



European Railway Agency	
Guide for the application of the PRM TSI	
Appendixes	
According to Framework Mandate C(2010)2576 final of 29/04/2010	
Reference in ERA:	ERA/GUI/02-2013/INT
Version in ERA:	1.00
Date:	17 November 2014

Document prepared by	European Railway Agency Rue Marc Lefrancq, 120 BP 20392 F-59307 Valenciennes Cedex France
Document type:	Guide
Document status:	Public





Amendment record

Version date	Author(s)	Version	Section number	Modification description
17/11/2014	ERA IU	1.00	All	First publication



APPENDIX 1: EXAMPLES TO ILLUSTRATE THE “EQUIVALENCE” OF NATIONAL STANDARDS WITH EUROPEAN OR INTERNATIONAL STANDARDS	4
1. Quantity of Parking Places (4.2.1.1)	4
2. Value of the ramps	5
APPENDIX 2: SPECIFIC METHODOLOGIES	7
1. Determination of the LRV values and of the contrast	7
2. Readability of a typeface.....	15
3. Palm operation	15
4. Slip resistance of boarding aids and rolling stock access steps.....	16
5. Stowing a baby nappy changing table (Interoperability Constituent)	18

Appendix 1: Examples to illustrate the “equivalence” of national standards with European or International standards

1. Quantity of Parking Places (4.2.1.1)

(1) Where a station specific parking area exists, there shall be sufficient and adapted parking spaces reserved for persons with disabilities and persons with reduced mobility eligible to utilise them at the nearest practicable position, within the parking area, to an accessible entrance.

The requirement to be fulfilled is the provision of a sufficient number of adapted parking places. Being a parameter of the second category, this requirement can be satisfied by an International standard and by other standards as expressed in point 2.3.1.

Regarding the quantity of parking spaces, ISO 21542:2011 requires:

“If no national requirements or regulations are available, the following minimum requirements concerning the number of parking places shall apply:

- a minimum of 1 accessible designated parking space should be provided in every parking area,*
- up to 10 parking spaces: 1 designated accessible parking space,*
- up to 50 parking spaces: 2 designated accessible parking spaces,*
- up to 100 parking spaces: 4 designated accessible parking spaces,*
- up to 200 parking spaces: 6 designated accessible parking spaces,*
- over 200 parking spaces: 6 designated accessible parking spaces + 1 for each additional 100.”*

For example, the French regulation (Annexe 8 of the Circulaire Interministerielle n° DGUHC 2007-53 of 30th of November 2007) requires the following quantity to be provided:

“Adapted parking places shall represent a minimum of 2% of the total number of places for the public. The minimum number of adapted places is rounded up to the superior value. Above 500 places, the minimum number, which shall not be lower than 10, is determined by a “Municipal Arrêté” (i.e regulated by the City).”

In the UK, the Code of Practice about Accessible Train Station Design for Disabled People, published by the Department for Transport (version 2 from September 2010) quotes the British Standard BS 8300, § 4.2.1.4:

“The number of designated disabled persons’ parking spaces will depend on the overall capacity of the car park. The minimum number of spaces designated for disabled motorists must be 5 per cent of the total capacity of the car park.

In addition to this 5 per cent of capacity, a minimum of one space should be provided per employee who is a disabled motorist.”

The table below summarizes the quantity of adapted parking places to provide according to each of the standards:

Number of parking places	Quantity of adapted places		
	ISO 21542	French legislation	British code of Practice (places for the public only)
10	1	1	0.5
50	2	1	2
80	4	2	4
100	4	2	5
150	6	3	7.5
200	6	4	10
400	8	8	20
600	10	10 or more (City regulation)	30

Obviously, the number of adapted parking places is not identical when calculated according to the three different standards. However, all solutions should be considered equivalent because they define a minimum quantity of adapted parking places to be provided: reasons why the French Regulation results in a lower number of places than ISO 21542 while the British Code of Practice results in a higher number need not to be examined as long as these National rules commonly apply to other car parks than station car parks.

For that reason, the point 3.1 of this guide mentions that “the equivalence only consists in a demonstration that the rule or standard is already commonly applied in railway /station infrastructure or other public areas or that it is mandatory by legislation.”

