BS EN 14752:2015

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Railway applications — Body side entrance systems for rolling stock

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National foreword

This British Standard is the UK implementation of EN 14752:2015. It supersedes BS EN 14752:2005 which is withdrawn.

The UK Committee advises, following the recommendations set out in the RAIB accident investigation report (report 19/2014, dated September 2014), that the door obstacle detection methods set out in this standard need to be combined with appropriate operational dispatch procedures to mitigate the risk of trap and drag incidents. The report can be accessed via the RAIB homepage at http://www.raib.gov.uk.

Normative: Requirements conveying criteria to be fulfilled if compliance with the document is to be claimed and from which no deviation is permitted.

Informative: Information intended to assist the understanding or use of the document. Informative annexes do not contain requirements, except as optional requirements, and are not mandatory. For example, a test method may contain requirements, but there is no need to comply with these requirements to claim compliance with the standard.

When rounded values require unit conversion for use in the UK, users are advised to use equivalent values rounded to the nearest whole number. The use of absolute values for converted units should be avoided in these cases. For the values used in this standard:
3 km/h has an equivalent value of 1 mph
10 km/h has an equivalent value of 5 mph

The UK participation in its preparation was entrusted by Technical Committee RAE/4, Railway Applications - Rolling stock systems, to Subcommittee RAE/4/-/6, Bodyside Entrances.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 14752:2015) 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 September 2015, and conflicting national standards shall be withdrawn at the latest by September 2015.

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.

This document supersedes EN 14752:2005.

EN 14752:2015 includes the following significant technical changes with respect to EN 14752:2005:

Clause/Paragraph/ Table/Figure	Change
3.2 bridging plate	added
3.4 contrast	added
3.11 entrance system	added
3.12 first step	added
3.17 manual ramp	added
3.18 moveable step	added
3.19 palm operated	added
3.24 semi-automatic ramp	added
3.25 slip resistant	added
3.26 tactile	added
4.1.2.1 Entrance area – General	a maximum of 4 steps added
4.1.2.2.1 Internal steps for external access	number of steps and height updated
4.1.2.2.2 External steps	door sill and verification updated
4.1.2.3 Step surface	contrasting band; added
4.1.3 Track level access	EN 16116-1; added
4.1.6 Door windows	dimension 1 000 mm added , other details more precise
4.3.1.4 Passenger door button location	dimensions changed
4.3.1.7 Visual indications of door buttons	added
4.3.2.1 Quantity and location of emergency of emergency egress device	“900” mm; dimension changed
4.8 Reliability, availability, maintainability, safety (RAMS)	FTA top events and some rules added
4.11 Manual and semi-automatic ramps, Bridging plates	added
5.1.2 Release doors and steps	updated

5.1.5.2 Manual doors	Palm operated; added
5.1.6.2 Step out-of-service	added
5.2.1.3 Closing and opening warning	rewritten
5.2.1.4.2.2 Closing force	force over whole door travel defined
5.2.1.4.2.3 Kinetic energy	added
5.2.1.4.2.4 Non-contact obstacle detection	added
5.2.1.5 Anti drag	added
5.4 Moveable step obstacle detection	rewritten
A.2 Design of door buttons	updated
D.1 General	new issue
Annex I	added
Annex J	added
Annex K	added
Annex ZA	updated
NOTE: The technical changes referred to include the significant technical changes from the EN revised but are not an exhaustive list of all modifications from the previous edition.	

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

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, Former Yugoslav Republic of Macedonia, 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 specifies the minimum requirements for construction and operation of railway passenger access systems to ensure:

— safe access and egress from passenger trains through body side doors and steps;

— usability for persons with reduced mobility;

— a minimum risk of injury to persons as a result of door and step operation;

— that the doors and moveable steps, ramps, bridging plates remain closed when the vehicle is in motion; and

— safe maintenance of the entrance systems.

1 Scope

This European Standard applies to passenger body side entrance systems of all newly designed railway vehicles such as tram, metro, suburban, mainline and high-speed trains that carry passengers. The requirements of this European Standard also apply to existing vehicles undergoing refurbishment of the door equipment, as far as it is reasonably practicable.

This European Standard also specifies the requirements for testing of entrance systems.

This European Standard makes reference to manual and power operated entrance systems. For manual doors, clauses referring to power operation are not applicable.

This European Standard does not apply to the following:

— entrance systems for equipment access, inspection or maintenance purposes and for crew only use;

— doors on freight wagons; and

— doors or hatches specifically provided for escape under emergency conditions.

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.

DIN 5032-7, *Photometry; classification of illuminance meters and luminance meters*

DIN 6164-1, *DIN colour chart; system based on the 2° standard colorimetric observer*

DIN 6164-2, *DIN colour chart; specification of colour samples*

EN 12663-1, *Railway applications — Structural requirements of railway vehicle bodies — Part 1: Locomotives and passenger rolling stock (and alternative method for freight wagons)*

EN 13032 (all parts), *Light and lighting — Measurement and presentation of photometric data of lamps and luminaires*

EN 13272, *Railway applications — Electrical lighting for rolling stock in public transport systems*

EN 14067 (all parts), *Railway applications — Aerodynamics*

EN 16116-1, *Railway applications — Design requirements for steps, handrails and associated access for staff - Part 1: Passenger vehicles, luggage vans and locomotives*

EN 45545-2, *Railway applications — Fire protection on railway vehicles — Part 2: Requirements for fire behaviour of materials and components*

EN 50121-3-2, *Railway applications — Electromagnetic compatibility — Part 3-2: Rolling stock - Apparatus*

EN 50125-1, *Railway applications — Environmental conditions for equipment — Part 1: Rolling stock and on-board equipment*

EN 50126 (all parts), *Railway applications — The specification and demonstration of reliability, availability, maintainability and safety (RAMS)*

EN 50128, *Railway applications — Communication, signalling and processing systems — Software for railway control and protection systems*

EN 50153, *Railway applications — Rolling stock — Protective provisions relating to electrical hazards*

EN 50155, *Railway applications — Electronic equipment used on rolling stock*

EN 50215, *Railway applications — Rolling stock — Testing of rolling stock on completion of construction and before entry into service*

EN 60077-1:2002, *Railway applications — Electric equipment for rolling stock — Part 1: General service conditions and general rules (IEC 60077-1:1999, mod.)*

EN 61373, *Railway applications — Rolling stock equipment — Shock and vibration tests (IEC 61373)*

EN ISO 10140-2, *Acoustics — Laboratory measurement of sound insulation of building elements — Part 2: Measurement of airborne sound insulation (ISO 10140-2)*

EN ISO 12567-1, *Thermal performance of windows and doors — Determination of thermal transmittance by the hot-box method — Part 1: Complete windows and doors (ISO 12567-1)*

UIC 566:1990, *Loadings of coach bodies and their components*

UIC 660:2002, *Measures to ensure the technical compatibility of high-speed trains*

3 Terms and definitions

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

3.1
access device
operating element used to unlock a locked door in order to allow for door opening from outside when the door is not available for normal operation

3.2
bridging plate
extendable device which is integrated into the vehicle as close as possible to the door threshold level, fully automatic and activated/controlled in conjunction with the door opening/closing sequences, to facilitate PRM (Persons with Reduced Mobility) and wheelchair access and which is not supported by the platform when extended

Note 1 to entry: The bridging plate retains its strength without support on the station platform.

3.3
central closing
powered closing of the door by remote command without intervention by the passenger

3.4
contrast
perception of a difference visually between one surface or element of a building/rail vehicle and another by reference to their light reflectance values (LRV)

[SOURCE: prEN 16584–1:2013, 3.5]

3.5
door
body side panel available for passenger access and egress, including its components

3.6
door button
device to initiate door opening or closing command

3.7
door/step out-of-service
door or step which is locked and not available for use

3.8
door/step isolated
door and/or step to which the pneumatic and/or electric power supply is isolated

3.9
door operation
all door operating sequences

3.10
emergency egress device
operating element used to unlock a locked door in order to allow for manual opening of the door from inside in case of an emergency

3.11
entrance system
system to facilitate passenger entrance to vehicles including door, step/ramp/bridging plates and the related drive and control devices

3.12
first step
first step of a vehicle that a passenger can use to board or alight from a train

Note 1 to entry: This will normally be the step that is closest to the platform edge. It may be a fixed or a moveable step.

[SOURCE: prEN 16586–1:2013, modified: Note 1 to entry shortened.]

3.13
leading edge
edge of the door, leading during closing movement

3.14
local closing
powered closing by intervention of a person or by a local automatic device

3.15
locked door
closed door held closed by a mechanical device

3.16
manual door
door that is closed or opened exclusively by hand power

3.17
manual ramp
device designed for the passage from one level to another, which is compatible with the vehicle and which is supported on the station platform when extended.

Note 1 to entry: Deployment by train crew or platform staff is manual.

Note 2 to entry: The purpose of the manual ramp is to facilitate wheelchair access.

Note 3 to entry: See prEN 16586–2:2013 for further details.

3.18
moveable step
retractable device integrated into the vehicle forming a step with the threshold, fully automatic and activated/controlled in conjunction with the door opening/closing sequences to reduce the gap in width and height between vehicle and platform

Note 1 to entry: The moveable step retains its strength without support on the station platform.

3.19
palm operated
operable by the palm or any part of the hand in its working position, not requiring fingers to be unclenched

[SOURCE: prEN 16585–1:2013, 3.10, modified to enable replacement of the term by its definition in the document]

3.20
power operated door system
door system which operates doors in opening and closing direction by machine power

3.21
released door
door in a state in which it may be opened by a member of the public or train crew by operating the door buttons

3.22
RIC-KEY
key according to the agreement on mutual use of vehicles for persons and goods in international transport (RIC = International coach regulations)

Note 1 to entry: See Annex H.

3.23
routine test
test to which each entrance system equipment is subjected during or after manufacturing

3.24
semi-automatic ramp
device designed for the passage from one level to another, which is integrated into the vehicle and which is supported on the station platform when extended

Note 1 to entry: Deployment is locally activated and supervised.

Note 2 to entry: The purpose of the semi-automatic ramp is to facilitate wheelchair access.

Note 3 to entry: See prEN 16586–2:2013 for further details.

3.25
slip resistant
rough or otherwise specifically formulated to maintain friction between the surface and a person's shoe or a mobility aid at an acceptable level in both wet and dry conditions

Note 1 to entry: Snow and ice are outside this definition therefore other special measures are to be taken for steps and platforms etc. that are exposed to these weather conditions.

[SOURCE: prEN 16584-1:2013, modified to enable replacement of the term by its definition in the document]

3.26
tactile
appertaining to touch

Note 1 to entry: Tactile signs or controls may include raised pictograms, raised characters or Braille lettering.

Note 2 to entry: See also prEN 16584-1:2013.

[SOURCE: ISO 9241-910, 2.5, modified: Note to entry added]

3.27
technical specification
agreement between manufacturer of the entrance system and buyer of that entrance system

3.28
train crew
persons authorized to carry out the duties for door operation

3.29
type test
test of one entrance system and its components to prove that the design meets the standard and the relevant specifications

3.30
unlocked door
door with mechanical door locking released

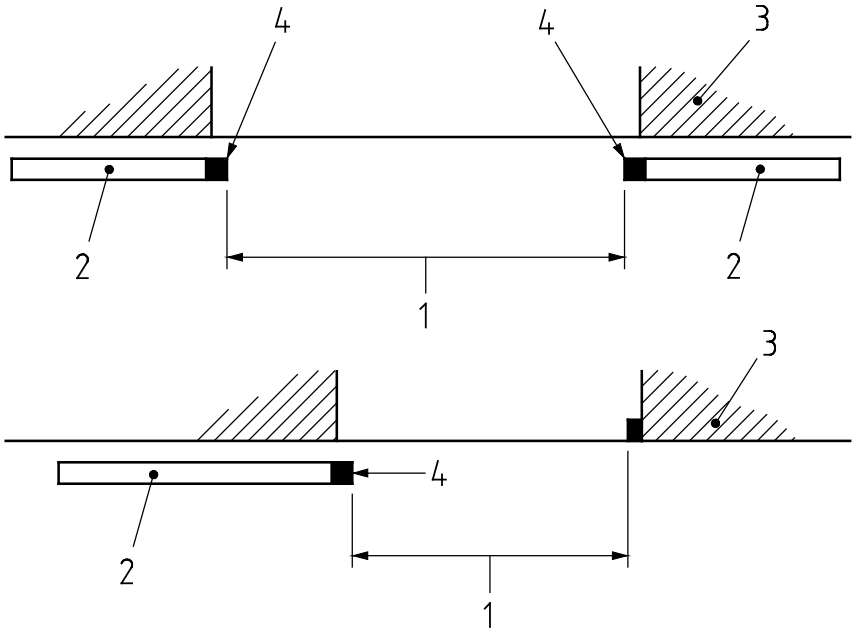
4 Constructional requirements

4.1 Door design

4.1.1 Door throughway design

4.1.1.1 Minimum width

Doors shall have an unrestricted clear usable width (1) of 800 mm minimum to allow unimpeded access and egress of passengers (Figure 1 shows two examples of doors). On trains where there is no step between the threshold of a dedicated wheelchair access door and the adjacent vestibule, that door shall have a minimum clear useable width of 1 000 mm when open.



Key

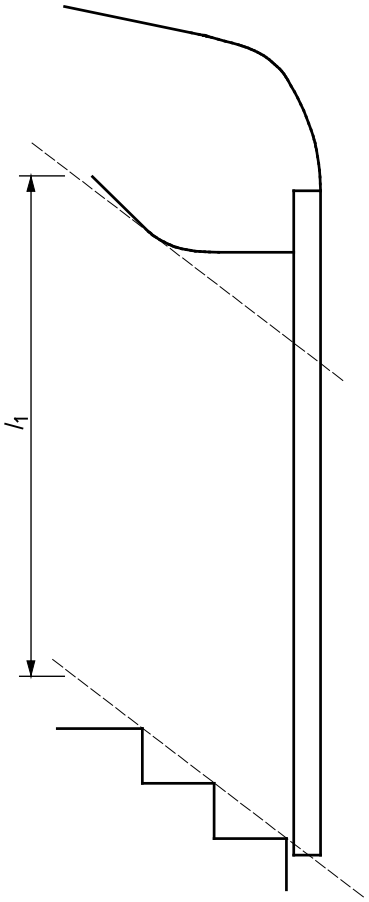
1	clear usable width	3	vehicle
2	door leaf	4	leading edge

Figure 1 — Minimum width

4.1.1.2 Minimum height

Doors shall have an unrestricted vertical clearway height of $l_1 \geq 1\,900$ mm minimum (see Figure 2 for the measuring method).

Dimensions in millimetres



Key

l_1 ≥ 1 900 mm

Figure 2 — Minimum height

4.1.2 Steps

4.1.2.1 Entrance area − General

External steps shall have at least the same clear width as the door and be in line with the throughway of the door.

Internal steps should have at least the same clear width as the door and be in line with the throughway of the door.

Passenger access from the defined platform to the vestibule of the vehicle shall be achieved with a maximum of four steps.

4.1.2.2 Step dimensions

4.1.2.2.1 Internal steps for external access

Internal steps for external access shall have a maximum height of l_1 = 200 mm and a minimum depth of l_4 = 240 mm between the vertical edges of the step. The rising height of each step shall be equal.

The height of each step may be increased to a maximum of l_1 = 230 mm if it can be demonstrated that this achieves a reduction of one in the total number of steps required.

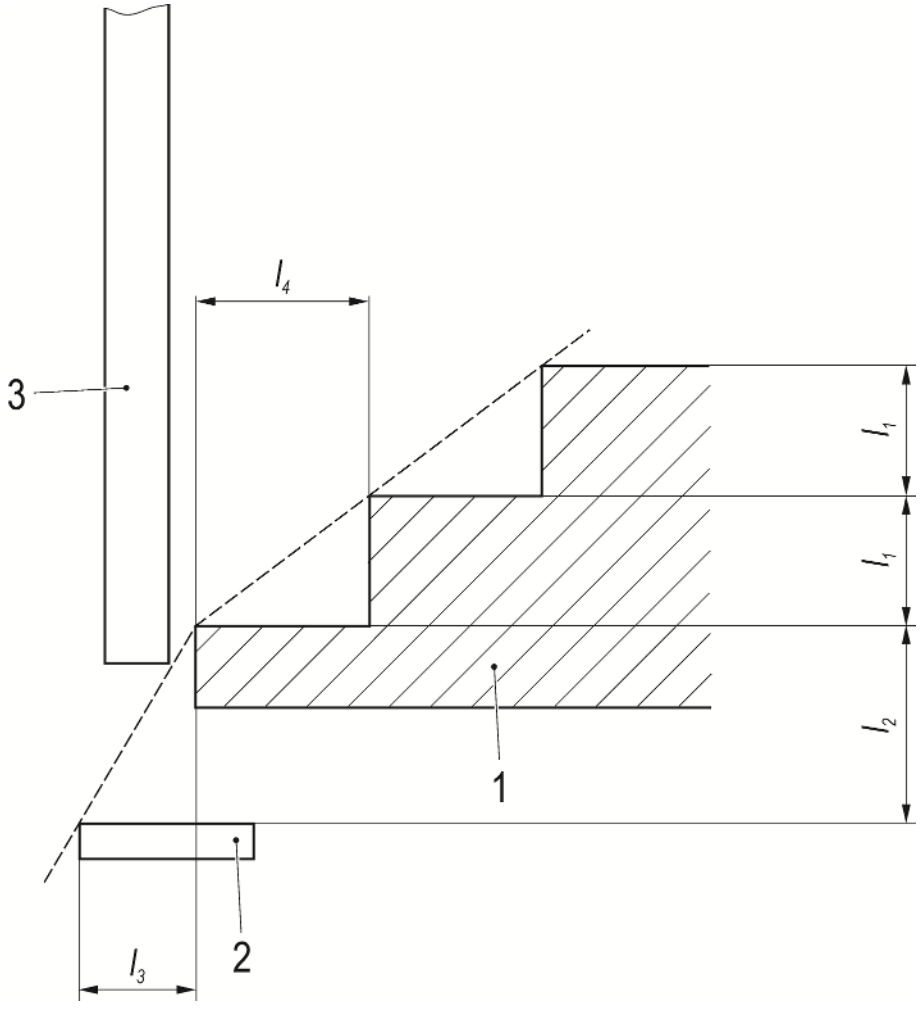
EXAMPLE If a vertical distance of 460 mm is to be traversed, it can be demonstrated that using steps of up to l_1 = 230 mm reduces the number of steps required from 3 to 2.

See Figure 3 for details.

4.1.2.2.2 External steps

An external access step, fixed or moveable, shall have a maximum height of l_2 = 230 mm between steps and a minimum depth of l_3 150 mm.

