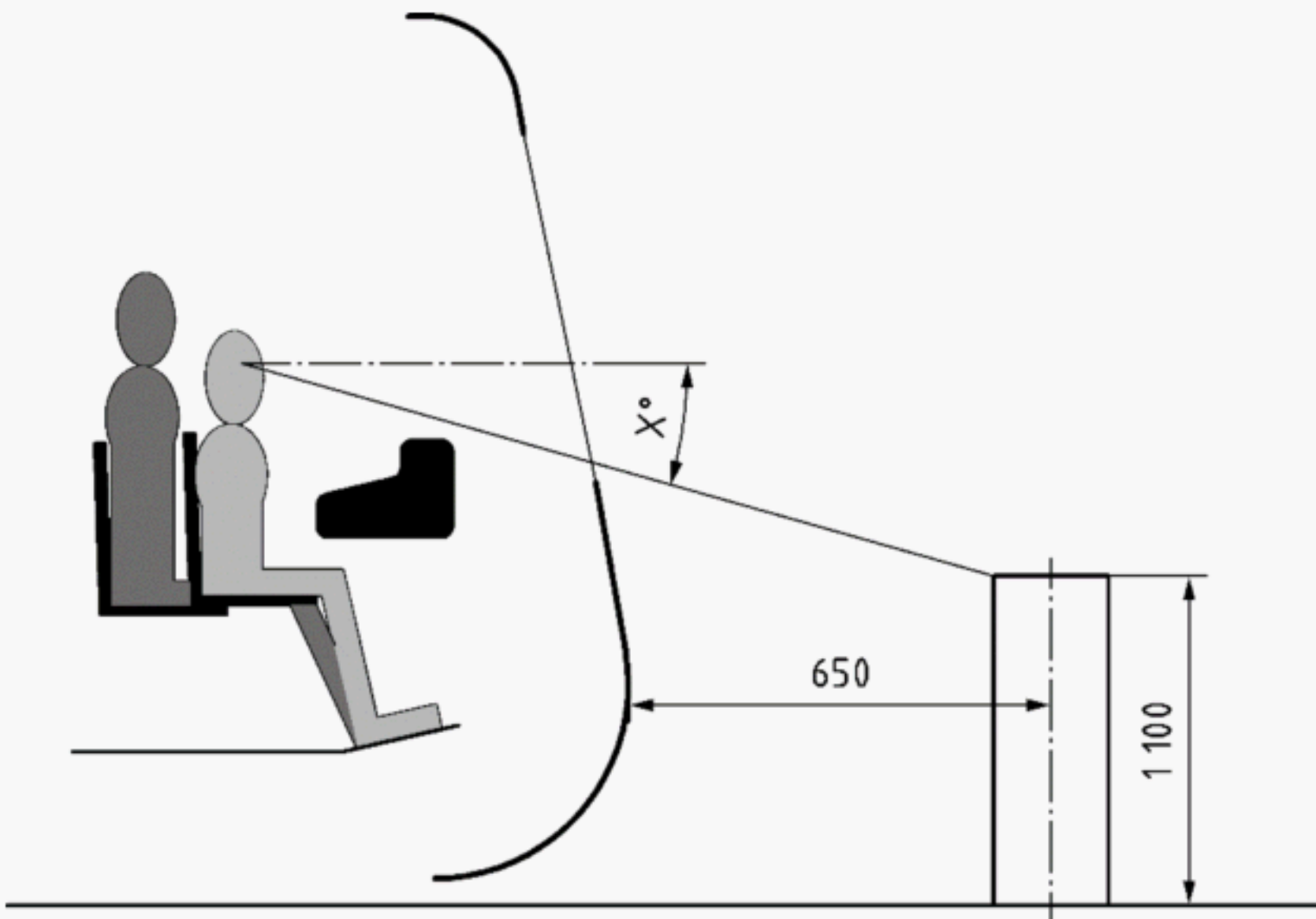
In case of close-up obstacles, the driver shall have a direct line of sight to the complete area in front of the vehicle. This requirement is assumed to be fulfilled when a cylinder of 1 100 mm in height and 300 mm in diameter, with its centre placed on the top of rail 650 mm away from the foremost surface of the tram is always be detected by the driver. The detection shall be possible within the forward field of view (as defined in 5.2.2).

The criteria are fulfilled, if at least the top surface of the cylinder can be seen by the driver.

If a direct line of sight is technically impossible for external side visibility, an indirect line of sight is allowed.