Also, this example illustrates the clarification provided in point 2.3.1 of this guide: “National/regional/local standards can only be applied on the territory they cover”: it is not the intention of the PRM TSI to allow cherry picking between all national/regional/local standards applicable in Europe; such cherry picking would be detrimental to the harmonisation at national or local level.

2. Value of the ramps

(3) Ramps shall be installed for persons with disabilities and persons with reduced mobility

unable to use stairs where lifts are not provided. They shall have a moderate gradient. A steep gradient is allowed for ramps on short distances only.

The ISO 21542 authorizes several gradients from 5% to 12.5%, and for each gradient authorizes a maximum length between two landings (no landing required for a 5% gradient, one landing every 600mm for a 12.5% gradient).

The French Regulation already cited authorizes a gradient of 5% with a landing every 10m, 8% with a landing every 2m and 10% with a landing every 500mm.

The Règlement Grand-Ducal of 25th January 2008 modifying the text from 23rd November 2001 from Luxembourg, relative to the accessibility to public buildings authorizes a gradient of 6% with a landing every 6m,

The British code of Practice already cited authorizes several gradients from 5% to 8.3%, and for each gradient authorizes a maximum length between two landings (10m between landings for a 5% gradient, and 2m between landings for a 8.3% gradient).

The Swiss standard (SN 640238) points out: for straight ramps with a slope of more than 6% a landing is required after a vertical height of 2,00m to 2,50m. Ramps to rail platforms need normally short ramps without landings (because of the safety for passengers waiting on the platform to reduce the part of the platform with narrow/small dimensions). A landing is required when the direction of the ramp is changing $\geq 90^\circ$.

These examples, which are not exhaustive, illustrate again the equivalence of technical solutions for the fulfilment of the requirement. They are all acceptable, even if resulting in different ramps.

Appendix 2: Specific methodologies

1. Determination of the LRV values and of the contrast

When applying colour to two adjacent surfaces, to provide sufficient contrast, the contrast between the colours shall be determined by the light reflectance value, the hue and by the chromatic value of each.

For the purposes of this methodology “Contrast” is to be assessed by the diffused light reflectance value, but can be enhanced by variation in hue and chroma.

1.1 Establishing LRV values

Method of establishing LRV value if the specification of the colour IS known

If the materials chosen are from a colour system that defines the LRV values of any given colour (e.g. NCS) or have a previously confirmed LRV value (following testing) then these are used when calculating the contrast.

Define colours for all items, surfaces, materials, etc. where contrast is required existing known LRV values shall be used.

Method of establishing LRV value if the specification of the colour IS NOT known

The method of test is applicable to:

- opaque paint coatings and paint systems, including those that cause extreme angular dependences of reflected light and those that have a surface texture of < 2 mm;
- opaque coverings including those that cause extreme angular dependences of reflected light, and those that have an unyielding texture of < 2 mm;
- opaque coverings with a yielding pile, e.g. carpet;
- opaque materials, including those that cause extreme angular dependences of reflected light, and those that have a texture of < 2 mm, e.g. finished metals;
- opaque materials coated with non-opaque coatings or coverings, e.g. timber door coated with a wood stain, including those that:
 - cause extreme angular dependences of reflected light;
 - have a texture of < 2 mm;
- multi-coloured surfaces;
- ordinary materials.

The method of test is not suitable for the following surfaces:

- thermochromic; photochromic; retroreflecting; fluorescent; phosphorescent; surfaces involving electrical power for light emission; self-luminous characteristics or for free-standing, non-opaque materials, e.g. glass and clear plastic for curved surfaces.

Apparatus

A sphere-type spectrophotometer shall be used, capable of measuring LRV to a precision compatible with the reproducibility of 1 unit % E CIE $L^*a^*b^*$ ¹.

This is termed "instrument" within this standard. The instrument shall have a spectral range capable of measuring the LRV of a specimen at 16 wavelength points spaced at 20 nm wavelength intervals from 400 nm across the visible spectrum. The instrument shall be capable of measuring a 10° visual field (Y10 or the 10° standard colorimetric observer).

The differences between the LRVs obtained from the 10° standard colorimetric observer and the 2° standard colorimetric observer (Y2) (CIE 15:2004) are generally minor. An LRV obtained from the 2° observer can be up to 1 point higher and for strong yellows up to 4 points higher.