Dimensions in millimetres



Key

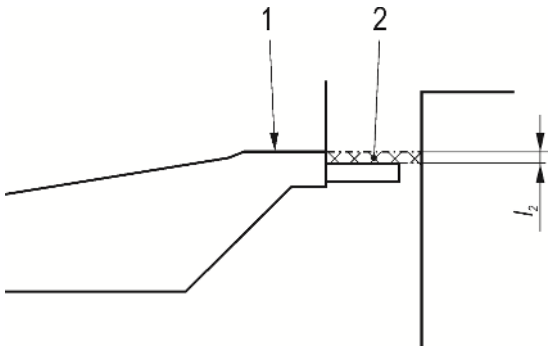
1	fixed steps inside the train	l_1	≤ 200 or ≤ 230	l_4	≥ 240
2	external fixed or moveable step	l_2	≤ 230		
3	door leaf	l_3	≥ 150		

Figure 3 — Step dimensions

A minimal drop in level, with a maximum of l_2 = 60 mm, between the floor surface of the vestibule/last step and that of the external step of the vehicle, used to guide and seal the door is also permissible and shall not be considered as a step so the minimum depth of l_3 150 mm does not apply. See Figure 4 for the permissible position of the external extension of the door sill.

If the external step depth l_3 is ≥ 150 mm the surface of the exterior step may be used as a reference for defining the stepping height when stepping up from a lower platform whereas the floor surface of the vestibule may be used when stepping down from a higher platform.

If a step is fitted and it is an extension of a door sill outside the vehicle, and there is no drop in level between the floor surface of the vestibule and that of the external step of the vehicle, this shall not be considered to be a step for the purposes of this specification. See Figure 4 for details



Key

1 floor surface vestibule l_2 ≤ 60 mm

2 extension of door sill

Figure 4 — Extension of door sill

4.1.2.3 Step surface

Steps shall be provided with a slip resistant surface across the usable surface area.

The first and the last step inside the vehicle shall be indicated by a contrasting band with a depth of 45 mm to 55 mm extending the maximum useable width of the steps on the front and the top surfaces of the step nosing.

The first and the last step outside the vehicle shall be indicated by a contrasting band with a depth of 45 mm to 55 mm extending the full width of the steps on the top surfaces of the step nosing.

4.1.2.4 Protection against water accumulation

The steps shall be arranged to allow water to drain away from the anti-slip surface. The design shall prevent water accumulation.

4.1.2.5 Manual operation

If a retractable step fails to close and the deployed step exceeds the vehicle kinematic gauge, it shall be possible to manually retract the step to a stable closed position, particularly from the platform it is intended for.

The operation manuals shall include an instruction stating that the step drive shall be isolated prior to manual operation, if this is necessary to avoid a possible injury due to the activation of the automatic drive.

4.1.3 Track level access

If specified, means shall be provided to ensure access and egress to and from the track level for staff on dedicated doors. Details need to be clarified in the technical specification as far as not defined in EN 16116-1.

4.1.4 Relative position of the step edge

The relative position of the step edge in relation to the vehicle body shell and vehicle floor (Dimensions l_2 and l_3 of Figure 3) shall be defined in the technical specification considering the requirements regarding the gap between step and platform.

NOTE See prEN 16586–1:2013 for further details.

4.1.5 Train surfing

Step edges, ledges or handholds on the outside surface of the entrance system shall be avoided or designed so they are not providing firm grip when the doors are closed (to avoid so called 'train surfing').

4.1.6 Door windows

Doors shall be fitted with transparent windows to allow passengers to identify the presence of a platform.

All door windows shall be fitted with safety glass (either laminated or toughened glass) which is in accordance with a relevant national or international standard. Other material achieving a comparable level of safety may also be used.

Where the distance of the lower edge of the door window is less than 800 mm above vehicle floor level adjacent to the door, a means of protection shall be provided to prevent passengers falling through the window when broken. Where internal steps are fitted this dimension shall be increased to 1000 mm.

Protection may be achieved by the use of a suitable laminated glazing system retained by appropriate fixing (mechanical retention, suitable bonding, etc.), or mechanical elements (e.g. a bar) or equivalent measures. If bars are used, they should be fitted so that they do not create hazards to passengers.

4.1.7 Design of body side entrance doors used for accessing driver's cabs

If a body side entrance door is used for accessing the driver's cab, the requirements shall be defined in the technical specification.

4.1.8 Water drainage

Means shall be provided to divert water from the vehicle roof away from the door throughway.

4.2 Mechanical strength

4.2.1 Door mechanical strength

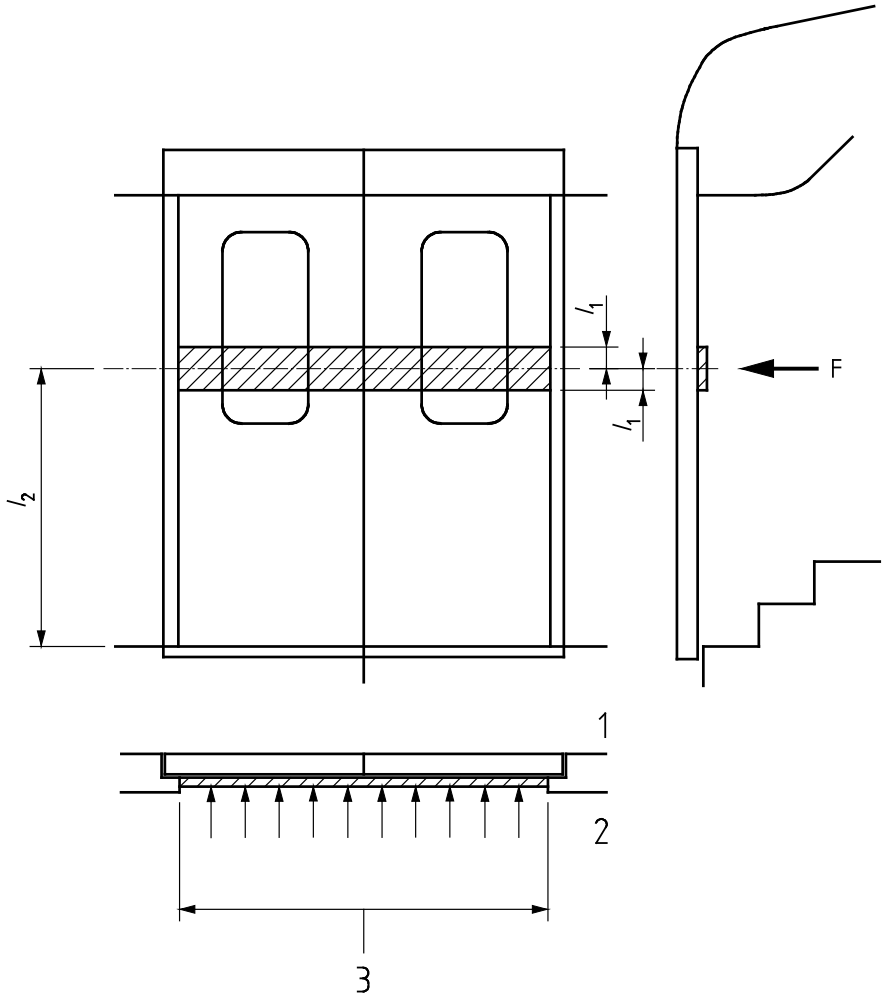
4.2.1.1 Passenger retention forces

The doors shall withstand the forces that occur when passengers are leaning or falling against the door leaves without causing any non-elastic deformation or loss of operation. It is permissible for some residual deflection after first loading to occur.

For this purpose a closed and locked door including the glazing shall withstand a pushing force applied from inside the vehicle onto the door leaf.

The load shall be represented by the application of a load distributed over a strip of 200 mm in height, positioned l_2 = 1300 mm above threshold. The value of this force shall be 1 000 N per linear metre over the width of the exposed internal surface of the door (see also Figure 5).

Dimensions in millimetres



Key

1	outside of doors	l_1	100 mm
2	Inside of doors	l_2	1 300 mm
3	exposed internal surface	F	1 000 N/m

Figure 5 — Arrangement for load case "passenger retention"

The locking system on sliding doors shall withstand a force in the opening direction of 1 200 N .

4.2.1.2 Aerodynamic stresses

Doors shall be capable of withstanding the effects of pressure pulses as given in Annex F, applied over the surface of the door without causing any non-elastic deformation or loss of operation. Some residual deflection after first loading may occur.

4.2.1.3 Relation to vehicle gauge

Under normal operation the loads defined in 4.2.1.1 and 4.2.1.2 may cause elastic door deformations. The car builder shall specify the acceptable limits so as not to infringe the kinematic gauge of the vehicle in the technical specification.

4.2.1.4 Vehicle overturning case

The door strength shall withstand without fracture or collapse the following load case based on vehicle overturning, if such load case is required in the technical specification:

— a sustained pressure of 6 kPa over its exposed internal surface.

The door and associated components may not necessarily remain operational after the application of this load.

4.2.1.5 Ability to withstand vibration and shock

The entrance system shall be designed to withstand the effects of vibrations and shocks as defined for equipment attachments in EN 12663-1. Alternatively this can be proven by a test in accordance with EN 61373.

Where specified vibration and shock testing of mechanical components shall be carried out in accordance with EN 61373.

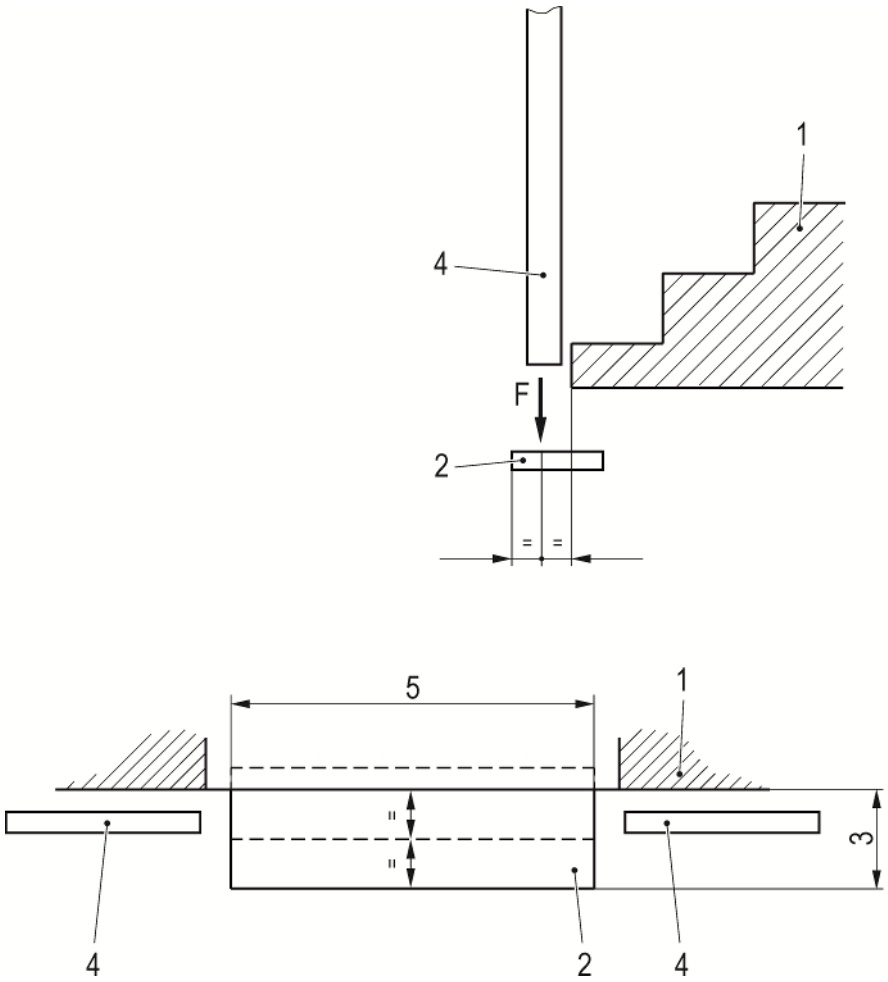
4.2.2 Step(s) mechanical strength

The following requirements shall apply:

— the steps shall be capable of withstanding a concentrated downward vertical load of 2 kN. This shall be applied on a surface area of 100 mm × 200 mm at any position on the exposed step surface without causing non-elastic deformation;

— the steps shall be capable of withstanding a distributed downward vertical load of 4 kN/m on the exposed length of the step without causing non-elastic deformation (see Figure 6), whereas some residual deflection after first loading may occur;

— means shall be installed in order to maintain the stability of moveable steps in the deployed and retracted position during normal operation.



Key

1	vehicle	4	door leaf
2	external fixed or moveable step	5	exposed length
3	exposed width	F	4 kN/m

Figure 6 — Step mechanical strength

4.3 Local door control devices

4.3.1 Door buttons

4.3.1.1 General

Where door buttons for passenger 'open' and/or 'close' functions are required by the technical specification or by Regulation (Interoperability), the requirements of 4.3 shall be met.

4.3.1.2 Inside

If the door buttons are fitted on the door leaf then:

- on single leaf doors they should be located near the leading edge of the door;
- on double leaf doors, the door buttons should be located on the right hand leaf (seen from inside) adjacent to the leading edge of the door.

If the door buttons are provided on the door pillar they should be fitted as close as possible to the door leaf.

4.3.1.3 Outside

On single-leaf doors the door buttons for 'open' and/or 'close' should be located near the leading edge of the door. On double-leaf doors, the door buttons should be located on the left hand leaf (seen from outside) adjacent to the leading edge.

If it is not practicable to mount the door open button on the moving door leaf (e.g. pocket sliding door) then door buttons should be provided on the door pillar as close as possible to the door leaf.

4.3.1.4 Passenger door button location

The centre of exterior door buttons, operable from the platform, shall be not less than 800 mm and not more than 1 200 mm measured vertically above platforms, for all platforms for which the train is designed (defined in the technical specification). If the train is designed for a single platform height, the centre of exterior door buttons shall be not less than 800 mm and not more than 1100 mm measured vertically above that platform height.

The centre of internal door button for the exterior door shall be not less than 800 mm and not more than 1 100 mm measured vertically above the vehicle floor level.

Where door 'open' and 'close' buttons are provided, the upper door button shall be the 'open' button.

The door buttons shall be positioned so that an opening door does not create a trapping hazard for the operating hand.

If additional door buttons for wheelchair users are agreed in the technical specification, they shall be mounted below any other buttons within the range defined in this clause.

4.3.1.5 Door button design

The design and the appropriate pictograms are given in A.1, A.2 and A.3.

4.3.1.6 Colour of door buttons

Requirements are given in A.2.

4.3.1.7 Visual indications of door buttons

4.3.1.7.1 Released indication

Doors in service, but not released shall not be illuminated (i.e. all lights of the door button off). When the door is released it shall be indicated by a constant green light in the area shown in Figure A.2.

4.3.1.7.2 Acceptance of Input and Opening warning

Once the door button input is accepted and during opening movement of the door and step the door button should provide flashing green light (at between 1 Hz and 2 Hz) in the area shown in Figure A.2.

4.3.1.7.3 Not accepted input

Not accepted input (door not released) shall be indicated with constant red light in the area shown in Figure A.2 (100 % of available red lights) for at least 1 s or as long as the button is pressed.

4.3.1.7.4 Door out-of-service

A door locked out-of-service as defined in 5.1.6 should be indicated with permanent red light in the area shown in Figure A.2 (100 % of available red lights).

Alternatively a separate indicator located adjacent to the door may be provided.

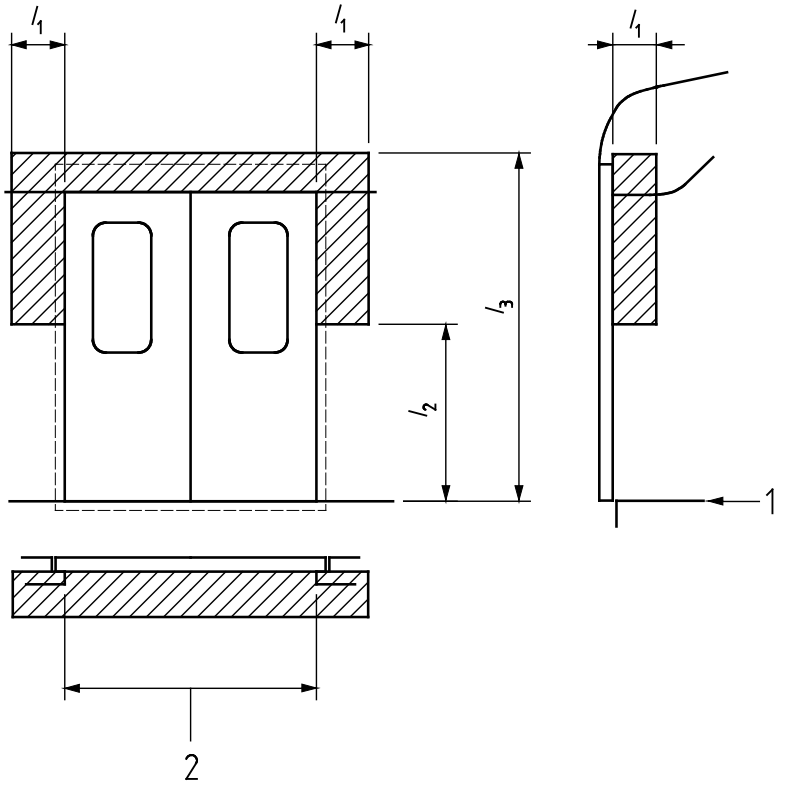
4.3.2 Emergency egress device

4.3.2.1 Quantity and location of emergency egress device

Each door shall be equipped with an emergency egress device.

The centre of the operating element of the emergency egress device shall be located inside the car in the area adjacent to the door (shown in the hatched zone of Figure 7).

NOTE Requirements for passenger emergency exit are given in EN 45545–4.



Key

l_1	400 mm	1	vestibule floor level
l_2	900 mm	2	throughway
l_3	1 950 mm		

Figure 7 — Emergency egress device location

4.3.2.2 Design of emergency egress device

An example of the recommended type and operation of the emergency egress device is shown in A.4.

4.3.2.3 Colour of emergency egress device

The colour of the emergency egress handle shall be red (recommended colour RAL 3020 in accordance with DIN 6164-1 and DIN 6164-2). It is recommended that the complete device is coloured in red in accordance with RAL 3020.

In case of local regulations different colours may be specified in the technical specification.

4.3.3 Access device

4.3.3.1 Quantity and location of access device

The operating element of the access device shall be located in the area adjacent to the door at a height so that it can be operated from track and from all relevant platform levels.