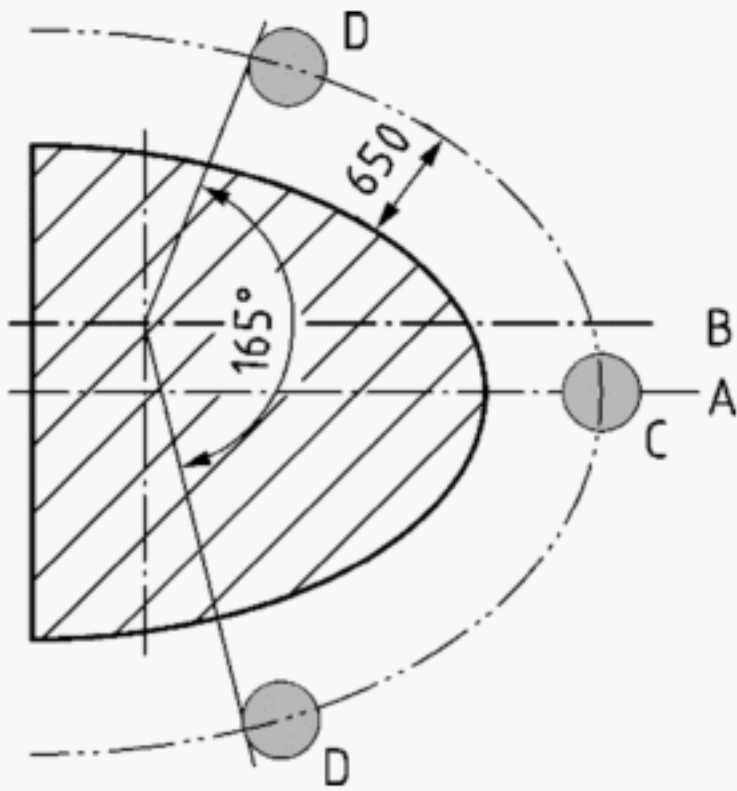
Dimensions in millimetres



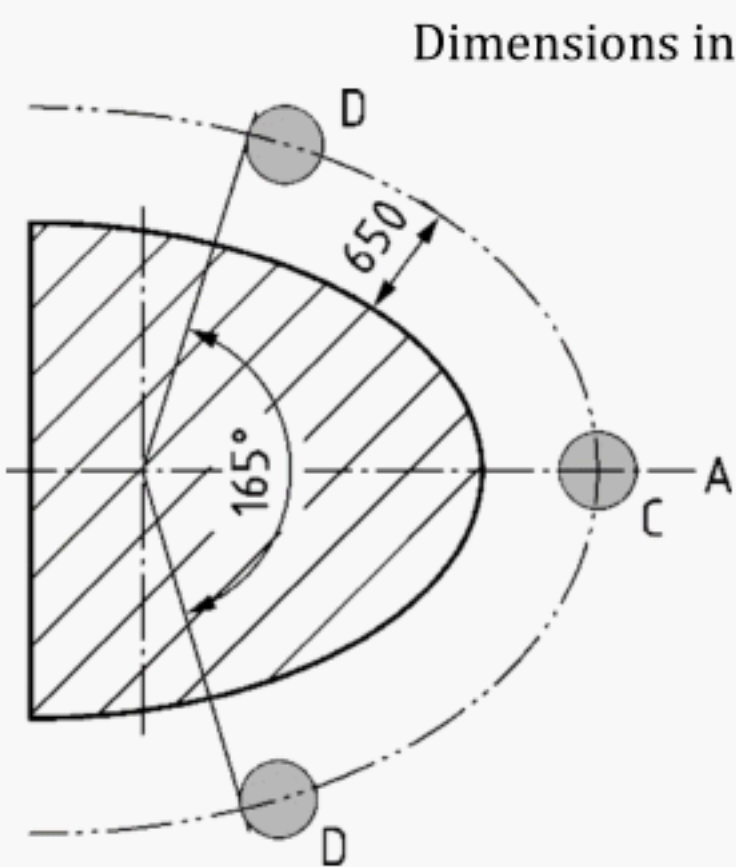
**Key**  
X visibility angle that enables the visibility of a small pedestrian

**Figure 4 — Minimum visibility - Downward visibility**

For each cylinder position within the field of vision, as defined in 5.2.4, X shall be evaluated individually.