The measured LRVs are affected by the geometric relationships between the measuring equipment geometry and the specimen, therefore a specific geometry is required. The instrument shall be designed such that a correctly positioned specimen is irradiated uniformly from all directions within the hemisphere bounded by its plane. The instrument aperture shall be delimited by the area over which the receiver senses flux rather than the area illuminated. Radiation reflected at the sampling aperture shall be evaluated uniformly at all directions within 5° of the axis of the collection beam. The axis of the reflected beam shall be 8° off the normal of the centre of the specimen plane in which the specimen is placed during measurements. The reduction in sphere efficiency due to specimen absorption shall be corrected to produce a linear output.

The d/8° shape of the instrument makes it applicable for high-gloss surfaces as well as matt surfaces. A spectrophotometer designed to meet the same conditions as 7.2 but with the light path reversed is permitted. Where a single beam integrating sphere is used, the treatment of the outputs needs to include a correction for the reduction in sphere efficiency caused by specimen absorption. Without such a correction the instrument shall give a non-linear output.²

This is generally representative of a phase of daylight with a correlated colour temperature of approximately 6 500 K.

Measurement area shall be at least 7 mm diameter compatible with that provided by commercially available spectrophotometers.

The measurement area allows the LRV of solid colour surfaces and surfaces having a fine coloured pattern to be determined.

Preparation of test specimens

Three specimens shall be selected as being representative of the surface for the test. Where there is variability in the colour of the three specimens, then nine specimens shall be selected.³

The surface of the specimens shall be clean and representative of the surface of the material. There shall be no pressure marks on, or foreign matter attached to, the surface of the specimens to be tested. Plastic or painted specimens require no specimen preparation but shall be clean. Prior to starting the test, specimens that are sensitive to stroking shall be brushed with a clothing brush, once against the grain, where the specimen would appear darker, and then once with the grain, where the specimen would appear lighter and more homogeneous in structure. Cut pile carpets shall be brushed with a clothing brush in the direction of the natural pile lay before measurement.⁴

¹ See CIE Colorimetry 15:2004

² Standard illuminant, CIE D65, (as defined in CIE 15:2004.)

³ Variability in the colour of the three specimens occurs where the difference between the highest and lowest LRV is W4

⁴ Surfaces that are not sensitive to stroking do not need to be pre-treated in this way.

Prior to starting the test, all specimens shall be held between an observer and an unobstructed patch of sky seen through a north-facing window glazed with clear glass. Any specimens that are light permeable, or non-opaque, shall not be measured.

Where there is concern with regard to the stability of the colour and appearance of a specimen over the period of the test, the specimen shall be tested in accordance with measurement requirements of the appropriate European or National Standard for the material as represented by the specimen.⁵

Specimens shall be large enough to extend beyond the measurement area of the instrument.

Procedure

The manufacturer's recommendations for monitoring the instrument performance and maintenance shall be followed.

The instrument shall be switched on and have been allowed sufficient time for stabilization in accordance with the manufacturer's recommendations. Where applicable, it shall be ensured that the instrument has sufficient battery voltage and capacity to undertake the required measurements.

Select the measurement conditions required for calibration of the instrument being used as follows⁶:

- wavelength range and interval;
- size of aperture;
- specular component included;
- standard illuminant type;
- where there is choice of % UV, select 100 % UV.

The instrument shall be calibrated in accordance with the manufacturer's recommendations.

During the use of the instrument, repeat the calibration at regular intervals in accordance with the manufacturer's recommendations.

Where appropriate, re-calibration may be required at regular intervals during measurements.

Test

The sequence to be followed may vary from one instrument to another, but shall include the following steps.

- the specimen shall be determined to be opaque, using the method shown above;
- the method of preparation and presentation of the specimens shall be selected;
- if the instrument conditions required to measure the specimen are not those used during the calibration, adjust to comply with the calibration requirements;
- measure the LRV of the specimen in accordance with this standard, using CIE Tristimulus Y10, Illuminant D65 and the 10° colorimetric observer;
- all measurements shall be taken with the instrument using even pressure without deforming the specimen.

⁵ For textiles the stability of the colour and appearance of a specimen is defined in BS EN ISO 105-B05 and BS 8475.