The quantity and location of the access devices are specified in other regulations or in the technical specification.

Interoperable trains need to be equipped with an access device at every door.

NOTE See also EN 45545–4.

4.3.3.2 Design of access device

The device shall be key or handle operated.

4.3.3.3 Colour of access device

It is recommended that the complete device is coloured in red in RAL 3020 in accordance with DIN 6164-1 and DIN 6164-2.

4.4 Labels/warning signs

Labels shall be used to instruct passengers on the use of the door equipment.

Symbols should be applied in preference to written instructions (or symbols used together with written information).

An example for suitable labels is given in Figure A.6 and UIC 413. The ISO 3864 series may be used for guidance when designing labels.

A label, located adjacent to or on the relevant device, shall provide information on the operation of that device.

4.5 Interfaces with the vehicle

4.5.1 Electric and pneumatic power supplies

The electrical and pneumatic equipment of the door shall be designed to meet the requirements of EN 60077-1:2002, 8.2.1, 'Operating conditions'.

4.5.2 Mechanical interface with the vehicle

The mechanical design of the door shall incorporate adjustments and clearances required for the performance of that door, such as:

— adjustment of position;

— sealing; and

— motion, body deflection.

The door adjustment should be simple and limited; the setting devices shall be easily accessible.

The tolerances and deflections imposed under various loading conditions shall be defined in the technical specification.

4.6 Other requirements

4.6.1 Fire protection

The fire protection of doors and associated equipment shall be defined in the technical specification to allow the overall vehicle fire requirements to be achieved. EN 45545-2 shall be fulfilled.

4.6.2 Insulation

4.6.2.1 Sound insulation

The criteria for sound insulation shall be defined in the technical specification to allow the overall vehicle requirements to be achieved. If sound measurements are required for the doors, they shall be performed in accordance with EN ISO 10140-2.

4.6.2.2 Thermal insulation

The criteria for thermal insulation shall be defined in the technical specification to allow the overall vehicle requirements to be achieved.

If measurements are required, they shall be performed in accordance with EN ISO 12567-1.

4.7 Electronic equipment

4.7.1 Hardware

Electronic equipment shall be designed to conform to the requirements of EN 50155 and EN 50121-3-2.

4.7.2 Software for electronic door control systems

The software shall be designed to the necessary software safety integrity level (SSIL) to achieve the overall safety requirements for the entrance system including envisaged failure modes.

NOTE EN 50128 gives rules concerning software for railway control and protection systems.

The function of the software shall be verified during the type test and in the case of door control system modification. Each software version released for passenger service shall be tested to verify the extent of change.

Functional integration with the vehicle shall also be verified, including in envisaged failure modes of the control interface.

4.8 Reliability, availability, maintainability, safety (RAMS)

If analyses concerning RAMS are required, the guidelines given in EN 50126 (all parts) shall apply. The details of the analyses shall be stated in the technical specification.

To demonstrate safety, the following top events shall be covered in a fault tree analyses:

— door opens at speed ≥ 3 km/h;

— step (or any semi-automatic ramp and bridging plates) opens at speed ≥ 3 km/h;

— emergency door opening of two adjacent doors fails when required (includes automatic and manual opening);

— door opens when not adjacent to a platform (including cases of no platform, short platform and platform at the wrong side);

— 'Closed and Locked' signal received but door is open;

— 'Closed and Locked' signal received but step is open;

— test object not detected when trapped and door interlock system signals closed and locked; and

— closed step (or any semi-automatic ramp and bridging plates) wrongly detected as open and allows the door to open (risk for passenger falling on track).

Safety analyses shall be conducted in accordance with the following rules:

— mechanical modes are assessed by qualitative methods (calculation and static/dynamic testing);

— software modes are assessed by qualitative methods (EN 50128); and

— control modes are assessed by quantitative methods (FTA - fault tree analyses).

Any quantitative targets are to be specified on a single entrance system level.

The safety targets at entrance system level for each top event mentioned above shall be defined in the technical specification to achieve the overall safety requirements for the train operation.

4.9 Protection against electrical hazards

Electrical equipment shall be designed to prevent direct and indirect contact with live components in accordance with the requirements given in EN 50153.

Entrance system components requiring access during maintenance for door setting/adjustment should not be positioned in the immediate proximity of any hazardous area, i.e. potential trapping hazard or electrical hazard, alternatively a local isolation system shall be provided.

Breakage of overhead contact wire should be taken into account.

The characteristics of the short circuit current shall be stated in the technical specification.

4.10 Environmental conditions

4.10.1 Weather

The environmental conditions for railway equipment are given in EN 50125-1, such as:

— temperature range;

— humidity;

— pollution; and

— ice, snow and rain.

Any deviation from the specified performance, e.g. at the temperature extremes, shall be specified in the technical specification.

Extended ranges in accordance with EN 50125-1 may be specified, if appropriate.

4.10.2 Water tightness

The door shall be designed to prevent water from entering into the vehicle when it is closed and locked.

The water tightness shall be tested as stated in the water test procedure in Annex B.

If a door is not capable of fulfilling the requirement of water tightness due to its design type (e.g. folding door, ventilation openings) then water entering the vehicle shall be drained adequately.

4.10.3 Air pressure tightness

If air tightness is required, the degree of air tightness required for the door shall be specified to meet the overall vehicle requirements, using the flowchart as shown in Figure C.1, specifying the equivalent leakage surface at the defined pressure levels.

NOTE UIC 660 specifies the tightness of complete vehicles.

The procedure shown in C.2 shall be used.

Tests shall be carried out in accordance with C.4.

4.11 Manual and semi-automatic ramps, bridging plates

The usable surface shall be slip resistant and shall have an effective clear width of at least 760 mm.

If the plate is less than 900 mm wide, it shall have raised edges with an effective height of 50 mm on both sides to prevent mobility aid wheels from slipping off.

The device shall withstand a vertical force of at least 3 kN, placed at the centre of the ramp distributed over an area of 660 mm by 660 mm. If the ramp is shorter than 660 mm, it shall fulfil the requirements on steps, see 4.2.2.

If the semi-automatic ramp or the bridging plate is not restrained in the closed position by the door in the closed position it shall be included in the interlock loop as defined in 5.2.2.2.

5 Operational requirements

5.1 Door control

5.1.1 General

Doors shall be released under the control of the train crew or of an automatic system.

5.1.2 Release doors and steps

Activation of train lines for enabling of the door shall only be possible at a train speed below 3 km/h. A lower value can be defined in the technical specification. Under special operating conditions, which are not subject to TSI regulation, the technical specification may require activation of the release train line at speed below 5 km/h. Release of the door shall not be possible if the power supply for the entrance system fails.

Door release shall be performed for each selected side of the train or vehicle. If required by the infrastructure, release may be performed on both sides of the train. This requirement may not be applicable, if the release signal cannot be transferred through the train because of interfacing problems with existing vehicles.

Train control shall be designed in a way that activation of the door release prevents traction power from being applied.

5.1.3 Interlocking of released doors

It shall be defined by the technical specification if selective door opening (some doors on one side shall not be released) due to operational reasons (e.g. short platforms) is required.

5.1.4 Single point failure

The control system shall be designed in such a manner that at least two independent faults shall occur at the same time before the respective door opens un-commanded if the door is not released.

If the release signal cannot be transferred through the train because of interfacing problems with existing vehicles, the requirement only applies when the speed exceeds 3 km/h.

5.1.5 Mechanical locking

5.1.5.1 Power-operated door systems

A mechanical locking device shall be provided to lock the door in the closed position.

Once locked the device shall remain locked until the door is released and an opening command is received or the emergency egress device or the access device is operated.

Once locked the locking device shall remain locked if the power supply to the door system or to the vehicle is disconnected or fails unless the emergency access / egress device is operated.

5.1.5.2 Manual doors

Manually operated doors shall be provided with a double locking system.

The double locking system shall consist of two separate components or of a single system operating in two stages (preliminary and main locking).

If the manual door is to be operated by the passengers the control device shall be palm operated by a force not exceeding 20 N.

5.1.6 Out-of-service devices

5.1.6.1 Door out-of-service

It shall be possible to lock a door out-of-service from inside the vehicle and/or if defined in the technical specification the outside of the vehicle.

The out-of-service device shall be designed in such a way that it can be operated manually by authorized personnel only.

The device shall:

— isolate the door from any open command;

— lock the door mechanically in the closed position;

— indicate the status of the out-of-service device; and

— bypass the door interlock switches (e.g. closed and locked switch) locally.

If specifically required by Legislation (TSI) each door shall be fitted with a device also operable from outside.

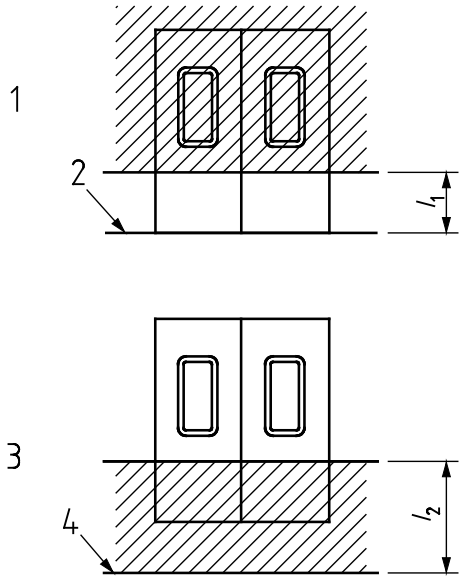
The design shall ensure that it is not activated as a consequence the effect of sudden acceleration or deceleration as defined in 4.2.1.5 (such as full emergency braking).

The location of the door out-of-service device shall be accessible as indicated in Figure 8.

The accessible height from inside shall not be less than l_1 = 400 mm above floor level adjacent to the door and from outside shall not exceed l_2 = 1 700 mm above rail level.

NOTE For international trains the RIC-KEY is used (see Annex H).

Indication to the passenger may be done by vehicle based means (e.g. door button illumination as per 4.3.1.7.4 or special displays) or by the train crew applying labels to door windows.



Key

l_1	400 mm	1	inside	3	outside
l_2	1 700 mm	2	top of floor level	4	top of rail level

Figure 8 — Door out-of-service device location

5.1.6.2 Step out-of-service

It shall be possible to lock a step out-of-service from inside or outside of the vehicle (detail to be defined in the technical specification) if it may exceed the vehicle kinematic gauge in the case of power failure.

The out-of-service device shall be designed in such a way that it can be operated manually by authorized personnel only.

The device shall:

— isolate the step from any open command;

— lock the step mechanically in the closed position;

— indicate the status of the out-of-service device; and

— bypass the step interlock switches (e.g. closed and locked switch) locally.

If the step is mechanically linked to the door, the door out-of-service device may cover this requirement.

The design shall ensure that it is not activated as a consequence of the effect of sudden acceleration or deceleration as defined in 4.2.1.5 (such as full emergency braking).

NOTE For international trains the RIC-KEY is used (see Annex H).

5.1.7 Isolation for maintenance purposes

It shall be possible to isolate the power supply to the entrance system at each door location for maintenance purposes.

5.2 Closing and opening conditions

5.2.1 Safety during closing

5.2.1.1 General

The aim of the door safety provisions is to prevent persons (including persons with reduced mobility) and obstacles, e.g. bags or luggage, becoming trapped in a door as far as reasonably practicable.

In order to minimize the risk and the extent of an injury, the following conditions apply.

5.2.1.2 Safety provisions

The following clauses define the requirements to reduce the possibility of passengers and objects being trapped by the door by:

a) warning the passenger prior to door motion;

b) minimizing the force of the impact on a person or obstacle trapped by the door edges (e.g. limiting the power of the door propulsion, sensitive edges); and

c) minimizing the risk of injury of passengers by the closing door through use of adequate design of the leading edges of the door (e.g. soft edges, obstacle removal forces).

5.2.1.3 Closing and opening warnings

5.2.1.3.1 General

Closing shall initiate an alert at each closing door to warn passengers that the door is about to close.

This may be omitted on Light Rail Vehicle/Tramways or Metros for doors that are directly under the supervision of the train crew in the case of:

— local closing (timer, light barrier, or by a local closing door button) the door closes at very slow closing speed (each leaf not exceeding 0,1 m/s) and the door button is released for opening during the closing stroke; and

— central and local closing in case of implementation of non-contact obstacle detection as described in 5.2.1.4.2.4.

External warning may be omitted if the whole line is equipped with platform screen doors and the warning signal is provided by platform based equipment.

5.2.1.3.2 Audible alert

5.2.1.3.2.1 General

A warning that is audible from inside and outside the vehicle shall be provided to warn passengers prior to door closure, release and opening.

5.2.1.3.2.2 Door closing alert sequence

The audible alert shall sound for at least 2 s before the door starts to close and continue to sound while the door is closing.

— Characteristics: A fast pulsed tone (6 pulses per second −10 pulses per second);

— Frequency: 1 900 Hz ± 50 Hz;

— Sound Pressure level: In case of using a device with a fixed sound pressure level: $L_{Aeq,T}$ = 70 +6/-0 dB(A) (t = total duration of the sound event).

An adaptive audible warning device shall give a sound with a pressure level that is between 5 dB and 10 dB L_{Aeq} above the surrounding noise level, up to a level of $L_{Aeq,T}$ = 70 + 6/-0 dB(A). The device shall define the surrounding noise level prior to the warning sequence. A frequency band from 500 Hz up to 5 000Hz shall be taken into consideration. The device shall be able to generate noise levels as low as $L_{Aeq,T}$ = 50 dB(A).

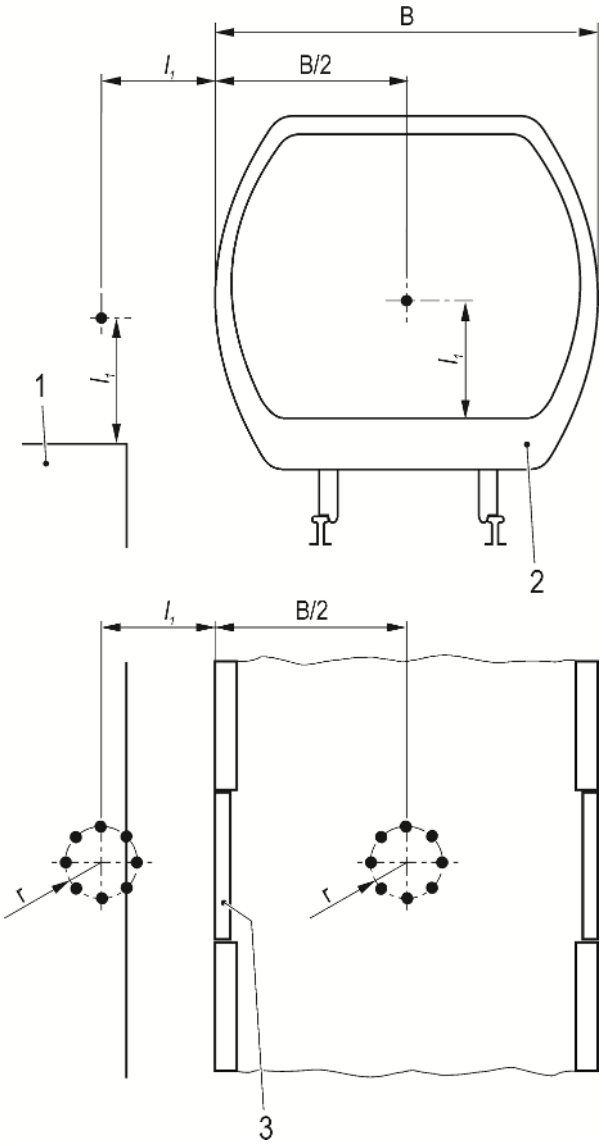
For measuring the sound pressure level, readings shall be taken outside the vehicle, l_1 = 1 500 mm away from the body side door centre line at l_1 = 1 500 mm above the platform level and inside the vehicle on the centre point of the vestibule at a height of l_1 = 1 500 mm above the floor level. See Figure 9 for illustration.

For trains dedicated for TSI-Platforms (550 mm, 760 mm) measurements shall be taken with reference to 550 mm platform only. For other vehicles designed for multiple platform heights the lowest platform level shall be used for measuring.

The measurement shall be done at a door which is representative by simple majority considering the different entrance areas in a unit or train. The determined setting shall be applied to all other doors.

The train shall be located outdoors and positioned in a way to minimize reflections. If the sounder is integrated in the door leaf, the door should be fully open for the close test and fully closed for the open test.

The arithmetical average of eight sequential readings in a circular horizontal area with a radius of r = 250 mm around the specified point as shown in Figure 9 shall be used to determine the sound pressure level.



Key

l_1	(1 500 ± 25) mm	1	platform	3	door
r	(250 ± 25) mm	2	vehicle	B	vehicle width

Figure 9 — Determination sound pressure level

For adaptive devices the following additional requirements apply.

Measuring of surrounding noise pressure shall cover the frequency band of 'pink' noise.

Type testing in the laboratory shall prove the performance at defined constant surrounding noise pressure levels of 50, 60, 70 dB(A). ‘Pink’ noise shall be used as source for surrounding noise.

Testing on the vehicle shall be done at 60 dB(A) 'pink' noise. The source to generate the ‘pink’ noise shall be positioned to generate the same noise level at the warning device and at the measuring device.

5.2.1.3.2.3 Release/Opening door alert

When a door is released for opening a signal shall be given that is clearly audible to persons inside and outside the train. This alert signal shall sound for five seconds. The alert may cease after 3 s if opening is initiated.

This requirement is not applicable for external audible signals on high speed trains Class 1 and Class 2 according to the TSI High Speed RST and trains not subject to interoperability legislation (TSI).

When a door is automatically or remotely opened by the driver or other member of the train crew without prior release, the alert signal shall sound at the moment the door starts to open.

— Characteristic: A continuous or slow pulse multi-tone (up to 2 pulses per second) of 2 tones emitted sequentially

— Frequencies: −2 200 Hz ± 50 Hz and 1 760 Hz ± 50 Hz

— Sound Pressure level: In case of using a device with a fixed sound pressure level: $L_{Aeq,T}$ = 70+6/-0dB(A) (t = total duration of the sound event).