**a) Driver not in the middle of the cab**



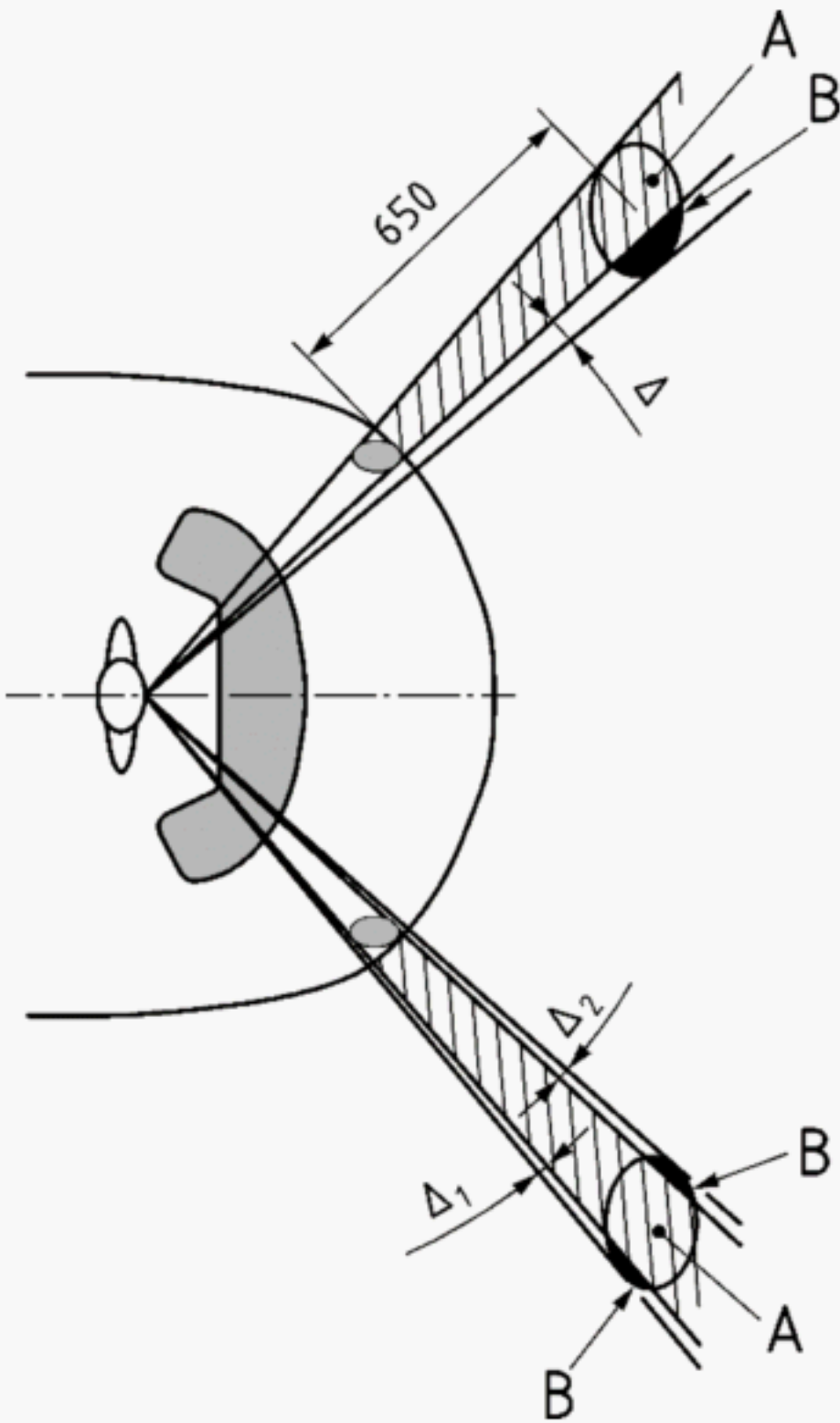
**b) Driver in the middle of the cab**

**Key**  
A vehicle axis  
B driver's axis  
C cylinder height 1 100 mm, 300 mm diameter  
D extreme cylinder positions, tangent to 165 °

**Figure 5 — Representation of the cylinder's extreme positions**

To be detected, the cylinder shall always be seen at a distance of 650 mm from the front of the vehicle in accordance with Figure 6. This requirement is fulfilled when  $\Delta > 0,5^\circ$  or  $\Delta_1 + \Delta_2 > 0,5^\circ$ .

Dimensions in millimetres



**Key**

- $\Delta$  angle covering the visible part on one side of the cylinder,  $\Delta > 0,5^\circ$ ;
- $\Delta_1, \Delta_2$  segments of the angle covering the visible part of the cylinder,  $\Delta_1 + \Delta_2 > 0,5^\circ$ ;
- A cylinders;
- B visible area of the top surface of the cylinder.

NOTE The desk and the driver can be off-centred.

**Figure 6 — Minimum visibility - masking by a pillar**

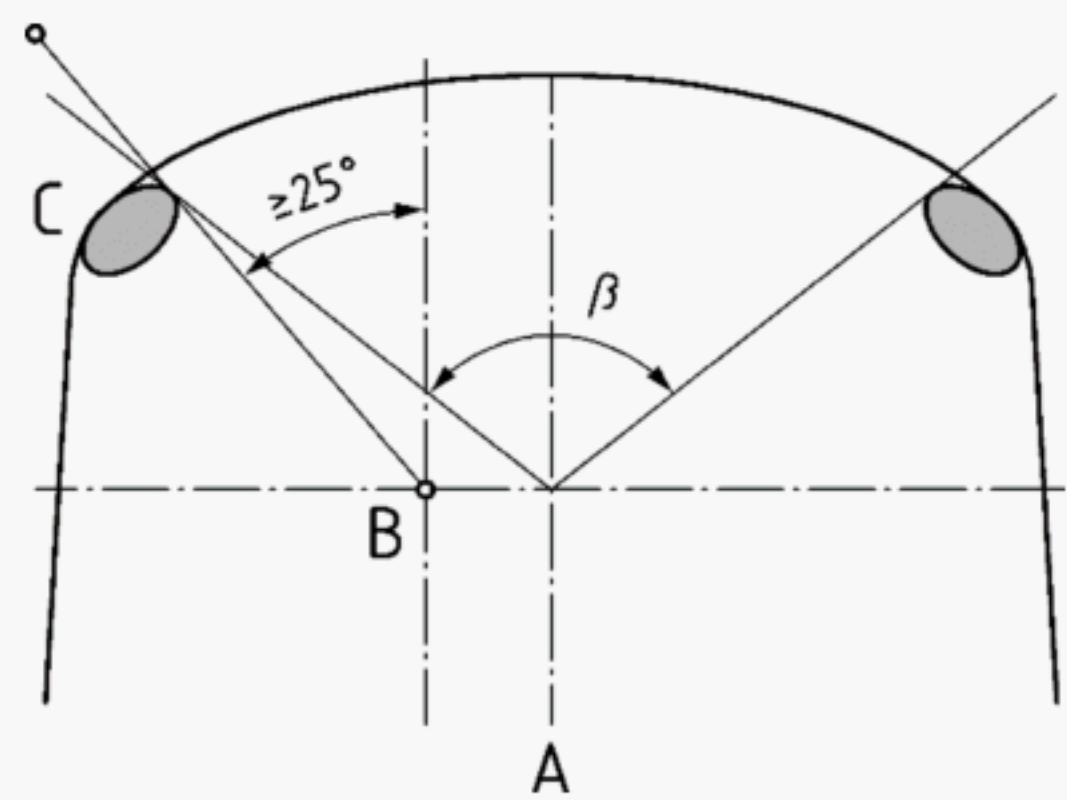
**5.2.5 Forward visibility**

There shall be no obstacles, in particular no pillars within an angle  $\beta$  of at least  $70^\circ$  ( $90^\circ$  recommended), symmetrical in relation to the vehicle's axis (see Figure 7).