⁶ The sequence to be followed varies between different instruments

When selecting the measuring points, they shall be distributed over the entire surface of the specimen.

- the measuring points for specimens that have a texture or surface structure shall be distributed over the surface so as to ensure that all differences in surface texture or structure are measured;
- the specimens shall be measured on a measurement grid as shown in Figure 8.
- for specimens which do not have a patterned or textured surface a specimen size of a minimum 150 mm x 100 mm shall be used. LRV measurements shall be taken at the centre points of a 75 mm x 75 mm grid that covers the surface of the specimen, as shown in Figure 8b.
- for multi-coloured specimens where areas of the surface are composed of different uniform colours, which when viewed from a distance of 3 m remain distinct areas of colour, the LRV shall be measured as follows. At least four measurement points shall be located on each distinct area of colour. Following the first measurement at each measurement point the instrument shall be turned 90° three times and measurements taken after each 90° turn. The results of each measurement shall be recorded and the average LRV for each area of distinct colour determined.

The average LRV (LRVav) for the overall specimen is given by:

- $LRVav = [(LRVav1 \times A1) + (LRVav2 \times A2) + (LRVavn \times An)]/A$

Where:

- LRVav = average LRV of the overall specimen (CIE Y10)
- LRVav1 = average LRV of distinct colour "1" of the specimen (CIE Y10)
- A1 = area of distinct colour "1" (m2)
- LRVav2 = average LRV of distinct colour "2" of the specimen (CIE Y10)
- A2 = area of distinct colour "2" (m2)
- LRVavn = average LRV of the last distinct colour "n" on the specimen (CIE Y10)
- An = area of the last distinct colour "n" (m2)
- A = total area of specimen (m2).

The area of the specimen is to be either 0,202 5 m2 for a 450 mm x 450 mm specimen or 0.81 m2 for a 900 mm x 900 mm specimen.

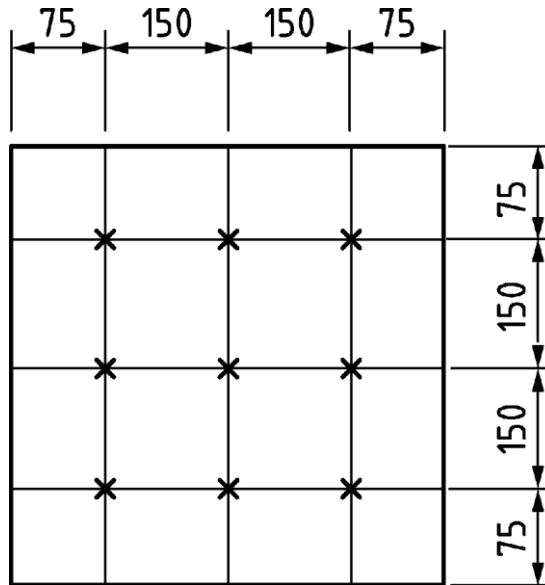
Where the surface comprises many small colour specks or chips which, when viewed from a distance of 3 m, assume the appearance of one slightly varying colour, the average LRV (LRVav) is found in accordance with 6.2.2.4.

Measurements on general surfaces, including carpet specimens, shall be taken on specimens of a minimum size of 450 mm x 450 mm where the nature of the pattern is such that a specimen size of these dimensions is fully representative of the pattern. LRV measurements shall be taken at the 9 centre points of each of the 150 mm x 150 mm area grids which cover the surface of the specimen, by placing the measurement point at the centre of equal areas of the specimen surface, as shown in Figure 8a).

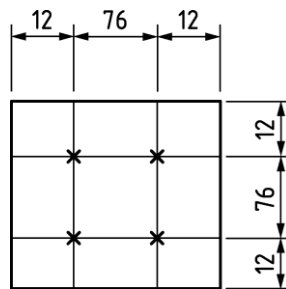
Following the first measurement at each measurement point the instrument shall be turned 90° three times and measurements taken after each 90° turn. The results of each measurement shall be recorded and the average LRV (LRVav) for the specimen determined.

Where patterns on surfaces cannot be fully represented by a specimen of this size (450 mm x 450 mm) then a specimen size of 900 mm x 900 mm shall be used and the LRV measurements shall be taken at the 36 centre points of each of the 150 mm x 150 mm grid, set out to place the measurement point at the centre of equal areas of the specimen surface.