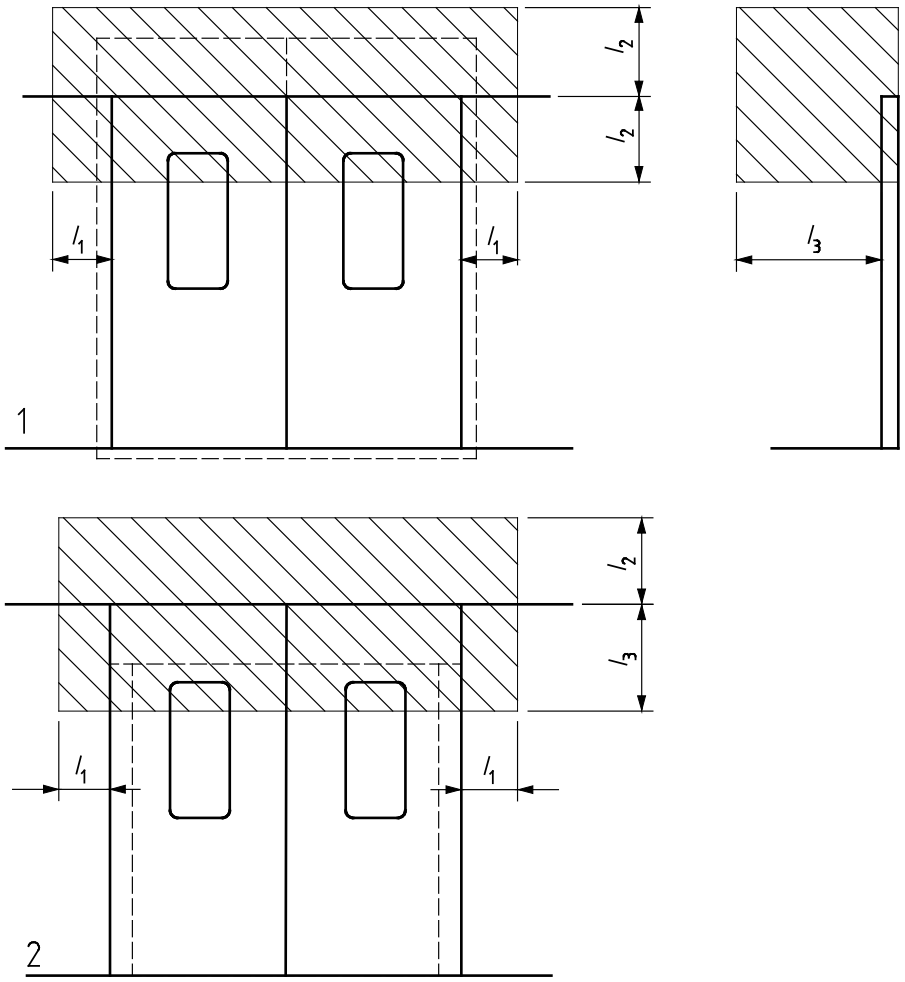
An adaptive audible warning device shall give a sound with a pressure level that is between (5 and 10) dB L_{Aeq} above the surrounding noise level, up to a level of $L_{Aeq,T}$ = 70+6/-0dB(A). The device shall define the surrounding noise level prior to the warning sequence. A frequency band from 500 Hz up to 5 000Hz shall be taken in consideration. The device shall be able to generate noise levels as low as $L_{Aeq,T}$ = 50 dB(A).

Measuring as defined in 5.2.1.3.2.2:

An external released alert may be omitted if the whole line is equipped with platform screen doors and the warning signal is provided by platform based equipment.

5.2.1.3.2.4 Position of audible warning devices

The sound source for door alert shall be located in the area local to the door within the shaded area shown in Figure 10 preferably in an area above the local door buttons.



Key

l_1 150 mm
l_2 400 mm
l_3 500 mm
1 inside
2 outside

Figure 10 — Position of warning devices

5.2.1.3.3 Visual alert

5.2.1.3.3.1 General

A warning that is visible from inside and outside the vehicle shall be provided to warn passengers prior to door closure. Positioned within an area as defined in Figure 10.

5.2.1.3.3.2 Door closing alert sequence

A visual alert should be illuminated for at least 2 s before the door starts closing and continue for at least 2 s in total.

5.2.1.3.3.3 Release / opening door alert

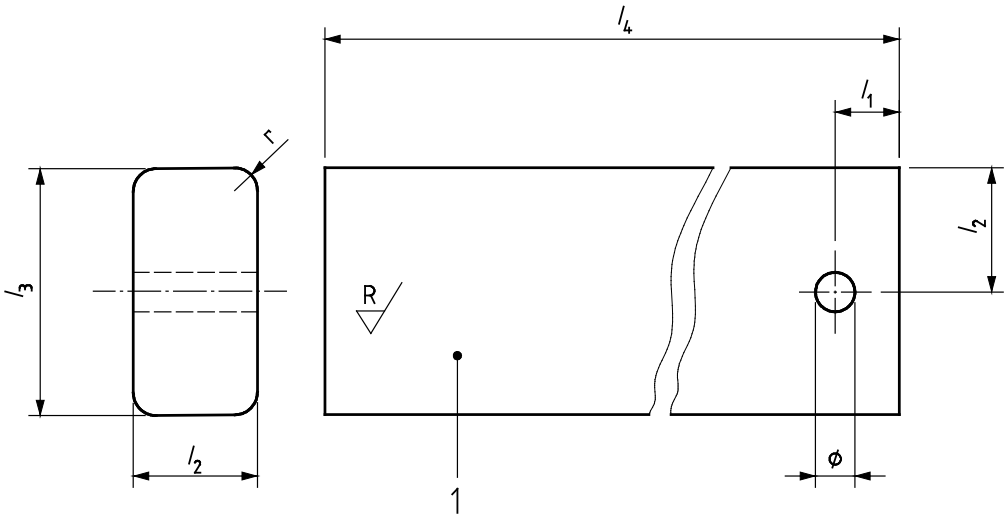
If door buttons are provided for operation of doors then each door button shall be illuminated when released. See Annex A for illuminated area.

Timing as 5.2.1.3.2.3.

5.2.1.4 Doors obstacle detection

5.2.1.4.1 Sensitivity of obstacle detection

When a non-elastic rod with a maximum rectangular cross-section of l_2 = 30 mm × l_3 = 60 mm (see Figure 11) is trapped with its long edge (l_3) vertically between the door leading edge and the frame or between two door leaves, the door shall not be indicated as closed and locked.

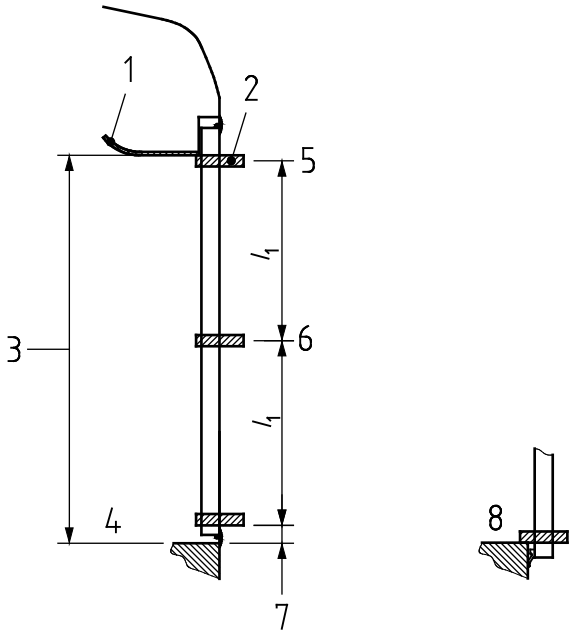


Key

l_1	15 mm	ø	10 mm
l_2	30 mm	r	5 mm
l_3	60 mm	R	0,8 mm
l_4	300 mm	1	test object

Figure 11 — Test object dimensions

The requirement shall be verified at three positions, the bottom, the middle and the top of the door. If soft horizontal bottom rubbers are provided, this requirement applies from the bottom edge of the door leaf upwards above the rubber (see Figure 12).



Key

1	doorgear cover	5	top of door
2	test object in upper position	6	test object in mid position
3	throughway height	7	test object above soft horizontal bottom rubber
4	top of floor	8	test object at top of floor

Figure 12 — Test points

5.2.1.4.2 Door impact

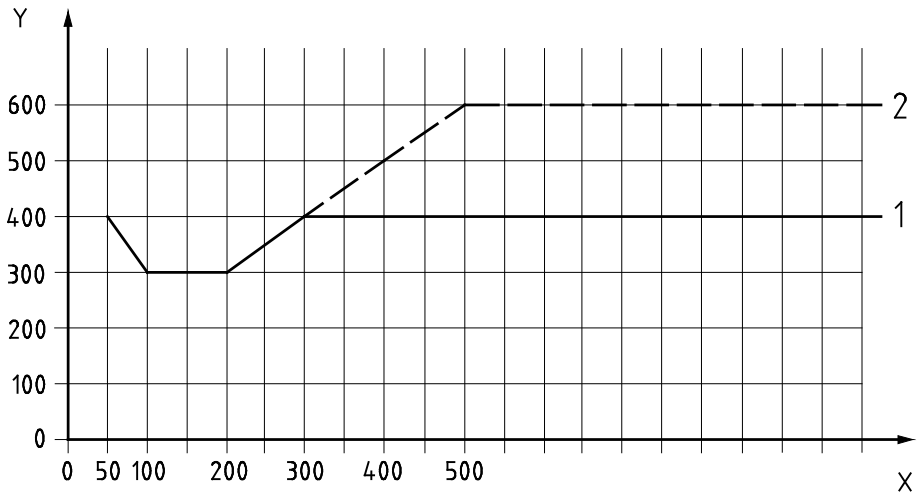
5.2.1.4.2.1 General

The following requirements define the limitations of impact on passengers.

5.2.1.4.2.2 Closing force

The maximum forces exerted on an obstacle represented by a measuring device according to Annex D during closing stroke shall not exceed the values defined in Figure 13:

The higher force level (2) is specifically intended for the needs of very high density traffic. In this case the operator shall specify this force level in the technical specification based on the general safety concept of the operation.



Key

1	standard	X	clear door opening, in mm
2	optional	Y	Fp, in N

Figure 13 — Peak force depending on clear door opening

This shall be proven by measurement of the peak force between abutting edges with a device with the same spring characteristics as defined in Annex D. The dimension of the aperture is to be measured at the end of the door test movement. (compressed measuring device, between two leaves or leaf and doorframe on single doors).

Spacers are to be applied to measure at various apertures.

The door control system shall contain control loops to stabilize detection force (e.g. control of speed, control of driving force and reaction on friction change). Therefore no regular measurements are necessary in the maintenance plan.

In case of detection of an obstruction the closing forces (dynamic and static) shall not be applied for longer than 1 s The duration shall be measured in accordance with Annex D. After this period the door shall automatically stop and the door shall either:

— fully reopen;

— partially reopen for at least 100 mm between abutting edges; or

— become free to be moved manually.

The time delay before reclosing shall be at least 0,5 s after the closing force has been removed.

5.2.1.4.2.3 Kinetic energy

The technical specification shall state if kinetic energy contained by the door throughout its travel on closing shall not exceed 20 J when calculated according to the examples given in Annex I. The maximum velocity of the door leaf during normal closing shall be used in the calculation.

5.2.1.4.2.4 Non-contact obstacle detection

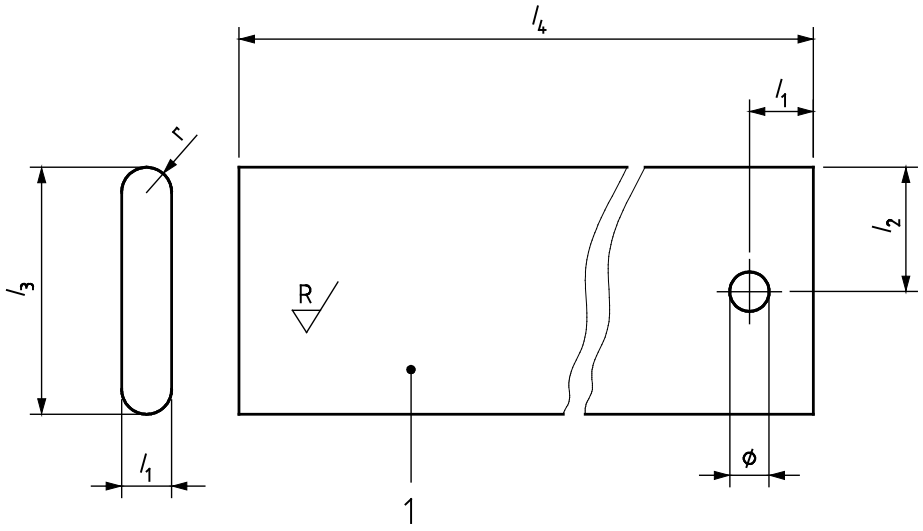
Additionally to the above mentioned requirements technical means may be provided to hold the door open or to reopen a closing door in case of an obstacle being detected in the doorway. Some examples of technical solutions are described in Annex J.

If 'non-contact obstacle detection' is required in the technical specification, the type shall be defined and the impact that the much greater sensitivity of the doors may have on the reliability and availability of the trains and their operation in traffic should be carefully considered.

It shall be stated in the technical specification if this feature is disabled after a number of closure attempts.

5.2.1.4.3 Obstacle removal force

An obstacle with maximum dimensions of l_1 = 10 mm × l_3 = 50 mm (see Figure 14) trapped with its long edge (l_3) vertically and the edge l_1 horizontally between the leading door edge and the frame or between two door leaves, shall be removable by being drawn slowly in an outward direction with a force not higher than 150 N, measured perpendicularly to the door surface. Alternatively, the door shall not be indicated closed and locked. The requirements shall be verified at the mid position of the door only (see Figure 12, position 6).



Key

l_1	10 mm	l_4	300 mm	R	0,8 mm
l_2	25 mm	Ø	10 mm	1	Test object: (Material: aluminium)
l_3	50 mm	r	5 mm		

Figure 14 — Test object dimensions

5.2.1.5 Anti-drag

To minimize the risk of a train dragging along a person or object trapped by the train doors, there are a number of ways in which this can be achieved, including the use of platform doors, cameras, or direct observation by competent personnel that no one is trapped in the closed train doors before authorizing departure of the train.

If anti-drag is required in the technical specification, the impact that the much greater sensitivity of the doors may have on the reliability and availability of the trains and their operation should be carefully considered.

With anti-drag, the primary objective is to detect small objects (Figure 15) trapped in the door, in order to prevent the train from moving.

In case an object as shown in Figure 15 is not detected statically, a secondary feature shall detect dynamically the force incurred on the door leading edge by dragging a person once the train has started to move.

The active anti-drag system shall at least be active immediately after door closing and locking and when the train begins to move. When this device (e.g. a leading edge contact strip) is triggered, the train shall either be prevented from starting, or shall be stopped within a reasonable time or distance.

The system should remain active in case of static detection at least until the train has reached 3 km/h and in case of dynamic detection at least until the last passenger vehicle has left the platform area. It may be switched off afterwards by an appropriate signal. The details of deactivation shall be defined in the technical specification.

Due to system design a dead zone may occur at top and bottom of the door leaf.

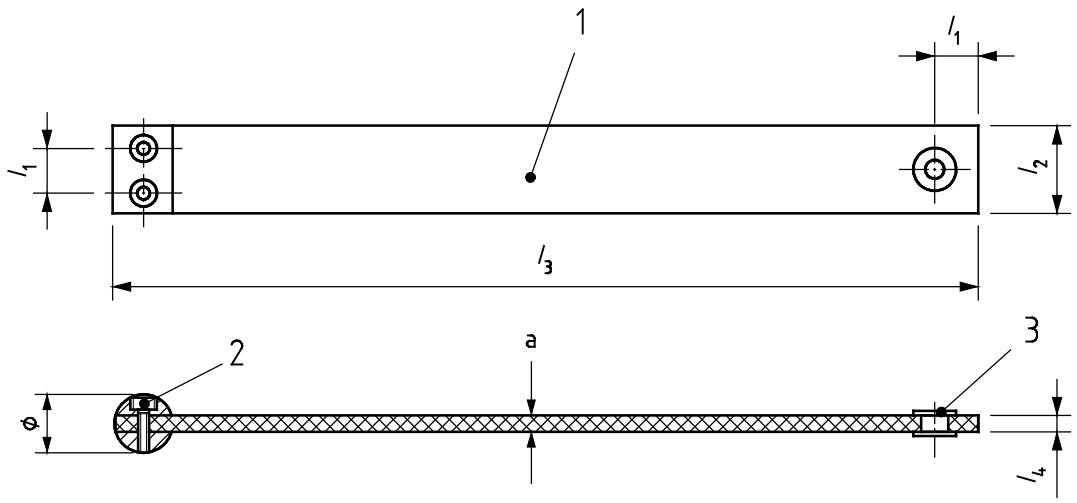
This dead zone shall not be higher than 40 mm above threshold at the bottom and 40 mm down from the top of the throughway.

In the case of soft horizontal bottom seals or radii in the top or bottom corner of the leading edge being used this dead zone shall not be higher than 40 mm above the soft horizontal seal or the bottom corner radius and not lower down than 40 mm below the upper corner radius.

The anti-drag system shall meet the requirements of Table 1.

Table 1 — Requirements of anti-drag system

Test	Safety target	Test object	System reaction	Test procedure	Remarks
1 static or	prevent train from moving	Figure 15	No signal ’All doors closed and locked’	Close the door onto the test object	Test at three positions as shown in Figure 12
2 dynamic	Stop moving train	Figure 15	Removal of signal ’All doors closed and locked’	Close the door onto the test object and pull the object.	Test at centre with maximum 150 N pullout force at 45° from driving direction. For bidirectional operation, at 45° from both directions.



Key

l_1	15 mm	l_4	5 mm	2	socket head screw EN ISO 4762 - M4 × 16
l_2	30 mm	Ø	10 mm	3	hollow rivet, DIN 7340, ø10, form A
l_3	300 mm	1	rubber strip (70 Shore A)	a	door closing direction

Figure 15 — Test object

5.2.1.6 Leading edges

The design of the leading edge should minimize the risk and extent of injuries caused by the door equipment.

5.2.2 Entrance system closed proving

5.2.2.1 Door interlock system

It shall be possible to apply traction power only when all doors are closed and locked except on existing locos and independent coaches, where the interlock signal is not available. A signal shall be provided by the entrance system that the passenger door is closed and locked prior to departure.

When the locking control is under staff control and activated from a door position, it is permissible for this door to remain open when the other doors close. It shall be possible for staff to close and lock this door afterwards. This door shall automatically close and lock when the train reaches 3 km/h.

On independent vehicles, intended for use with existing vehicles and locomotives where the transmission of the interlock signal is not available, the passenger doors shall automatically start to close when the speed of the train exceeds 3 km/h.

Any local bypass switches shall only be operated when the isolation device in accordance with 5.1.6 is mechanically engaged with the door in the closed position.

Indication of loss of door interlock to the train crew shall be clearly related to door status and not be combined with other indications such as passenger communication activation.

5.2.2.2 Step interlock system

A signal shall be provided to the train system proving that all steps are retracted prior to departure if the extended step infringes the gauge.