The angle between the pillars and the horizontal projection of the driver's sagittal plane shall be at least  $25^\circ$ .

The angles shall be verified on a horizontal level at eye level.





- Key**
- A vehicle axis
  - B driver's eyepoint (shown in the offset position as an example)
  - C pillar
  - β angle of the viewing field between the pillars

**Figure 7 — Angular conditions (central driver's cab)**

**5.2.6 Visibility of couplers**

It should be possible for the driver in a standing position to see the leading end of the automatic coupler during the coupling process.

**5.3 Windscreen and side windscreen related requirements**

**5.3.1 General**

This document is not intended to define the material properties of windscreens.

The primary vision area is based on the definition of visibility of external signals in accordance with 5.2.3. The secondary vision area of the windscreen is outside the primary vision area through which the driver can also look from the driving position.

Other requirements for windscreens are given in EN 15152:2019, in particular in Clause 5. The windscreens that cover the outside field of vision shall not modify either the perception of the colour of the signals for tram vehicle drivers or the colour of the road signals.

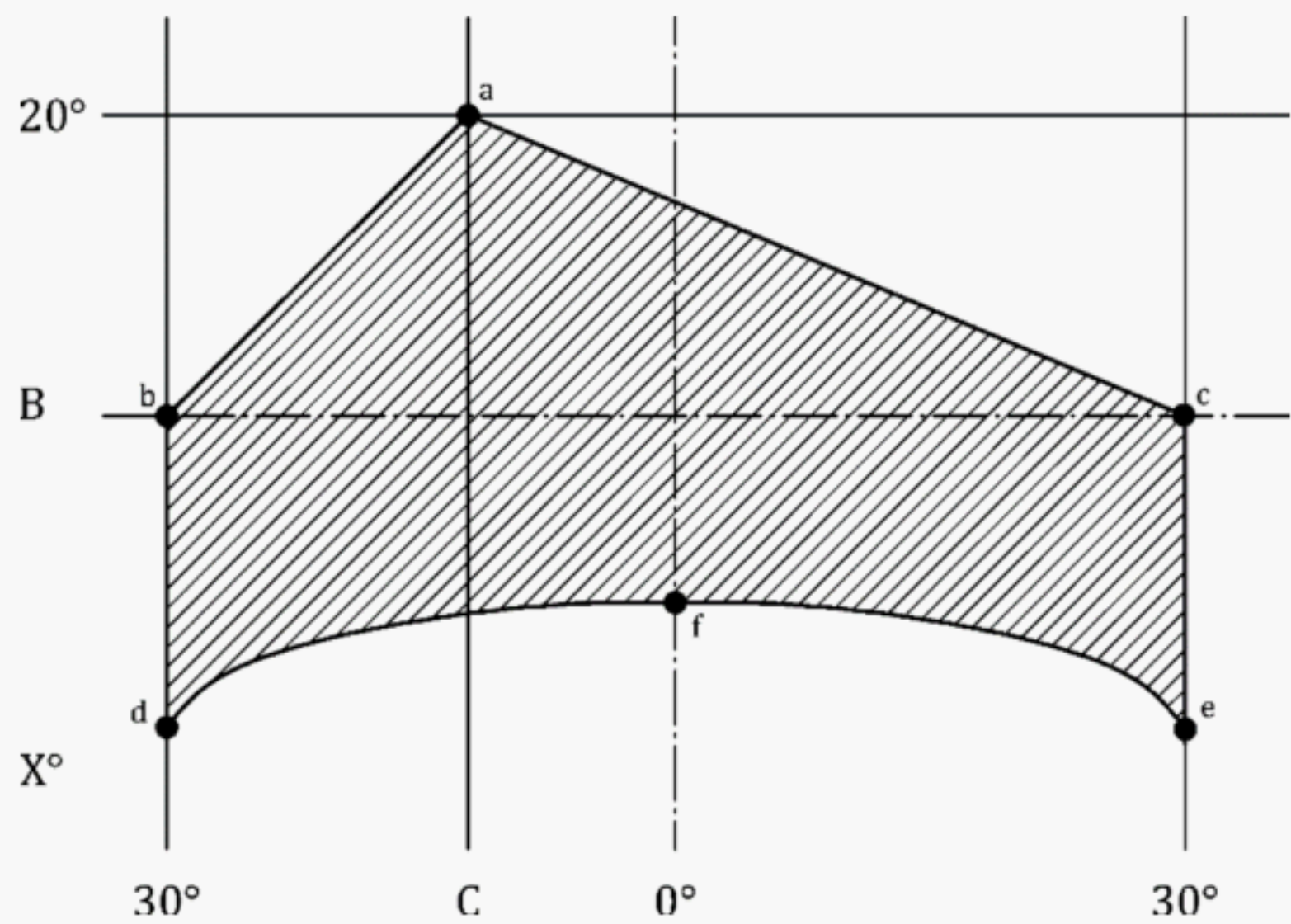
**5.3.2 Front windscreen cleaning device**

The windscreen wiper(s) shall cover at least 95 % of the surface A represented in Figure 8 and defined as the sum of the following surfaces:


- a triangular surface above the horizontal plane at eye level, whose peak (a) is on the driver's sagittal plane at least 20 ° upwards and whose other points (b, c) are at least 30 ° (recommended value  $\frac{\beta - 10^\circ}{2}$ ) on each side of the vehicle axis at eye level.
- the surface below the horizontal plane placed at eye height, with the two points b and c, going downwards parallel to the windscreen edges until they intersect the view line from the driver to the cylinder (with X ° as defined in Figure 4) and the arc from the two resulting points (d, e) and the point f where the view line touches the windscreen at the sagittal plane.