Dimensions in millimetres



a) Measurement grid for 450 × 450 mm specimens



b) Measurement grid for 100 × 150 mm specimens



c) Typical paint samples (150 mm × 100 mm)
Figure 8 Measurement grids for specimens

Expression of results

The instrument shall, either independently or with additional software and hardware, calculate the LRV, which is the CIE Tristimulus Y10 value.

Additionally the x10, y10 of the colour shall be calculated. Output and record the LRV as required.

Test report

The results of all the LRV measurements for the specimen surface shall be reported in a way that enables the LRV difference between two visually adjacent surfaces to be readily determined. The test report shall contain at least the following information:

- the reference to this application guide;
- name of organization carrying out the test;
- date of test;
- the specimen identification details;
- the number of specimens measured;
- the method of specimen preparation used;
- identification of the instrument used including, where appropriate, manufacturer, model, serial number and optical geometry;
- details of the conditions of test;
- measurement area and observer angle;
- description of specimen including CIE Y10, x10, y10 colour identification;
- description of additional feature, e. g. texture, gloss or grain;
- size of specimen used in the test;
- LRV measurements for all measurement points;
- average LRV (LRVav) measurement for each specimen and the range of measured LRVs;
- for multi-coloured specimens the average LRV for the overall specimen (LRVav) and the average LRV for each of the distinct colours on the specimen;
- any deviations from the specified procedures.

In the test report inclusion of a visual record of the specimen, e. g. a photograph or scan is useful.

1.2 Specific assessment criteria for stainless steel

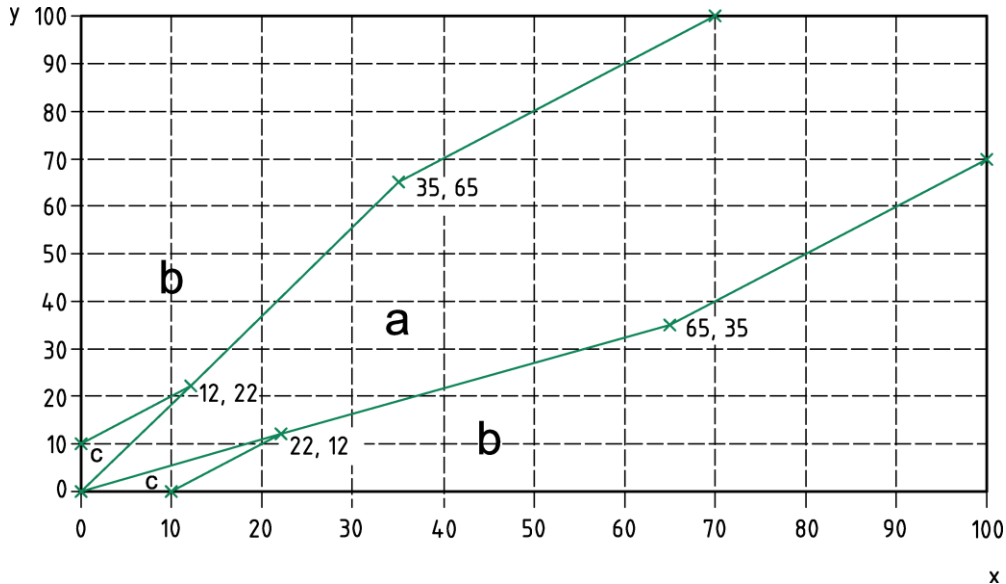
Stainless steel has many unique properties that make it a desirable material for handrail, grab rail and grab pole applications but as it is a reflective surface it has had problems with consistency when measuring and can give a variance in excess of 5 points. The following condition shall then be considered when assessing stainless steel:

- Stainless steel in all other applications than the specific situation specified in 7.2 shall meet the contrast requirement to its background in accordance with the assessment/measuring methodology above and shall be assessed with an increased difference of 35 points (0,35) to ensure that the variance in readings doesn't drop below 30 points.