Synchronization of door and step movement shall be such that the door is not open more than 400 mm unless the step is in the deployed position. The steps shall not move when the door is fully open.

The requirements also apply to semi-automatic ramps.

5.3 Opening conditions

5.3.1 Safety during opening

The door shall be designed to prevent persons and obstacles (e.g. luggage) from being trapped during opening of the door as far as practicable and to minimize the risk and the extent of the injuries caused by the door equipment.

Details to be agreed in the technical specification.

5.3.2 Limitation of opening

Opening of the door or step outside the vehicle gauge shall only be possible when the vehicle has come to a stand (i.e. speed below 3 km/h).

5.4 Moveable step obstacle detection

5.4.1 General

Different requirements apply to steps moving inside or outside the vehicle.

5.4.2 Steps outside the vehicle

The step shall be fitted with a device capable of stopping the movement of that step if its front edge comes into contact with any object or person while the step is in movement.

The following requirements shall apply:

— the maximum force exerted by an external moveable step at its front edge in direction of opening movement shall not exceed a peak value of 300 N when hitting an obstacle; a measuring device in accordance with D.3.3 shall be used.

The peak force may be increased to 400 N provided that the front edge is equipped with a protective rubber edge (50 to 70 Shore A, min. 10 mm thick).

On the initial 50 mm of opening stroke forces may be higher to allow reliable operation .

The requirements also apply to semi-automatic ramps.

5.4.3 Steps inside the vehicles

Where passengers are expected to stand on a vertically moveable step inside a vehicle, the step shall not operate with a vertical force of ≥ 150 N applied on an area of 40 mm diameter at any position of the step surface. This requirement shall be tested with a vertical load of 150 N.

5.5 Emergency operation

5.5.1 Emergency egress

5.5.1.1 General

The emergency egress device shall unlock the individual door from inside the vehicle. Under power supply failure conditions, the emergency egress device shall remain functional and allow egress. Requirements for the emergency egress device are given in 4.3.2.

5.5.1.2 Emergency egress conditions

The emergency egress device shall be operable at any time, provided that the door has not been put out-of-service.

The technical specification shall specify that the door opening under conditions not compatible with passenger safety (speed above 10 km/h, position of the vehicle) shall be prevented.

The emergency egress inhibition command can be provided via a train line and/or a local control system.

5.5.1.3 Operating force of emergency egress device

The operating force of the emergency egress device shall not exceed 150 N. Figure 16 gives the measuring points on the handles when pulling slowly in the direction of operation.

The design shall prevent the device from operating as a result of the effect of the acceleration experienced in service.

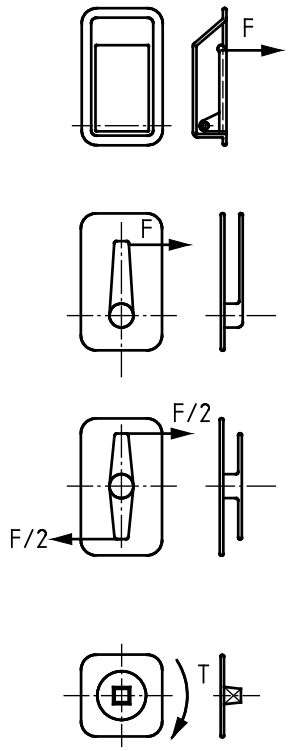


Figure 16 — Application of operating force

The last type of actuating devices shown in Figure 16 refers to the crew access devices only. (5.5.3.2.2) The design of the device shall be such that the application of the required force to operate the handle is possible by a passenger.

5.5.1.4 Impact of load on a door leaf

It shall be possible to operate the emergency egress device with the operating forces specified in 5.5.1.3 under the conditions of passengers leaning against the door, as specified in 4.2.1.1.

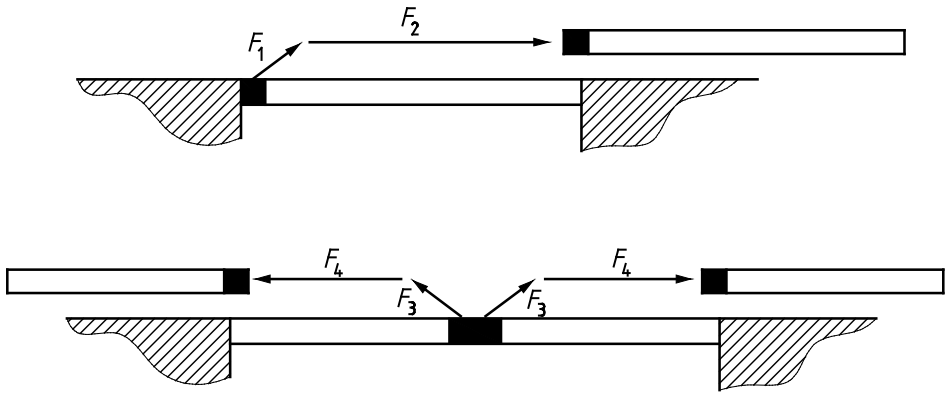
5.5.1.5 Manual force to open the door

When opening the unlocked door (after operating the emergency device) the force required to be exerted by a person (inside or outside the vehicle) shall not exceed 150 N (F2, F4) at an opening speed of up to 5 cm/s. The force shall be applied in door open direction (see Figure 17).

Means to apply the force shall be available. If there are no edges (e.g. window frame) available, recessed grips shall be provided.

In case of a sliding plug door, the necessary force to unplug the door shall not exceed 250 N (for single door) and 300 N (for double door) at an opening speed of up to 5 cm/s in the door open direction (see Figure 17).

The values for the opening force are valid for a vehicle on level track.



Key

Symbol	Values in N	
F_1	250	unplug force per leaf – single door
F_2	150	sliding force per leaf – single door
F_3	150	unplug force per leaf – double door
F_4	75	sliding force per leaf – double door
		All Forces applied in direction of movement.

Figure 17 — Application of manual operating force

5.5.1.6 Emergency egress device operation

An emergency egress device that has been operated shall be indicated as follows:

— to the train system (on board crew or control centre);

— locally at the related door (visually and/or audible).

Clear proof of operation of the device shall be provided (e.g. break glass, lead seal, data recording). The exact method shall be specified in the technical specification.

5.5.1.7 Recommended device

If the emergency egress device uses a lever or a toggle, it shall be designed so that a clockwise rotation is required to release the door.

The recommended emergency egress device is given in A.4.

NOTE For international vehicles the RIC-KEY is used (see Annex H).

5.5.1.8 Protection against accidental operation

To prevent unintentional or accidental operation of the emergency egress device, one of the following requirements shall be adopted:

— successive operation of two sub-devices;

— protection by a removable cover; or

— the door is held closed until it is safe for passengers to leave the vehicle. In this case it shall be possible to open the door manually under power failure conditions of the door.

The emergency egress device shall be installed in such a manner that the risk of unintentional or accidental operation is minimized. Any confusion with other operational devices shall be avoided by design.

The technical specification shall specify if sealed or covered devices shall be operable with a crew key without destroying the seal or cover.

5.5.2 Emergency windows in access doors

The technical specification shall define if emergency windows are to be provided in the door and may define protection against accidental trapping if the door opens while the window is being used for egress.

5.5.3 Access device

5.5.3.1 General

Passenger doors that are intended for emergency/crew access shall be provided with an access device. This device shall unlock the individual door from outside the vehicle. Requirements for the device are given in 4.3.3.

5.5.3.2 Access conditions

5.5.3.2.1 General

Under a power supply failure condition the access device shall remain functional and allow access, provided that the door has not been locked out-of-service.

5.5.3.2.2 Operating force of access device

The operating force of the access device shall not exceed 200 N. See Figure 16 for application of operating force.

If the crew access device is designed so that it requires a RIC key to operate it, the operating torque shall not exceed the value of 10 Nm.

The design of the device shall be such that the application of the required force is possible.

The design shall prevent the device from operating as a result of the acceleration experienced in service.

5.5.3.2.3 Impact of load on a door leaf

It shall be possible to release the door manually with the operating forces specified in 5.5.3.2.2 under the conditions of passengers leaning against the door specified in 4.2.1.1.

5.5.3.2.4 Manual force to open the door

The maximum force to be applied to open a door that has been released using the access device shall be in accordance with 5.5.1.5.

5.5.3.2.5 Access device operation

An emergency access device that has been operated shall be reported to the the train control system.

5.5.3.2.6 Recommended access device

If the access device uses a lever, a toggle or a key, it shall be designed so that a clockwise rotation is required to release the door.

NOTE For international vehicles the RIC-KEY is used (see Annex H).

5.5.3.2.7 Protection against accidental operation

The access device shall be installed in such a manner that the risk of unintentional or accidental operation is minimized. Any confusion with other operational devices shall be avoided by design.

5.5.4 Powering up

After shut down, power failure, isolation or emergency operation, powering up of the entrance system shall be in a controlled and safe manner to prevent injury.

5.6 Other requirements

5.6.1 Passenger access door area illumination

The passenger access door area shall be equipped with sufficient lighting under normal and emergency conditions to support safe access/egress. The lighting in the door areas shall fulfil the requirements specified in EN 13272.

5.6.2 Status indication

The quantity, position and colour of local status indicators shall be specified in the technical specification.

Each door that does not close on command shall be clearly highlighted to the train crew (e.g. via onboard monitoring system) This information should not be confused with other functions.

6 Categories of tests

6.1 General

The test plan (shown in Annex E) shows the testing necessary to prove compliance with this European Standard.

6.2 Type tests

Type tests to prove the design shall be undertaken.

If the type tests are performed on a prototype or pre-production entrance system, any additional tests required on the first production entrance system shall be agreed.

A comprehensive series of measurements shall be made covering all the relevant parameters to ensure the performance requirements are achieved as declared in the test plan.

The test conditions on a mock-up or vehicle shall meet the following criteria:

— the vehicle or mock-up shall be positioned so that it is flat and horizontal and (where applicable) on straight track;

— the vehicle shall be at standstill;

— HVAC systems shall run at their agreed performance;

— the temperature inside the vehicle or mock up shall be between 10 °C and 30 °C.

The tests shall be conducted under conditions of nominal, minimum and maximum power supply.

Additional tests shall be conducted on the obstacle detection system with the vehicle at a cant of 3°.

If any endurance test is required, the details shall be agreed in the technical specification.

6.3 Routine tests

These tests shall be carried out on all door sub-assemblies.

These tests shall include measurements and checks to confirm conformity to production documents. The extent of testing shall be defined in the Quality plan for that technical specification.

6.4 Functional test on the fully assembled vehicle/train consist

Checks shall be carried out in accordance with EN 50215 to prove that the entrance system functions correctly in accordance with this standard.

The checks shall include all door indicators, safety circuits and control systems for normal and emergency access and egress under all operating conditions in accordance with this standard.

See Annex E for the test plan.

7 Documentation related to installation and maintenance of the entrance system

The documentation shall include information to maintain the entrance system in a safe and reliable condition throughout the agreed lifetime. It shall be incorporated in manuals for the vehicles.

The existence of a safety data sheet for a maintenance material shall be mentioned in the documentation.

The content of documentation shall be agreed in the technical specification.

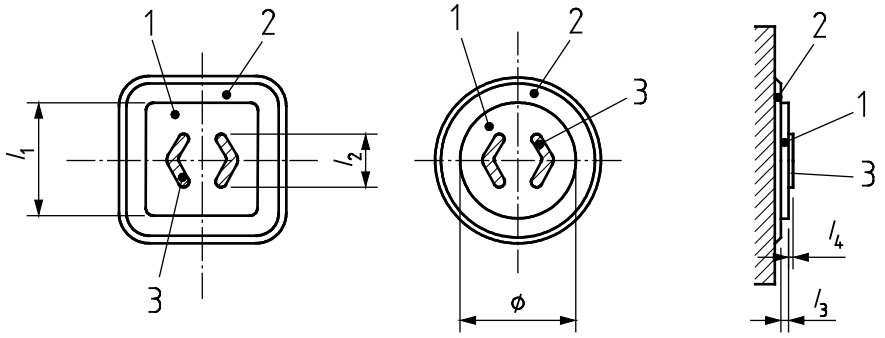
Annex A
(normative)

Passenger Interface devices

A.1 Purpose

The design and the appropriate pictograms for door operation by passengers are set out in this annex.

A.2 Design of door buttons



Key

l_1	30 mm	Ø	30 mm
l_2	15 mm	1	minimum active surface
l_3	3 mm	2	frame
l_4	0,5 mm	3	arrow

Figure A.1 — Examples of door buttons

The activation area which is sensitive to inputs shall have at least a dimension of l_1 = 30 mm.

As a door button shall be palm operated and identifiable by touch, the button press shall protrude at least l_3 = 3 mm.

The door button should provide at least 0,5 mm pressing movement. Pressing movement shall not be more than the protrusion of the pressel.(l_3). Door buttons that have no or little pressing movement shall be provided with a system that acknowledges operation (e.g. audible or visual or tactile).

To indicate the functionality to visually impaired persons the arrows should protrude by at least l_4 = 0,5 mm from the surrounding surface and be a minimum height of l_2 = 15 mm. Alternatively, Braille may be used instead.

The force F required to operate the door button shall be F ≤ 15 N.

Such door buttons shall be locatable and identifiable by touch (for example, tactile markings) and shall indicate the functionality (e.g. raised chevrons).

The design shall prevent the door button operating as a result of the acceleration experienced in service.

The illuminated red or green areas shall have a minimum luminance of 30 cd/m^2 .

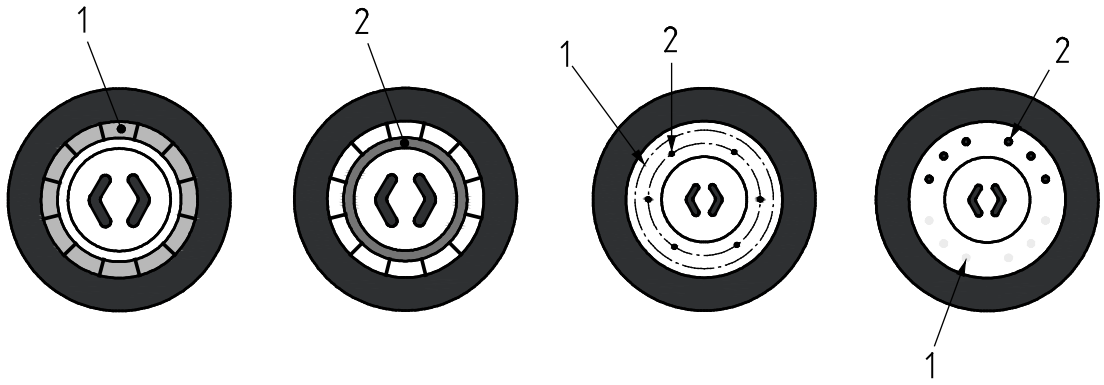
Measuring method for luminance:

- Device: DIN 5032-7 and EN 13032 Class B (e.g. Gossen Mavo-Spot 2).
- Arrangement: button fixed to wall in a dark room, button and device on same height, measuring angle 1°, covering the illuminated area.
- power supply: at nominal

The door button colour shall contrast from its adjacent surface. The colour for the 'open' button frame should be green, the colour for the 'close' button frame should be red. The frame of buttons for doors allocated for prams and wheelchairs should be blue.

Examples of illumination areas:

The area of the red and green illumination shall be arranged in a way that a change in colour also results in a change of the illuminated area.



Key

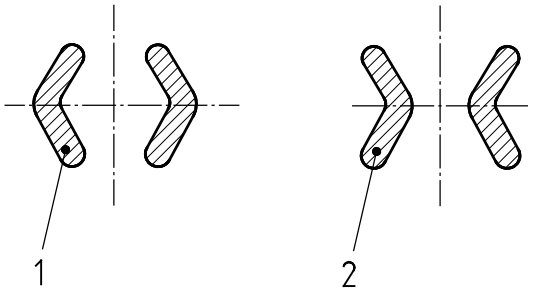
1 green illuminated area

2 red illuminated area

Figure A.2 — Illuminated area

A.3 Labels on or near door buttons

Arrow indicating opening/closing: the colour shall be different than the surrounding area.



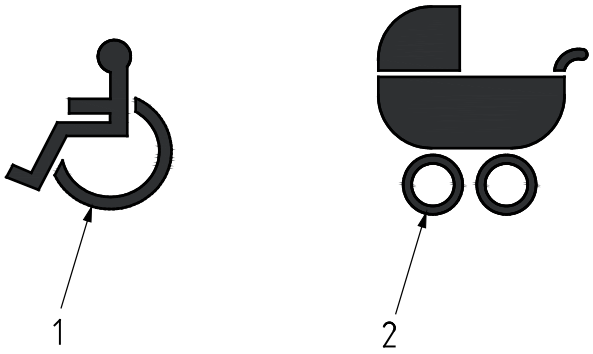
Key

1 open

2 close

Figure A.3 — Arrow indicating opening or closing

Door button with special functions will be indicated with relevant, not necessarily protruding symbols, for example:



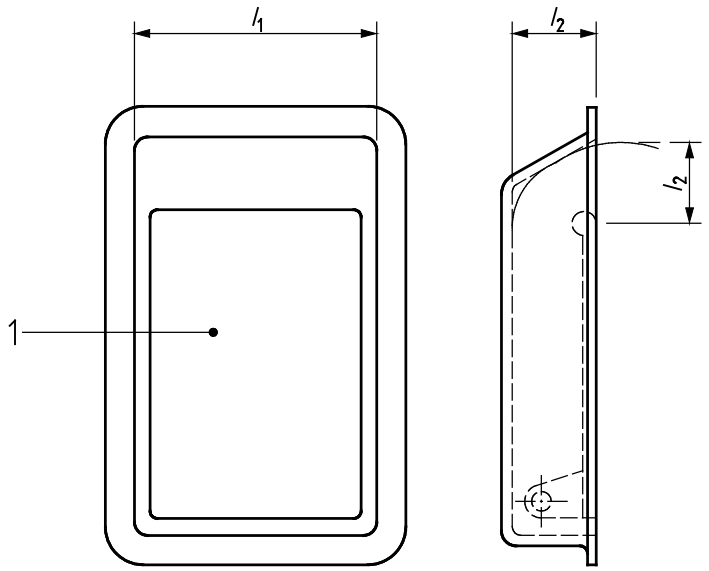
Key

1 wheelchair (ISO 7000-0100)

2 pram

Figure A.4 — Examples of labels

A.4 Recommended emergency egress device



Key

1 handle

l_1 ≥ 80 mm

l_2 ≥ 25 mm

Figure A.5 — Recommended emergency egress device

A.5 Sample of labels

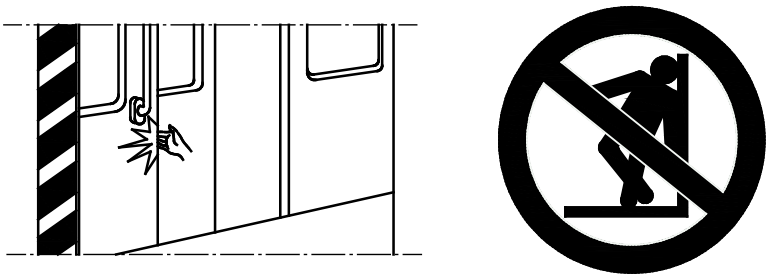


Figure A.6 — Sample of labels used in 4.4

Annex B
(normative)

Water test procedure

B.1 Purpose

This annex defines the water test requirements for the door.