Verification shall be done for both driver dummies.





**Key**

-  surface A area to be wiped by 95 %
- B eyepoint level
- C driver's sagittal plane (shown in the offset position as an example)
- a peak point on the driver's sagittal plane (at least 20 ° upwards)
- b,c points at eye level on each side of the vehicle axis
- d,e below b and c, at X ° downwards
- f on the driver's sagittal plane, at X ° downwards

NOTE The given figure shows a non-central driving position. For the central driving position, plane C is on the centre line.

**Figure 8 — Wiped windscreen area**

The windscreen wiper(s) shall have at least two fixed speeds and shall allow intermittent operation.

In parking position the blades shall be positioned outside the sweeping area or at the limits.

For right-hand traffic, the parking position should be on the left side.

There shall be a windscreen washing device under control of the driver from inside the cab. Fluid windscreen washing detergents shall be usable by this device.

During windscreen washing and for at least two cycles after the washing jets have stopped, wiping shall automatically be applied.

**5.3.3 Windscreen glare protection**

Adjustable blinds or other glare protections (for example sun-shield, tinted or coated windscreens) shall be provided against solar glare for the front windscreen without affecting the forward visibility in its stowed position. It should also be provided for the side windscreens. They should be able to be actuated from an ergonomic position that is close to the driver's operating position or by remote-controlled systems. If the glare protection device depends on an external energy supply, it shall also allow manual adjustment.

The position of the glare protection device shall not be changed unintentionally.

If transparent, the glare protection device shall not modify the perception of the colour of the signals for drivers.

The sun protection device, if not transparent, should have a heat-reflective surface facing outwards.



5.3.4 Front Windscreen de-icing and de-misting

A device shall be provided for de-misting and de-icing e.g. heating system and/or ventilation. Any devices provided shall comply with vision requirements of EN 15152.

The device shall cover at least the defined windscreen wiper sweeping area according to Figure 8.

Heating for the windscreen shall include the windscreen wiper’s parking position.

5.3.5 Side Windscreen de-icing and de-misting

The following requirements apply to side windscreens within the 165 ° of the forward viewing field:

A device shall be provided for de-misting and de-icing e.g. heating system and/or ventilation. Any devices provided shall comply with vision requirements of EN 15152.

The device shall cover at least 80 % of the surface of the side windscreens over the height between X ° (with X ° as defined in Figure 4) under the horizontal plane at eye height and 15 ° (20 ° recommended) above (see Figure 9).