B.2 Test arrangement

The test shall be performed under normal atmospheric conditions on a door assembled on the vehicle or on a structure with interfaces identical to those of the vehicle body. The door is closed and locked as in service.

The door is sprayed with jets of water on its external surface and protected from splashing water onto the internal surface.

Table B.1 — Details concerning the water test

Water pressure	(3 ± 0,3) bar
Flow rate/nozzles	(14 ± 1) l/min
Distribution/number of nozzles	l_2 = (500 ± 20) mm (see Figure B.1)
Distance to vehicle	l_3 = (1 000 ± 50) mm
Spray pattern: Fan form oval	Fan angle: α = 50° ± 10° Maximum fan width: 135 mm
Duration of test	one single passage
speed of longitudinal displacement	(3 ± 1) cm/s

The following phase shall be performed:

— spray the door once;

— wait 10 min;

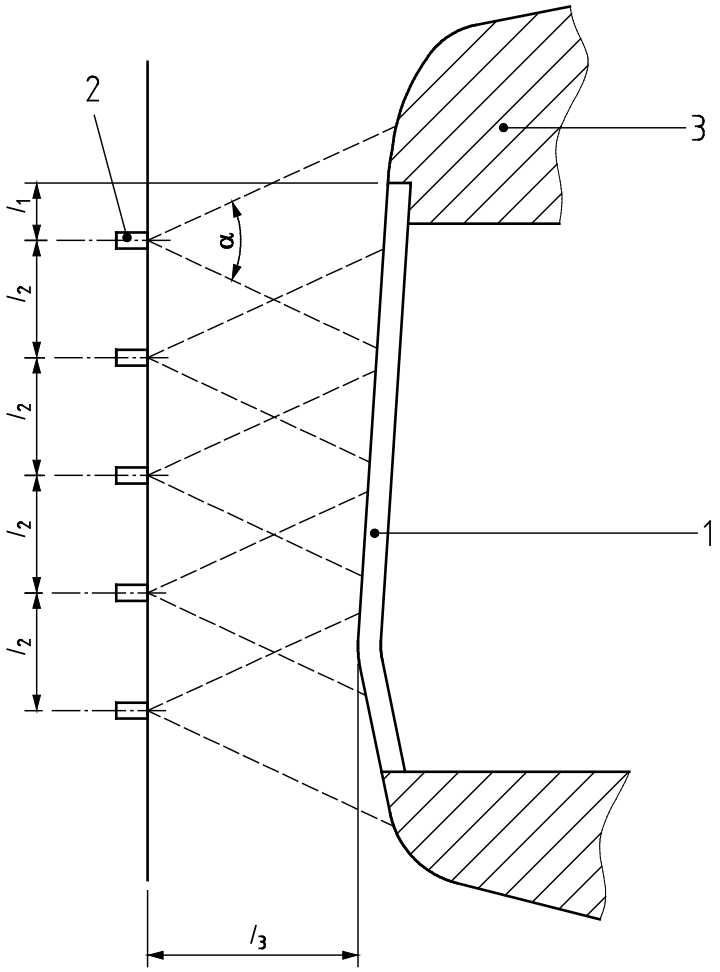
— observe the leak tightness for 10 min; and

— note any defects in the report.

B.3 Test decision

On internal surface, when the door is closed, there shall be no trickles of water visible; isolated drops shall be permitted. Trickles are permitted on the leading edge seals only.

Any entering water shall not affect the function of any door components.



Key

1	door	l_2	500 mm
2	nozzles	l_3	1 000 mm
3	vehicle / mock up	α	50°
l_1	250 mm		

Figure B.1 — Water test arrangement

Annex C
(normative)

Specification and testing of the air tightness of door

C.1 Purpose

This annex defines the air tightness test requirements for doors.

C.2 Calculation – Flowchart

For definitions see C.4.1.

C.3 Example of air tightness requirement specification

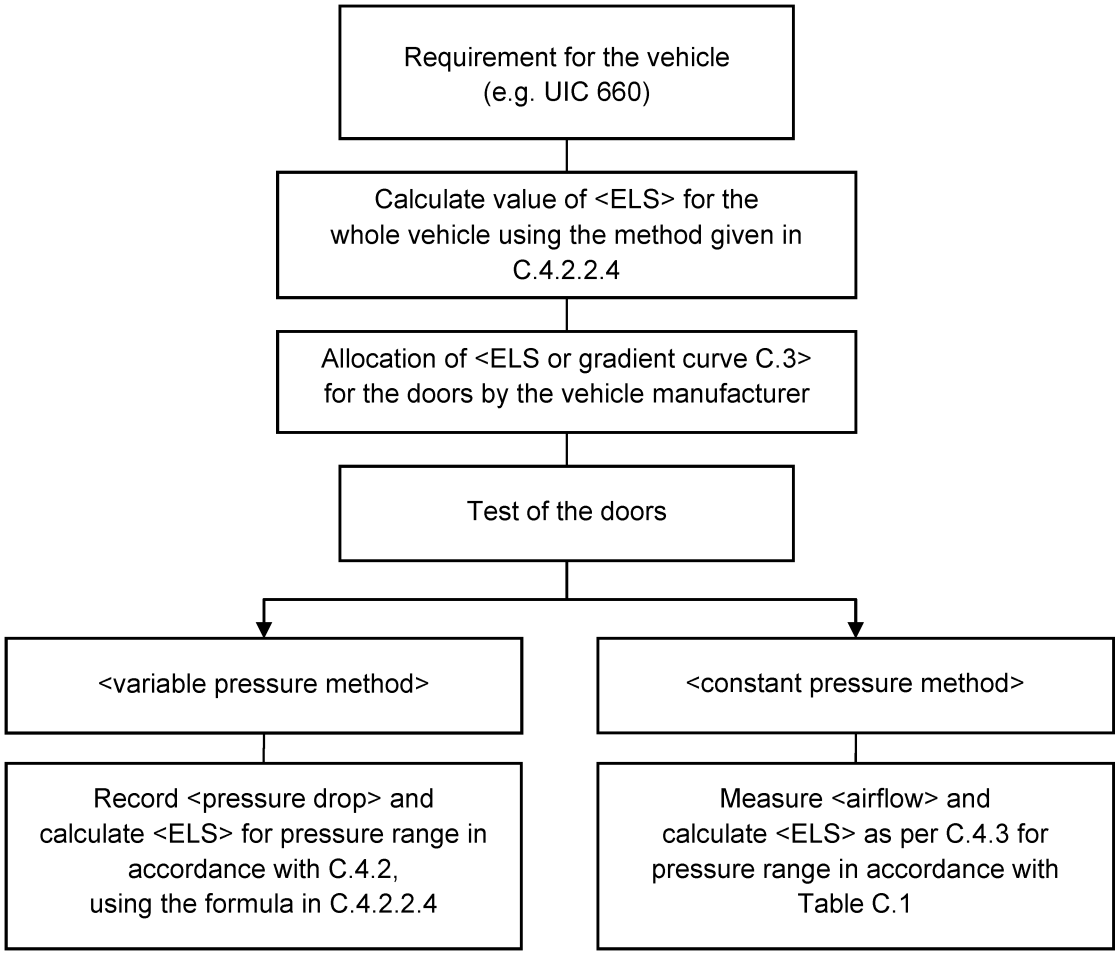


Figure C.1 — Flowchart

Table C.1 — Example of Air tightness requirements specification form

Reading	t	$p_i\ (0) - p_e$	$p_i\ (t) - p_e$	A	O
	s	Pa	Pa	mm^2	Pa/s
1		6 000	5 000		
2		5 000	4 000		
3		4 000	3 000		
4		3 000	2 000		
5		2 000	1 000		

C.4 Air tightness testing

C.4.1 General

C.4.1.1 Sealing surface

The sealing surface is the physical shell separating the internal space of the vehicle from the external air. This shell includes the apertures which generate leaks.

C.4.1.2 Leakage surface

Each aperture has a cross-section through which air can flow. The sum of these cross-sections represents the leakage surface.

C.4.1.3 Equivalent leakage surface (ELS)

The equivalent leakage surface is the cross-section of a single aperture that would produce the same effects as the leakage surface defined in C.4.1.2, under the test conditions described in this European Standard.

C.4.1.4 Approximate equivalent leakage surface

This is the equivalent leakage surface, the approximate value of which can be determined by calculation, as set out in C.4.2.2.4 and C.4.3.3.

C.4.2 Variable pressure measurement method

C.4.2.1 Principle of measurement

The door is first subjected to internal over pressure; the measurement method consists of measuring the difference in pressure inside and outside the chamber, in time, to a final inside over pressure value.

C.4.2.2 Modelling the phenomenon

C.4.2.2.1 Symbols

A leakage surface (of the chamber), in m^2;

V internal volume of the chamber, in m^3;

ρ density of the air in the chamber at time t and at test conditions, in kg/m^3;

m mass of the air in the chamber at t, in kg;

p_i internal pressure at t, in Pa;

p_e external pressure, in Pa;

$\Delta p(0)$ $\left[p_i(t=0)-p_e\right]$ (initial excess or negative pressure), in Pa;

$\Delta p(t)$ $\left[p_i(t)-p_e\right]$ (excess or negative pressure at t), in Pa;

t time, in s;

v_s air speed on leakage surface, in m/s;

γ $\frac{c_p}{c_v}$ isentropic exponent

with c_p and c_v, thermal massic capacity of the air in J/(kg K), respectively, in terms of constant pressure and volume

c speed of sound in air, in m/s

$$c=\sqrt{\frac{\gamma p_e}{\rho}} \quad \text{(C.1)}$$

C.4.2.2.2 Modelling

The vehicle is modelled in the form of a rigid chamber (see Figure C.2).

Key

A door

Figure C.2 — Scheme of a rigid chamber

C.4.2.2.3 Calculation of $\Delta P(t)$

It is assumed that the air is not compressed ($p_i - p_e$ < 4 000 Pa); its velocity in the outlet jet is given by the following approximate expression:

$$\frac{p_i}{\rho}=\frac{p_e}{\rho}+\frac{v_s^2}{2} \quad \text{(C.2)}$$

where

$$v_s=\sqrt{\frac{2(p_i-p_e)}{\rho}} \quad \text{(C.3)}$$

The mass flow rate is:

$$\frac{dm}{dt}=-V\frac{d\rho}{dt}=\rho A v_s=A\times\sqrt{2\rho(p_i-p_e)}\Rightarrow\frac{d\rho}{dt}=-\frac{A}{V}\times\sqrt{2\rho(p_i-p_e)} \quad \text{(C.4)}$$

The phenomenon is assumed to be adiabatic, therefore:

$$\frac{dp_i}{p_i} - \gamma \times \frac{d\rho}{\rho} = 0 \Rightarrow \frac{dp_i}{dt} = \frac{\gamma\, p_i}{\rho} \times \frac{d\rho}{dt} = -\frac{c^2 A}{V} \times \sqrt{2\rho(p_i - p_e)} \quad \text{(C.5)}$$

Following integration, the following is obtained:

$$p_i - p_e = \left(\frac{-c^2 At}{V} \times \sqrt{\frac{\rho}{2}} + \sqrt{p_i(t=0) - p_e} \right)^2 \quad \text{(C.6)}$$

$$\Delta P(t) = \left(-\frac{C^2 At}{V} \times \sqrt{\frac{\rho}{2}} + \sqrt{\Delta p(0)} \right)^2 \quad \text{(C.7)}$$

This expression is valid for:

$$t_e = \left[0, \frac{V\sqrt{2\Delta p(0)}}{c^2 A\sqrt{\rho}} \right] \quad \text{(C.8)}$$

Excess pressure in time is therefore a familiar parabolic curve which has been well proven. The same reasserting can be applied to negative pressure.

C.4.2.2.4 Equivalent leakage surface

The model below results in the approximate value of the equivalent leakage surface.

$$A = \frac{V}{c^2 t} \times \sqrt{\frac{2}{\rho}} \times \left(\sqrt{\Delta p(0)} - \sqrt{\Delta p(t)} \right) \quad \text{(C.9)}$$

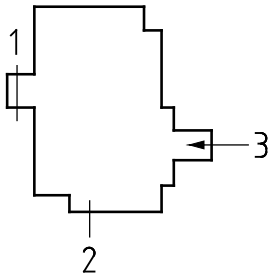
C.4.3 Variant: Constant pressure method of measurement

C.4.3.1 General

The previous method presupposes the availability of a large chamber suitable for equipment that creates the chamber (e.g. vehicle body). If not, this chamber can be very difficult to create, and it is for this reason that the 'constant pressure leak rate measurement' method should be used.

A cabinet to enclose the door shall be built.

C.4.3.2 Principle: Equipment forms a chamber



Key

1 door equipment to be tested

2 measurement of relative pressure ($p_i - p_e$)

3 flow rate Q_a

Figure C.3 — Test chamber

The sealed chamber is closed on one of its fronts by the door to be tested. The functional openings in the chamber are fully sealed. Air is fed through one of these openings at a flow rate of Q_a. The relative internal excess pressure $[p_i - p_e]$ is measured continuously. For a given flow rate, Q_a, the excess pressure $[p_i - p_e]$ is held at the required value. The flow rate Q_a is equal to the leak Q_f of the equipment to be tested. From the leak rate Q_f, it is possible to determine the equivalent leakage surface A, using the expression in C.4.3.3.

C.4.3.3 Modelling the phenomenon

$$Q_f = v_s \times A \tag{C.10}$$

Then v_s can be calculated as:

$$v_s = \sqrt{\frac{2(p_i - p_e)}{\rho}} \tag{C.11}$$

and A results as:

$$A = \frac{Q_f}{v_s} \qquad A = \frac{Q_f \sqrt{\rho}}{\sqrt{2(p_i - p_e)}} \tag{C.12}$$

Q_f the value at test conditions.

Annex D
(normative)

Requirements for measuring the closing forces of power-operated doors

D.1 General

The closing of a power operated door is a dynamic process. When a moving door hits an obstacle, the result is a dynamic reaction force. Its variation in time depends on several factors (e.g. mass of the door, acceleration, dimension).

D.2 Terms and definitions

D.2.1
closing force
$F(t)$

time function, measured at the closing edges of the door (see D.2.4)

D.2.2
peak force
F_p

maximum value of the closing force

D.2.3
pulse duration
T

time between t_1 and t_2:

$$T = t_2 - t_1$$

where

t_1 is the threshold of sensitivity, where the closing force exceeds 100 N and

t_2 is the fade away threshold, where the closing force becomes less than 100 N.

D.2.4
force graph
relation between the above parameters as shown in Figure D.1:

Values in N

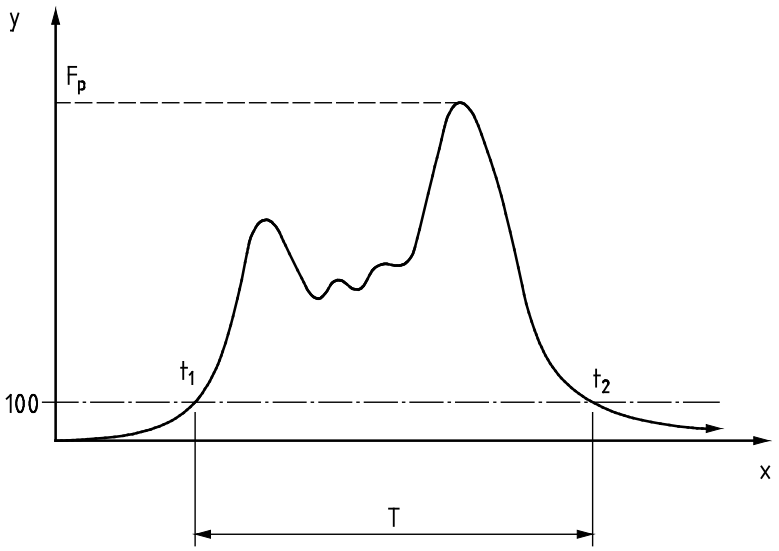


Figure D.1 — Force graph

This is the arithmetical mean value of the peak forces, measured at the same measuring point subsequently more times (n).

$$F = \frac{\sum_{i=1}^{i=n} \left(F_p\right)_i}{n} \qquad \text{(D.1)}$$

D.3 Measurements

D.3.1 Conditions of measurement

Temperature range: 10 °C to 30 °C.

The vehicle shall stand on a horizontal track.

D.3.2 Measurement points

Measurement points shall be at the main closing edges of the door at middle height (Key 6 of Figure 12).

The device shall be held between the abutting edges.

The peak force shall be measured at about (50, 100, 200, 300 and 500) mm opening (uncompressed device positioned at 90 mm, 130 mm, 230 mm, 340 mm, 560 mm) and at an additional point where the highest force is to be expected.

D.3.3 Measuring method

At least three measurements (n) shall be taken at each measuring point to determine the mean peak force in accordance with D.2.4. After each reading the door shall be allowed to close normally for one cycle.

The signal of the closing force shall be recorded by means of a low-pass filter with a limiting frequency of 100 Hz.

Measuring device:

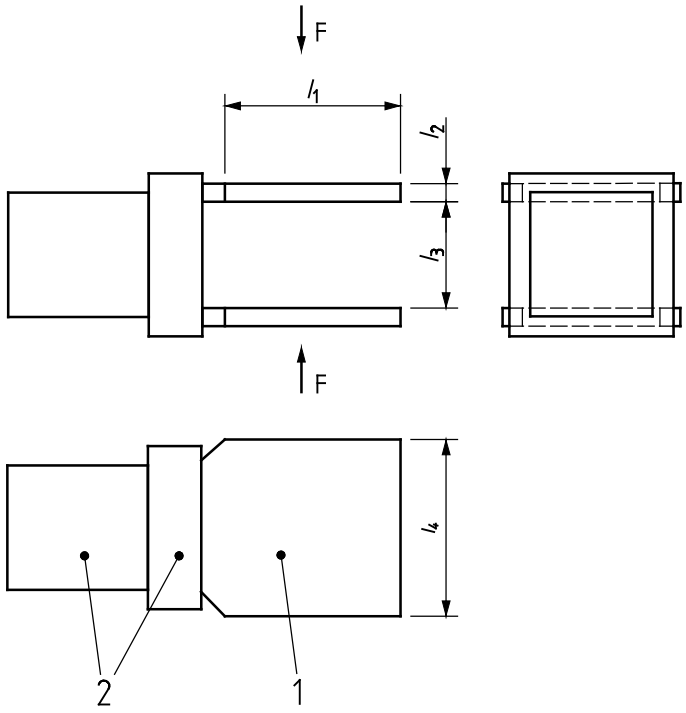
The measuring device shall consist of two parts: one handle and one measuring part which is a load cell (see Figure D.2).

The load cell shall have the following characteristics:

— it shall consist of two contact plates with the outer dimension of l_1 = 100 mm by l_4 = 100 mm

— inside the load cell a compression spring shall be fitted between the two housings so that the load cell can be pressed together if an appropriate force is applied;

— the stiffness of the spring shall be (10 ± 0,5) N/mm. The spring deflection shall allow a maximum peak force of 700 N. Accuracy of force F readings: Forces up to 100 N ± 3N, forces above 100 N ± 3 % of the measured value.



Key

1	movable element	l_2	5 mm
2	handle	l_3	70 mm
l_1	100 mm	l_4	100 mm

Figure D.2 — Measuring device

Annex E
(normative)

Test plan

This test plan shows the required testing to prove conformance to this European Standard.

Table E.1 — Test plan

Subclause	Title	Type test 6.2	Function test 6.4
4.1.1.1	Minimum width	X	X
4.1.1.2	Minimum height	X	X
4.1.2.2	Step dimensions	X	X
4.2.1.1	Passenger retention forces	X	
4.2.1.2	Aerodynamic stresses	X	
4.2.1.3	Relation to vehicle gauge	X	
4.2.1.4	Vehicle overturning case	X	
4.2.1.5	Ability to withstand vibration and shock	X	
4.2.2	Step(s) mechanical strength	X	
4.5.1	Electric and pneumatic power supplies	X	
4.6.1	Fire protection	X, sample of components	
4.6.2.1	Sound insulation	X	
4.6.2.2	Thermal insulation	X	
4.7.1	Hardware	X	
4.7.2	Software for electronic door control systems	X	
4.9	Protection against electrical hazards	X	
4.10.2	Water tightness	X	X
4.10.3	Air pressure tightness	X	
5.1.2	Release doors and steps		X
5.1.3	Interlocking of released doors		X
5.1.5.1	Power-operated door systems	X	X
5.1.6	Out-of-service devices	X	X
5.2.1.3.2	Audible Alert *noise level (vehicle)*	X	
5.2.1.3.2	Audible Alert function (door)		X
5.2.1.3.2	Audible Alert frequency (component)	X	
5.2.1.3.3	Visual alert	X	X

Subclause	Title	Type test 6.2	Function test 6.4
5.2.1.4.1	Sensitivity of obstacle detection	X	X
5.2.1.4.2	Door impact	X	X
5.2.1.4.3	Obstacle removal force (Bar)	X	
5.2.1.5	Anti-drag	X	X
5.2.2.1	Door interlock system		X
5.2.2.2	Step interlock system		X
5.4	Moveable step obstacle detection	X	X
5.5.1.2	Emergency egress conditions	X	X
5.5.1.3	Operating force of emergency egress device	X	
5.5.1.4	Impact of load on a door leaf	X	
5.5.1.5	Manual force to open the door	X	
5.5.1.6	Emergency egress device operation		X
5.5.3.2	Access conditions	X	X
5.5.3.2.2	Operating force of access device	X	
5.5.3.2.3	Impact of load on a door leaf	X	
5.5.3.2.4	Manual force to open the door	X	
5.5.3.2.5	Access device operation		X
5.6.1	Passenger access door area illumination		X
5.6.2	Status indication		X
6.2	Type tests	X	

Annex F
(normative)

Load requirements for doors due to aerodynamic loads on passenger trains

This annex defines the load requirements on doors due to aerodynamic loads.

1) Where applicable, UIC 566:1990, 2.1.2.1 (static load) and UIC 660:2002, 4.5.4, shall be conformed to.

2) Specific requirements with different parameters are to be specified in the technical specification. The EN 14067 series shall be used.

3) These requirements are not applicable to metros and trams on their independent networks.

Annex G
(informative)

Clauses in this European Standard requiring clarification in the technical specification

Table G.1 gives an overview of those normative clauses of this European Standard which require clarification in the technical specification.

Table G.1 — Clauses to be clarified

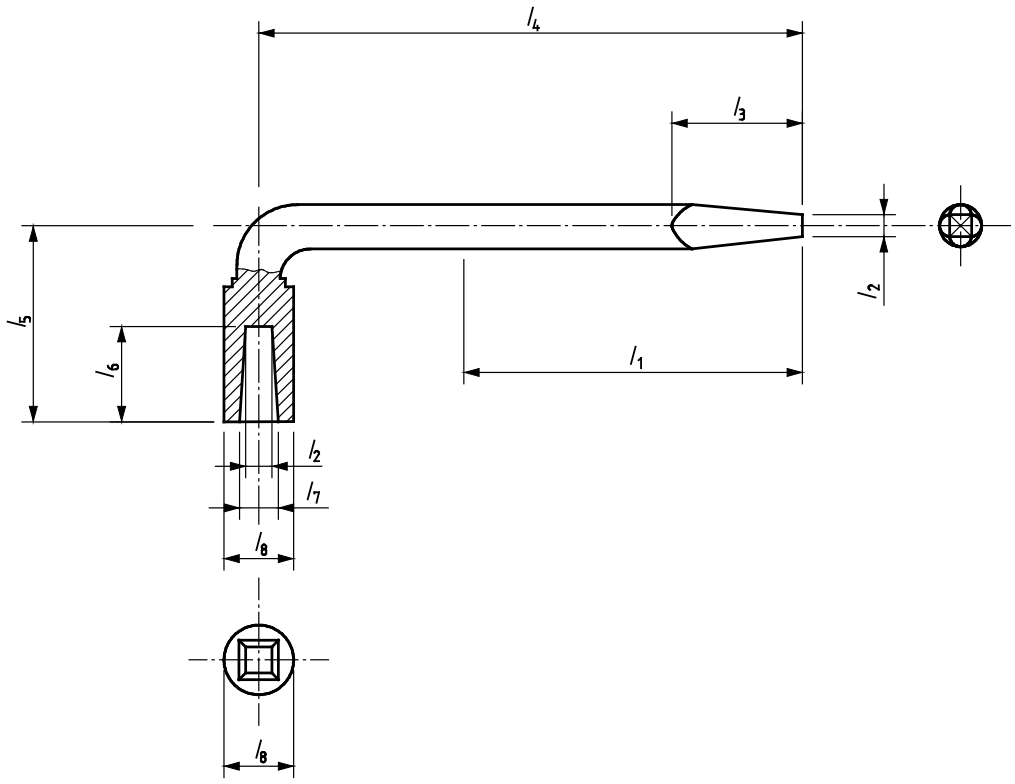
Clause/Subclause	Title
4.1.2.5	Manual operation
4.1.3	Track level access
4.1.4	Relative position of the step edge
4.2.1.2	Aerodynamic stresses (see Annex F)
4.2.1.3	Relation to vehicle gauge
4.2.1.4	Vehicle overturning case
4.2.1.5	Ability to withstand vibration and shock
4.3.1	Door buttons
4.3.1.4	Passenger door button location
4.3.2.3	Colour of emergency egress device
4.3.3.1	Quantity and location of access device
4.5.2	Mechanical interface with the vehicle
4.6.1	Fire protection
4.6.2.1	Sound insulation
4.6.2.2	Thermal insulation
4.8	Reliability, availability, maintainability, safety (RAMS)
4.9	Protection against electrical hazards
4.10.1	Weather
4.10.3	Air pressure tightness
5.1.2	Release doors and steps
5.1.3	Interlocking of released doors
5.1.6	Out-of-service devices
5.2.1.3.2.2	Door closing alert sequence
5.2.1.4.2.2	Closing force
5.2.1.4.2.4	Non-contact obstacle detection
5.2.1.5	Anti-drag

Clause/Subclause	Title
5.3.1	Safety during opening
5.5.1.2	Emergency egress conditions
5.5.1.6	Emergency egress device operation
5.5.1.8	Protection against accidental operation
5.5.2	Emergency windows in access doors
5.6.2	Status indication
6.1	General
6.2	Type tests
6.3	Routine tests
6.4	Functional test on the fully assembled vehicle/train consist
7	Documentation related to installation and maintenance of the entrance system

Annex H
(normative)

RIC-KEY

Geometry and dimensions of the RIC-KEY according to the Agreement governing the exchange and use of coaches in international traffic .



Key

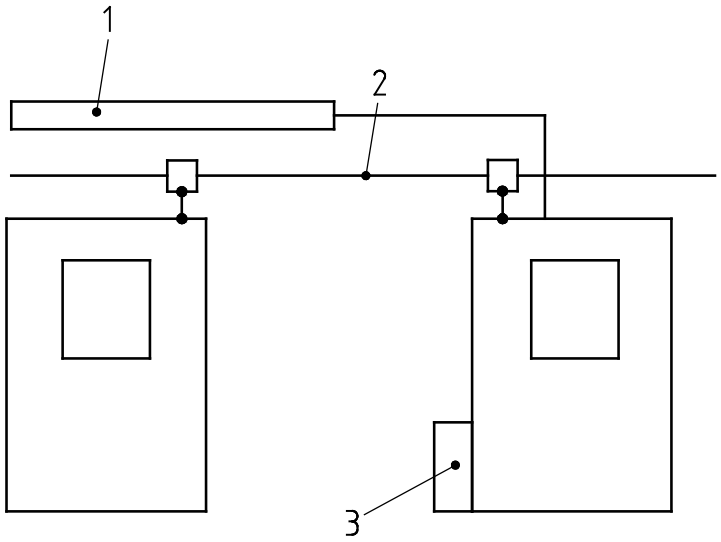
l_1	> 80 mm (minimum gripspan)	l_5	≥ 45 mm
l_2	6 mm	l_6	22 mm
l_3	30 mm	l_7	9 mm
l_4	≥ 125 mm	l_8	16 mm

Figure H.1 — RIC-KEY

Annex I
(informative)

Calculation of kinetic energy

The following examples of calculations for different doors shall be used as a guideline of how to calculate the kinetic energy applied on an obstacle:



Key

1 pneumatic cylinder
2 coordinating screw with two nuts
3 obstacle

Figure I.1 — Pneumatic double sliding or sliding plug door – with screw

Kinetic energy calculation on obstacle (J):

$$E = \frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2 \eta^2 \quad \text{(I.1)}$$

Where

E is the kinetic energy;

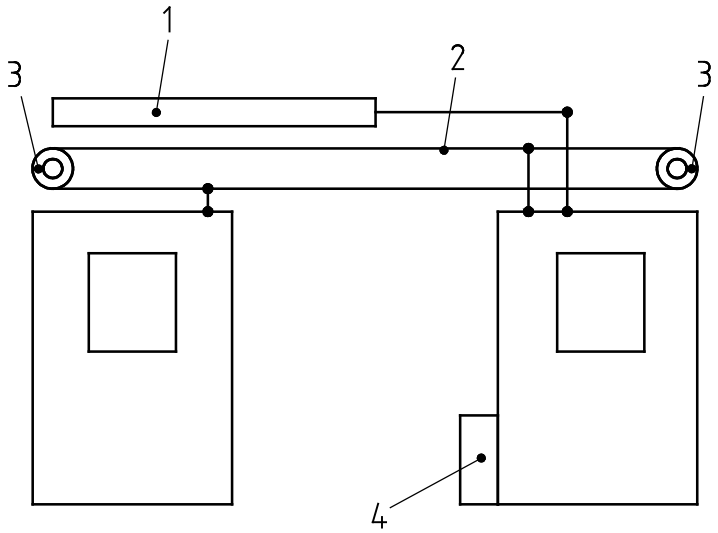
m_1 is the mass of the leaf blocked by the obstacle (kg);

m_2 is the mass of the second leaf (kg);

v is the maximum measured closing speed of the leaves (m/s);

η is the efficiency of the nut/screw interface.

NOTE The kinetic energy of the mobile parts of the cylinder is neglected due to internal friction.



Key

1	pneumatic cylinder	3	pulley
2	belt	4	obstacle

Figure I.2 — Pneumatic double sliding or sliding plug door – with belt

Kinetic energy calculation on obstacle (J):

$$E = \frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2 \eta^2 \quad \text{(I.2)}$$

Where

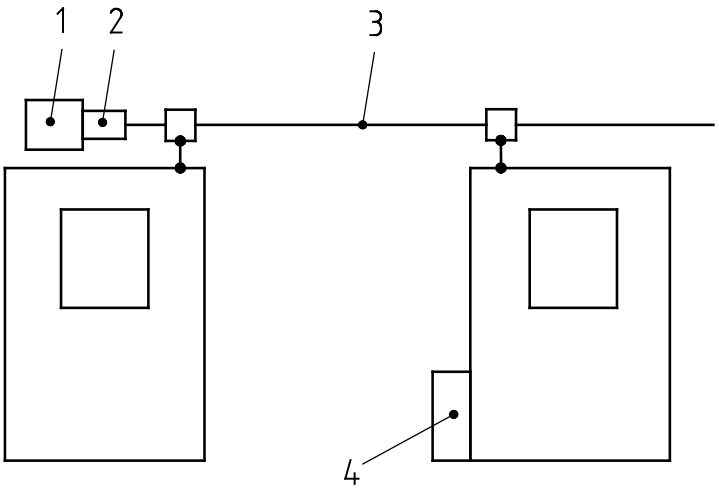
E is the kinetic energy;

m_1 is the mass of the leaf blocked by the obstacle (kg);

m_2 is the mass of the second leaf (kg);

v is the maximum measured closing speed of the leaves (m/s);

η is the efficiency of the belt – pulley interface.



Key

1	electric motor	3	coordinating screw with 2 nuts
2	reduction gear	4	obstacle

Figure I.3 — Electric double sliding or sliding plug door – with screw

Kinetic energy calculation on obstacle (J):

$$E = \frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2 \eta_1{}^2 + \frac{1}{2} \eta_1 \left[\left(i_3 + i_2 \right) \Omega_1{}^2 + i_1 \eta_2 \left(\Omega_1 r \right)^2 \right] \quad \text{(I.3)}$$

Where

E is the kinetic energy;

m_1 is the mass of the leaf blocked by the obstacle (kg);

m_2 is the mass of the second leaf (kg);

v is the maximum measured closing speed of each leaf (m/s);

η_1 is the efficiency of the nut – screw interface;

η_2 is the efficiency of reduction gear;

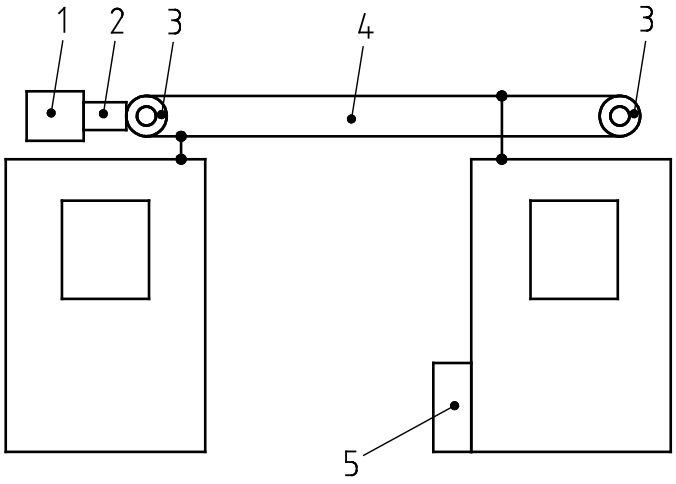
r is the ratio of reduction gear;

i_1 is the inertia moment of electric motor ($\mathrm{kg \cdot m^2}$)

i_2 is the inertia moment of gear ($\mathrm{kg \cdot m^2}$)

i_3 is the inertia moment of coordinating screw ($\mathrm{kg \cdot m^2}$)

Ω_1 is the angular speed of coordinating screw (rd/s)



Key

1 electric motor
2 reduction Gear
3 pulley
4 belt
5 obstacle

Figure I.4 — Electric double sliding or sliding plug door – with belt

Kinetic energy calculation on obstacle (J):

$$E = \frac{1}{2} m_1 v^2 + \frac{1}{2} m_2 v^2 \eta_1{}^2 + \frac{1}{2} \eta_1 \left[(i_2) \Omega_1{}^2 + i_1 \eta_2 (\Omega_1 r)^2 \right]$$

Where

E is the kinetic energy;

m_1 is the mass of the leaf blocked by the obstacle (kg)

m_2 is the mass of the second leaf (kg)

v is the maximum measured closing speed of the leaves (m/s)

η_1 is the efficiency of the belt- pulley interface

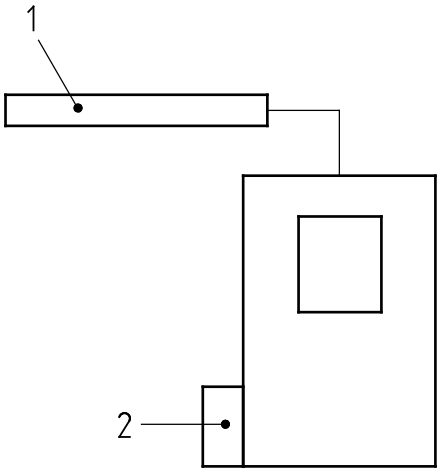
η_2 is the efficiency of reduction gear

r is the ratio of reduction gear

i_1 is the inertia moment of electric motor ($\mathrm{kg \cdot m^2}$)

i_2 is the inertia moment of gear ($\mathrm{kg \cdot m^2}$)

Ω_1 is the angular speed of reduction gear (rd/s)



Key

1 pneumatic air cylinder 2 obstacle

Figure I.5 — Pneumatic single sliding or sliding plug door

Kinetic energy calculation on obstacle (J):

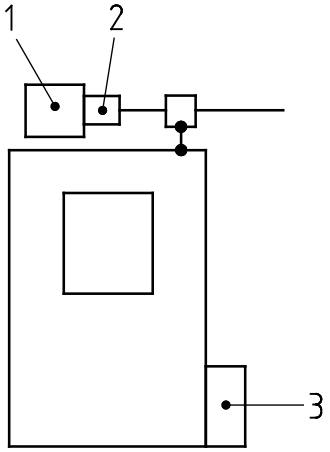
$$E = \frac{1}{2}mv^2$$

Where

E is the kinetic energy;

m is the mass (kg)

v is the maximum measured closing speed (m/s)



Key

1 electric motor 3 obstacle

2 reduction gear

Figure I.6 — Electric single sliding or sliding plug door

Kinetic energy calculation on obstacle (J):

$$E = \frac{1}{2} m v^2 + \frac{1}{2} \eta_1 \left[(i_3 + i_2) \Omega_1^2 + i_1 \eta_2 (r \Omega_1)^2 \right]$$

Where

E is the kinetic energy;

m mass (kg)

v maximum measured closing speed (m/s)

η_1 efficiency of the nut- screw interface

n_2 efficiency of reduction gear

r ratio of reduction gear

i_1 inertia moment of electric motor ($kg \cdot m^2$)

i_2 inertia moment of electric gear ($kg \cdot m^2$)

i_3 inertia moment of coordinating screw ($kg \cdot m^2$)

Ω_1 angular speed of coordinating screw (rd/s)

Annex J
(informative)

Non-contact obstacle detection

J.1 General

Following description of monitoring devices is a non-exhaustive illustration of some possible options currently in development.