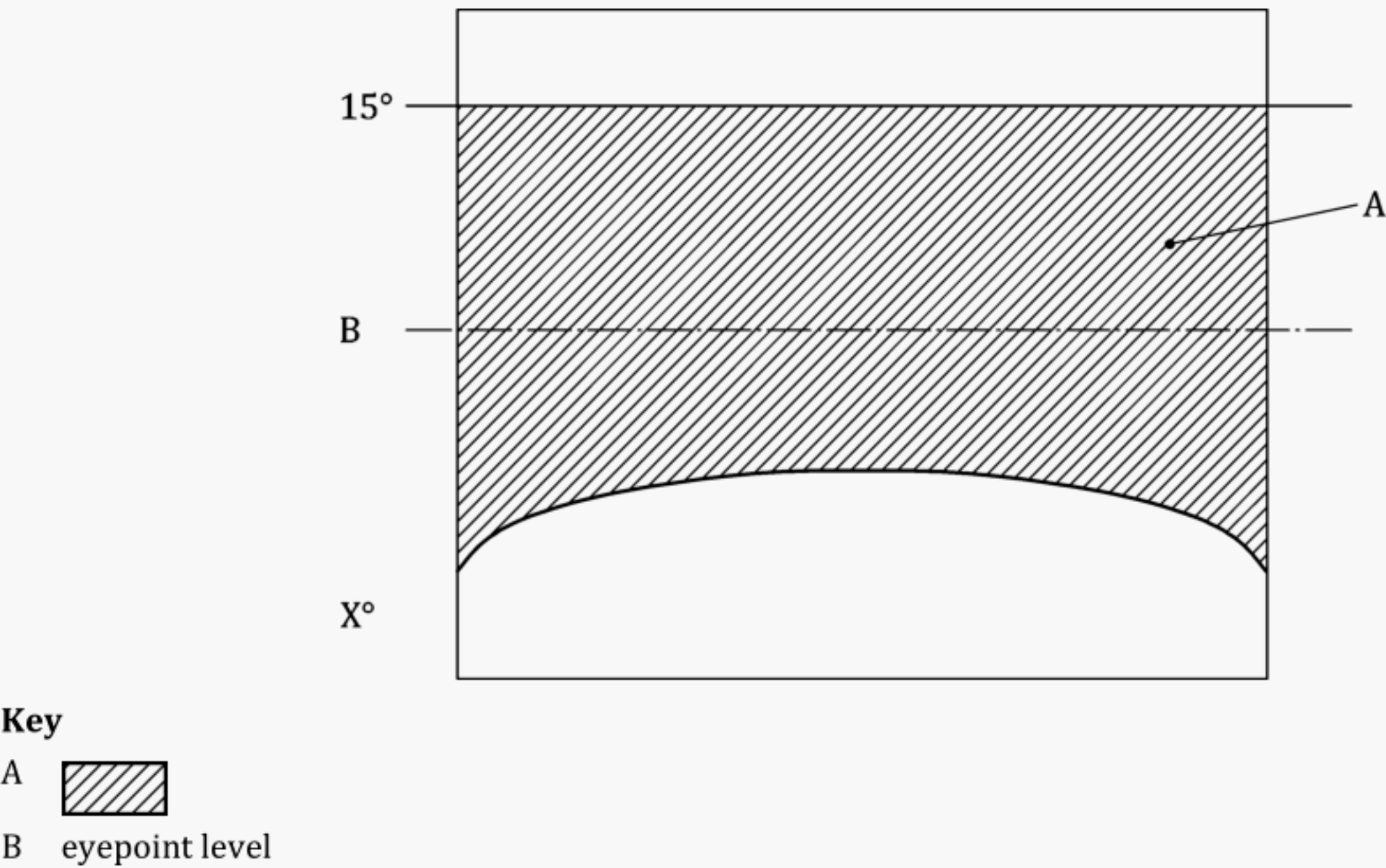


Figure 9 — De-misting and de-icing side windscreen area

5.3.6 Reflection protection

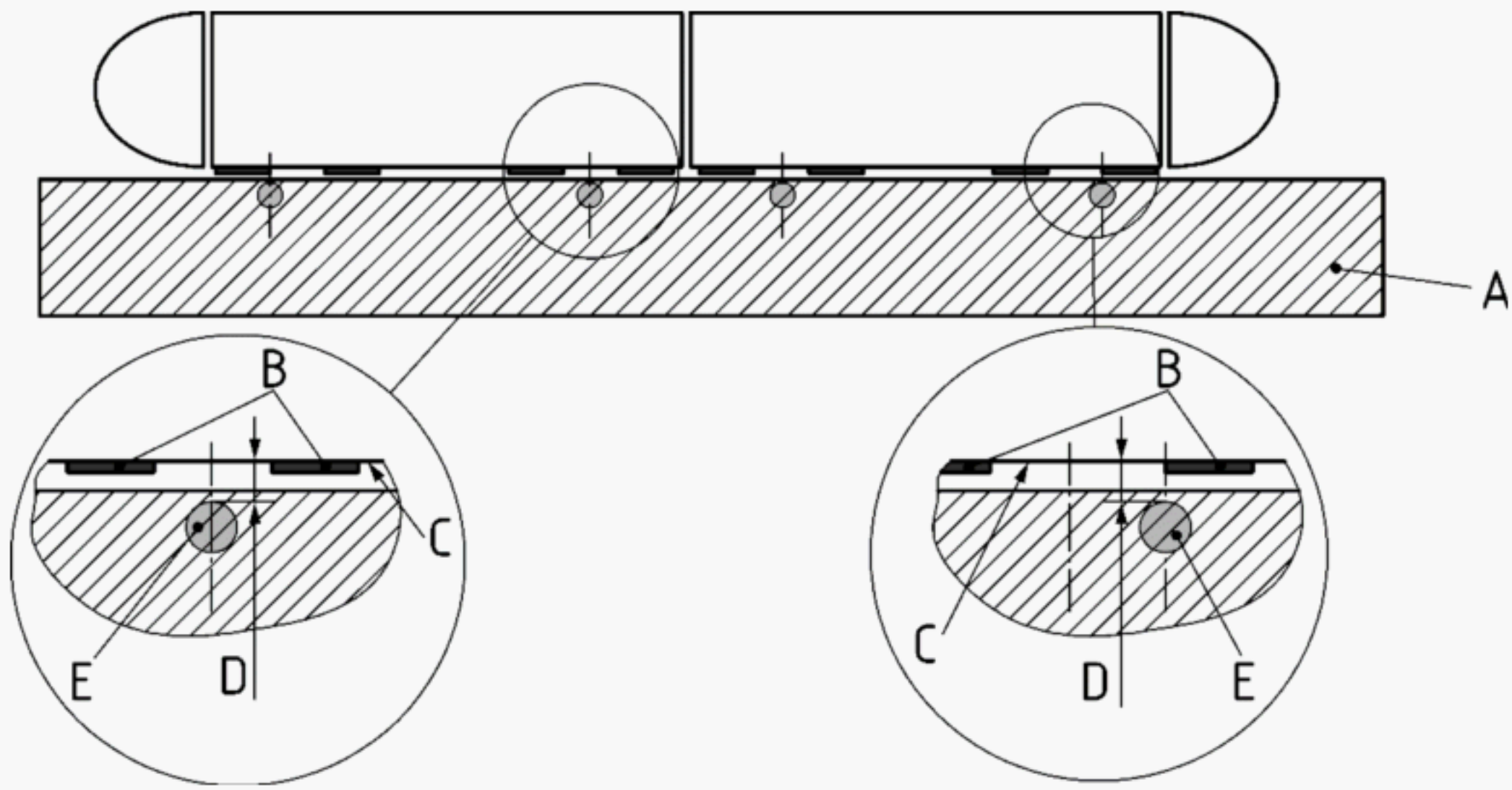
Light sources from the passenger area and the inside of the cab shall not distract the line of sight of the driver in his normal seated position when the vehicle is in motion (except for head-up display).

## 6 External rear visibility

The cab shall be designed to ensure a rear view of the tram vehicle. This can be achieved by one or several rear view device(s) (e.g. a mirror or a camera). These devices should be positioned in accordance with relevant operational rules.

If any rear view device is required on the vehicle, it should be positioned so that the driver still has unimpeded visibility to the rear when the passenger doors are open. The viewing direction to the rear view device should not deviate upwards by more than  $10^\circ$  from the horizontal plane of the driver's sightline.