For the purpose of this annex, the interior floor or the first interior step (if any) in the vehicle are taken as the vertical reference point.

J.2 Light barrier

If these systems are used, the objective to minimize risks is fulfilled applying the following criteria:

Optical monitoring devices (e.g. light barriers, light sensors) may be installed at a minimum height of 100 mm and at a maximum height of 400 mm above the vehicle floor level for detecting prams, and at a minimum height of 300 mm and at a maximum height of 700 mm above the threshold (floor or step) for detecting the access and egress of passengers. Depending on the design of the door, these criteria can be fulfilled by one or by two optical monitoring devices. They should be located as close as possible to but not more than 150 mm from the vehicle exterior.

J.3 Step sensors for external steps

If step sensors are used, the tread plate should be covered over its full range. For design reasons, the lateral edges of the step surface may not be sensitive up to a maximum width of 50 mm. Step sensors should respond to a vertical proof load of 150 N applied on an area of 40 mm diameter at any point of the sensitive surface along its front edge.

J.4 Area monitoring systems

J.4.1 Arrangement of area monitoring system

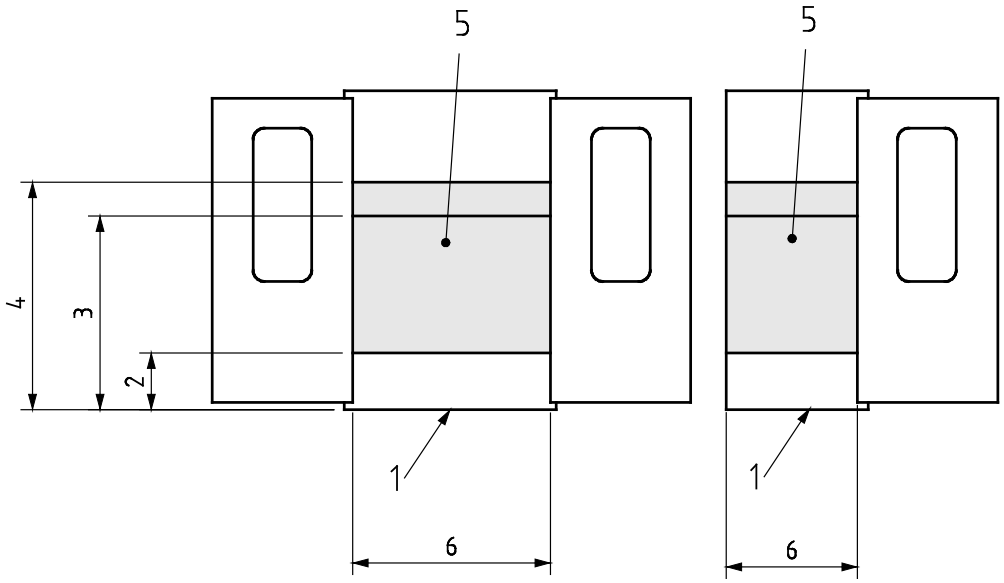
If these systems are used, the objective to minimize risks is fulfilled by applying the following criteria:

— The upper end of the detection area should be at a height of at least 1 430 mm above the vertical reference point. If it can be excluded that the platform is at a higher level than the vertical reference point, the value may be reduced to 1 270 mm (see Figure J.1).

— The lower end of the detection area should be at a height of not more than 400 mm above the vertical reference point (see Figure J.1).

— In entrance areas with more than one interior step, the lower end of the detection area may be positioned at a higher level if the distance between the lower edge of the detection area and the walking line is $l_1 \leq 300$ mm, measured perpendicularly to the walking line (see Figure J.2).

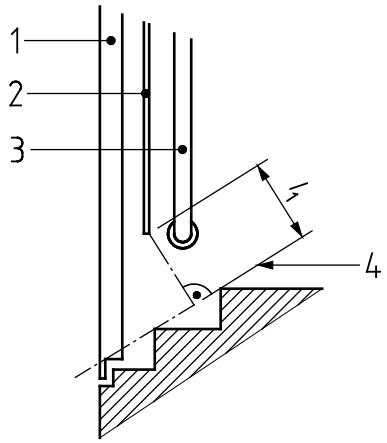
— The inner end of the detection area should be not more than l_1 ≤ 80 mm from the inner surface of the closed door leaf. For curved doors, the maximum distance can be measured at the upper and the lower end of the detection area (see Figure J.3).



Key

1 vertical reference point
2 (lower) end of detection area max. 400 mm
3 minimum height of detection area (for platforms below the vertical reference point) 1 270 mm
4 minimum height of detection area 1 430 mm
5 detection area
6 clear usable width

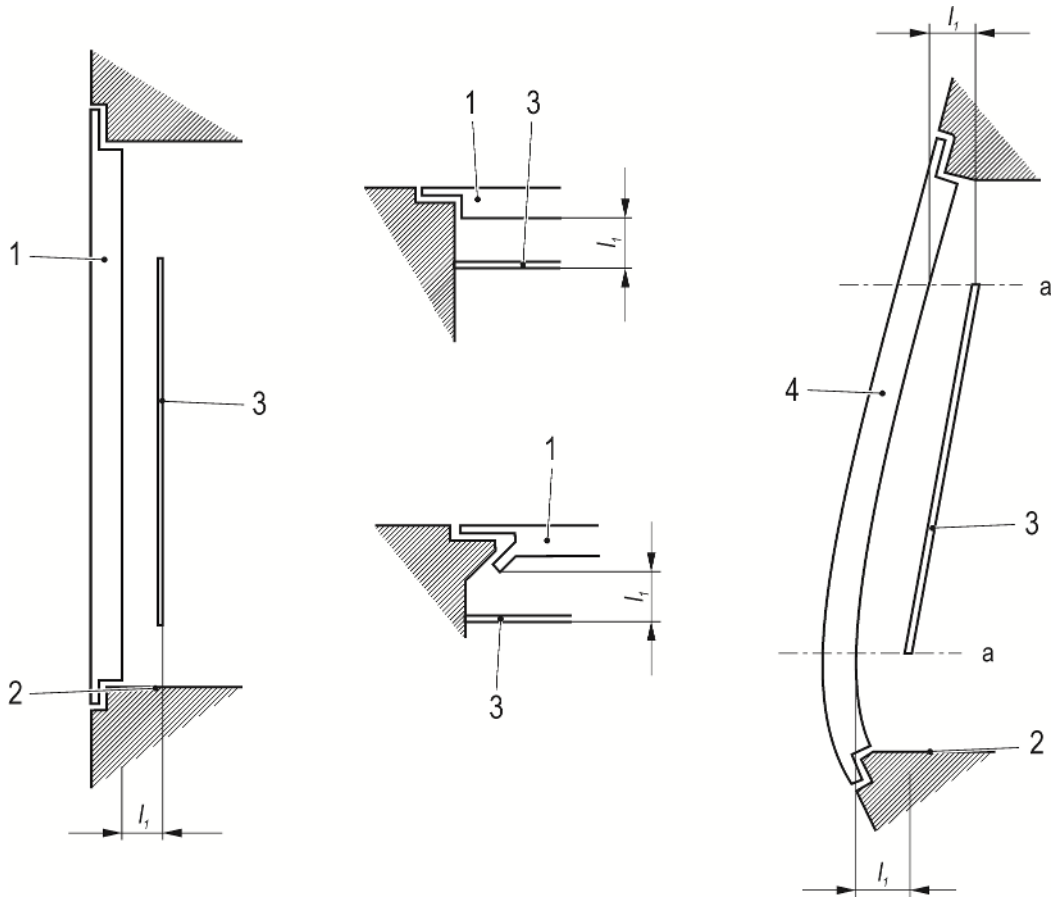
Figure J.1 — Dimension of detection area



Key

1 closed door leaf
2 detection area
3 handhold, boarding aid
4 walking line
l_1 max. 300 mm

Figure J.2 — Detection areas for steps

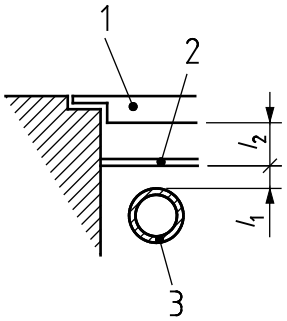


Key

1	closed straight door leaf	4	closed curved door leaf
2	vertical reference point	l_1	max. 80 mm
3	detection area	a	horizontal line

Figure J.3 — Depth of detection area

In order to avoid erroneous responses, the clear distance to adjacent handholds should be at least 45 mm (see l_1 of Figure J.4).

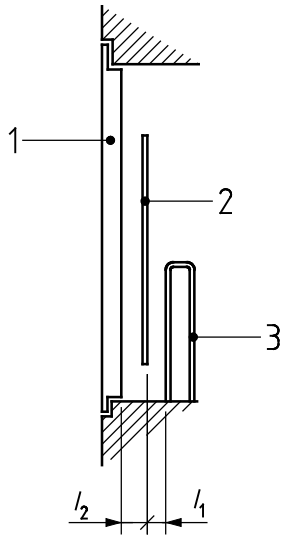


Key

1	closed door leaf	l_1	min 45 mm
2	detection area	l_2	max. 80 mm
3	handhold, boarding aid		

Figure J.4 — Distance to handhold

If the layout of a handhold gives the presumption that passengers do not grab hold of the part of the handhold which is located next to the interior of the closed door leaf, this distance may be reduced (see Figure J.5). However, it should be ensured that grabbing hold of this part of the handhold from the exterior triggers the system.



Key

1	closed door leaf	l_1	≤ 45 mm
2	detection area	l_2	≤ 80 mm
3	handhold, boarding aid		

NOTE The distance between detection area and handhold/boarding aid may be reduced to l_1 < 45 mm.

Figure J.5 —Distance to centre handhold

J.4.2 Testing of area monitoring system

J.4.2.1 Test object

Test object A (see Figure 11):

— Dimensions: a rod with a rectangular cross-section of l_2 = 30 mm × l_3 = 60 mm;

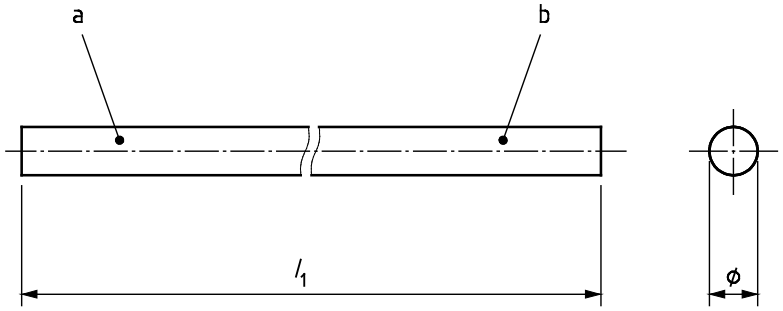
— Material: non-deformable, non-light transmitting material, e.g. wood or aluminium.

In all tests, the test object A can be positioned with its edge l_3 vertically in the detection area.

Test object B (see Figure J.6):

— Dimensions: a rod with a diameter of ø 8 mm;

— Material: non-deformable non-light transmitting material, e.g. wood or aluminium.



Key

a	reflectivity 2 % to 5 %	l_1	300 mm
b	reflectivity > 90 %	ø	8 mm

Figure J.6 — Test object B

J.4.2.2 Open door (closing is not yet triggered by door control)

J.4.2.2.1 Static

Holding test object A with its long edge vertically at any position of the defined detection area (see Figure J.1) prevents triggering the automatic door closing.

J.4.2.2.2 Dynamic

Moving test object B slowly in the detection area should prevent triggering the automatic door closing.

The test object should be moved in the following directions:

— circularly in a diameter of about 300 mm in the detection area.

The test should be conducted with both ends of the test bar (low and high radiance).

J.4.2.3 Automatically closing door (door leaf is moving)

J.4.2.3.1 Static

Holding test object A with its edge l_3 vertically at any height of the defined detection area in the test area shown in Figure J.1 should interrupt the door closing. Contact with the door leaf resulting in a slight displacement of the test object until the door leaf comes to a halt is allowed (entrance system response time).

J.4.2.3.2 Dynamic

Moving test object B slowly in the detection area should interrupt the automatic door closing. Contact with the door leaf resulting in a slight displacement of the test object until the door leaf comes to a halt is allowed (entrance system response time), but the test object should not be trapped.

The test object should be moved in the following directions, and the detection of the test object should be ensured:

— circularly in a diameter of about 300 mm in the detection area.

The test should be conducted with both ends of the test bar (low and high radiance).

Annex K
(informative)

Migration rule for this European Standard

The obligation to apply a standard can be stated by law, a regulation or a private contract, but cannot be stated in the standard itself. However, the stakeholders who are represented in the CEN Technical Committee responsible for the standard are of the opinion that the standard should be applied as follows.

Unless specifically called for by a European regulation or TSI, the standard, for which the CEN received a mandate by the EC under the interoperability directives, should NOT be used for homologation and certification or authorization for putting into service purposes of rolling stock, when such rolling stock falls under one of the following exemption categories:

— rolling stock that is purchased under a contract already signed or was at the final phase of the tendering procedure at the date of publication (dop) of this European Standard;

— renewed or upgraded rolling stock where the work that would be necessary to achieve compliance requires alterations of the entrance system that would necessitate re-validation of the entrance system.

Also exempt during a transitional period are

— rolling stock that are purchased under options of contracts already signed, or at the final phase of a tendering procedure, at the date of publication (dop) of this European Standard;

— rolling stock built in accordance with an existing design approval, having received a homologation, certification or an authorization for putting into service within the European Union before the date of publication (dop) of this European Standard, which is purchased under contracts signed during this transitional period.

The proposed transitional period of four years should start from dop.

These exemptions should continue to apply during the whole operational life of the rolling stock concerned, and would also include parts for maintenance and repair, as long as this rolling stock is neither renewed nor upgraded.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under mandates given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the Directive 2008/57/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 clauses of this standard given in Tables ZA.1, ZA.2 and ZA.3 confers, within the limits of the scope of this standard, give a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard, the HS TSI RST (Decision 2008/232; 21 Feb 2008, amended by Decision 2012/464/EU; 23 July 2012) and Directive 2008/57/EC

Clause/subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable.	4. Characterisation of the subsystem 4.2 Functional and technical specification of the subsystem 4.2.2 Structure and mechanical parts 4.2.2.4 Access §4.2.2.4.2 External access door §4.2.2.4.3 Passenger access doors	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3 1.2. Reliability and availability 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.1 Safety §§6,7,8	

Table ZA.2 — Correspondence between this European Standard, the CR TSI Locomotives and Passenger Rolling stock (Decision 2011/291; 26 April 2011) and Directive 2008/57/EC

Clause/subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable.	4.Characterisation of the Rolling stock subsystem 4.2 Functional and technical specifications of the subsystem 4.2.5 Passenger related items § 4.2.5.6 Exterior doors: passenger access to and egress from Rolling Stock § 4.2.5.7 Exterior door system construction 4.2.10 Fire safety and evacuation § 4.2.10.4 Passenger evacuation	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.3, 1.1.5 1.2. Reliability and availability 1.5 Technical compatibility 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.1 Safety §6	

Table ZA.3 — Correspondence between this European Standard, the CR/HS PRM TSI relating to 'Persons with reduced mobility' (Decision 2008/164/EC; 21 Dec 2007 amended by Decision 2012/464/EU; 23 July 2012) and Directive 2008/57/EC

Clause/subclauses of this European Standard	Chapter/§/annexes of the TSI	Corresponding text, articles/§/annexes of the Directive 2008/57/EC	Comments
The whole standard is applicable.	4. Characterisation of the sub-systems 4.2 Subsystem rolling stock 4.2.2 Functional and technical specifications 4.2.2.4 Doors §4.2.2.4.1. General §4.2.2.4.2. Exterior doors §4.2.2.4.2.1. Sub-system requirements §4.2.2.4.2.2. Interoperability constituent requirements 4.2.2.12 Step position	Annex III, Essential requirements 1 General requirements 1.1 Safety Clauses 1.1.1, 1.1.5 1.2. Reliability and availability 2 Requirements specific to each subsystem 2.4 Rolling stock 2.4.1 Safety	

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

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[2] EN 15684, *Building hardware — Mechatronic cylinders — Requirements and test methods*

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[5] prEN 16584–1:2013, *Railway applications — Design for PRM Use — General requirements — Part 1: Contrast*

[6] prEN 16585–1:2013, *Railway Applications — Design for PRM Use Equipment and Components onboard Rolling Stock — Part 1: Toilets*

[7] EN 45545-1, *Railway applications — Fire protection on railway vehicles — Part 1: General*

[8] EN 45545-3, *Railway applications — Fire protection on railway vehicles — Part 3: Fire resistance requirements for fire barriers*

[9] EN 45545-4, *Railway applications — Fire protection on railway vehicles — Part 4: Fire safety requirements for rolling stock design*

[10] EN 45545-6, *Railway applications — Fire protection on railway vehicles — Part 6: Fire control and management systems*

[11] EN 45545-7, *Railway applications — Fire protection on railway vehicles — Part 7: Fire safety requirements for flammable liquid and flammable gas installations*

[12] EN ISO 4762, *Hexagon socket head cap screws (ISO 4762)*

[13] EN ISO 12947-1, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method - Part 1: Martindale abrasion testing apparatus (ISO 12947-1)*

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[18] prEN 16586–1:2013, *Railway applications — Design for PRM Use — Accessibility of Persons with Reduced Mobility to rolling stock — Part 1: Steps for Egress and Access*

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