In the station, on a vehicle in design mass under normal design payload conditions according to EN 15663, on a straight and level track, if any rear view device is required by operational rules for monitoring passenger exchange, it shall enable the detection of the complete top surface of a cylinder with a diameter of 300 mm and a height of 1 100 mm over the full width of each open passenger door; the cylinder is positioned on the platform at a distance of 70 mm from the door threshold with the situations as shown in Figure 10.



**Key**

- A platform
- B door leaf, open door
- C threshold
- D distance 70 mm
- E cylinder

**Figure 10 — External rear visibility assessment**

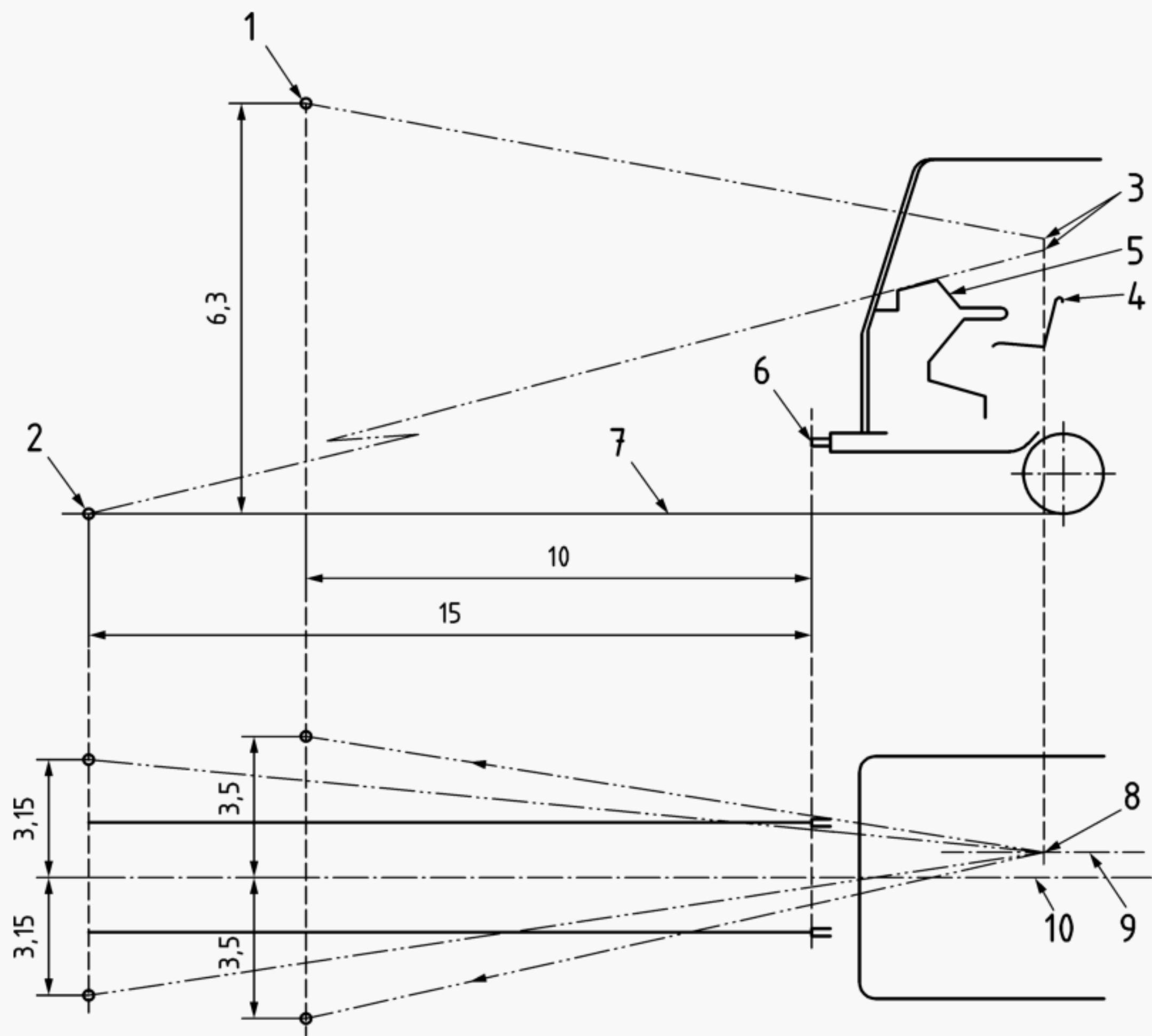


Annex A  
(normative)

Forward visibility reference surfaces

The reference surfaces are made of points 1, 2 and 3. This area shall be free of any obstruction. Figure A.1 shows the reference surfaces of the eyes and conditions of forward visibility of high and low reference points.

Dimensions in metres



Key			
1	high reference points	6	front plane
2	low reference points	7	top of rail
3	eye points of the seated driver (see Figure 1 and Figure 2)	8	top view of the eye points
4	seat	9	centre line of seat
5	desk	10	centre line of vehicle

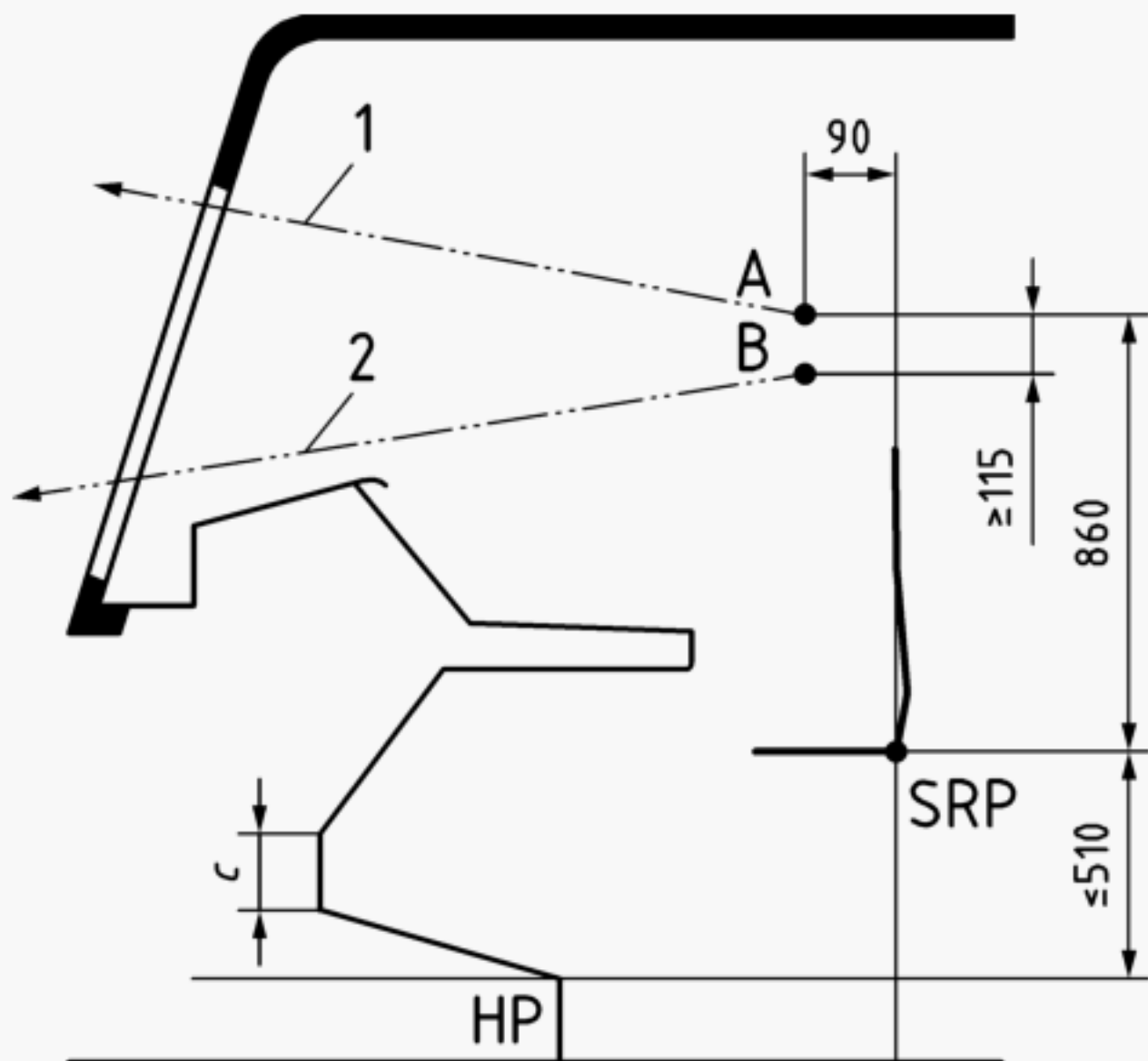
Figure A.1 — Forward visibility reference surfaces

The driving position on the right side serves only as an example. The driver can also be located in the centre or on the left side of the cab.

**Annex B**  
(normative)

**Forward visibility reference eye points — Adjustable foot rest and adjustable seat**

Dimensions in millimetres



Key		
A	Point A	1 forward visibility of high reference points
B	Point B	2 forward visibility of low reference points
SRP	seat reference point	
HP	heel point	
c	construction dimensions	

**Figure B.1 —Adjustable foot rest and adjustable seat**



**Annex C**  
(informative)

**A-deviations**

**A-deviation:** National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN-CENELEC national member.

This document does not fall under any Directive of the EU.

In the relevant CEN-CENELEC countries, these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

**Clause   Deviation**

**France**

- 5.2.5      The value of 90 ° for the defined  $\beta$  angle is **mandatory** in France.
- National regulations require that all new rolling stock be designed, built and, where necessary, modified in such a way that the overall level of safety for users, operating staff and third parties is at least equivalent to the existing level of safety, taking into account the evolution of good engineering practice (decree on the safety of guided public transport)<sup>2</sup>.
- Thus, for the design of driver's cabs of tramway vehicles, the French reference guide for new rolling stock<sup>3</sup> requires a  $\beta$  angle of at least 100 ° (90 ° tolerated). This technical solution represents a safety requirement that has been in application since 2012 by the national safety authority in accordance with the provisions laid down in the national technical reference framework.
- Any  $\beta$  angle value inferior to 90 ° represents a safety regression and is contrary to French national regulations.

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<sup>2</sup> Requirements stemming from Decree n° 2017-440, related to *Guided Public Transport Systems*, published on the 30th of March 2017. Full text available via:  
<https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000034315240&categorieLien=id>.

<sup>3</sup> STRMTG, *Technical Guide on Safety in Tramway Driver's Cab*, version 3.1, April 2016.

## Bibliography

- [1] EN 16186-1:2014+A1:2018, *Railway applications - Driver's cab - Part 1: Anthropometric data and visibility*
- [2] CEN/TR 16823, *Railway applications - Driver's cab - Background information on anthropometric data*
- [3] ISO 20176, *Road vehicles - H-point machine (HPM-II) - Specifications and procedure for H-point determination*
- [4] EN 16186-8<sup>4</sup>, *Railway applications - Driver's cab - Part 8: Tram vehicle layout and access*

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<sup>4</sup> Under preparation. Stage at the time of publication: prEN 16186-8:2020.



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