1.3 Method of assessing contrast with LRV values established

The contrast shall be assessed using Figure 9 which has been derived from the following:

- 1) TSI/DIN formula up to a point then 30 points constant with an initial 10 point minimum difference for non flooring finishes;
- 2) Flooring finishes uses the lines derived from the formula from 0 up to the 30 point difference point on the graph (this is required due to the degradation of a flooring material with use or wear).



Key

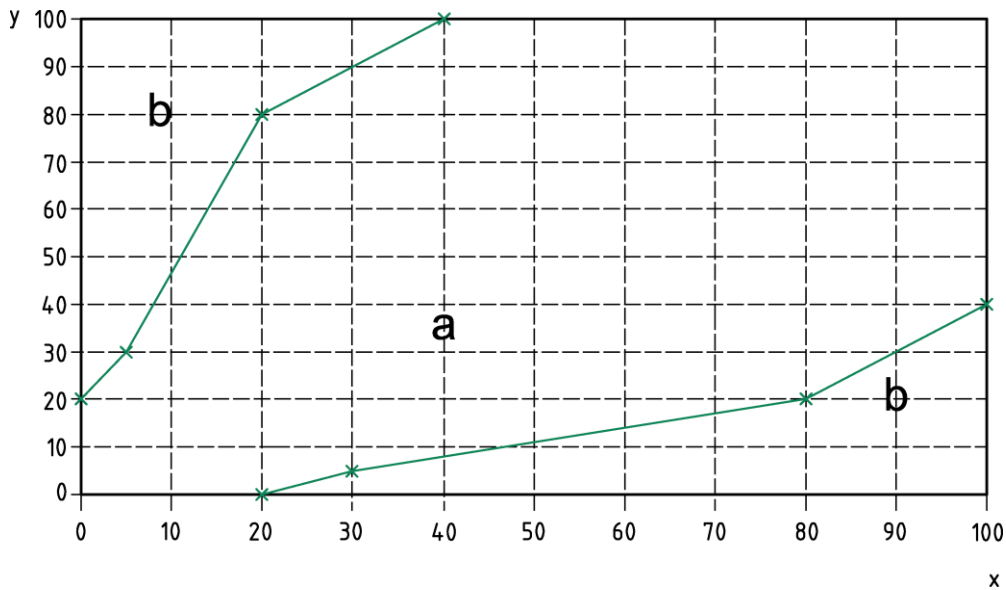
- 'a' LRV values that intersect in this area do not achieve an acceptable contrast level
- 'b' LRV values that intersect in this area achieve an acceptable contrast level
- 'c' LRV values that intersect in this area achieve an acceptable contrast level ONLY if the material being assessed is a flooring material
- x the LRV of the object L₀
- y the LRV of the background or adjacent surface L_h

Figure 9: Acceptable and not acceptable contrast chart

The contrast measured value shall be maintained in normal operation and not just when assessed as new. Therefore when reviewed at type test etc. the selected materials chosen to deliver requirements shall be demonstrated to have suitable properties that make them fit for purpose, e.g. decals shall be UV stable and colour fast as applicable to the relevant application. ISO 17398 shall be used when assessing the durability of signage and decals.

1.4 Specific requirements for signage

When the LRV values for the parts of the sign are known then the simple calculation based on 0,6 minimum is all that is required. It is accepted that the areas marked 'b' in the following diagram correspond to the fulfilment of this requirement..



Key

- a' LRV values that intersect in this area do not achieve an acceptable contrast level
- 'b' LRV values that intersect in this area achieve an acceptable contrast level
- x the LRV of the background or adjacent surface Lh
- y the LRV of the character Lc (number, letter or symbol)

Figure 10: Contrast for signage

1.5 Specific requirements for displays

As above when the relevant criteria from the electronic displays is known then the simple calculation based on 0,6 minimum is all that is required.

The criteria that are pertinent to this assessment are:

- 1) visual acuity of 0,3 shall be the assumed minimum with a recommended 0,1;
- 2) reading distance range, height and angle range of the display, height the eye points shall be assumed to be 1,5 m above the floor;
- 3) ambient light limits;
- 4) luminance of the display and reflection of the screen (including the protective housing/cover/ glass);
- 5) character heights (quantity of information and size of display are key consideration when defining the character height).

Points 1 to 5 can be assessed independently to the installation (e.g. under laboratory conditions) except point 3 which is dependent on the installation so can only be defined as a set of limits under which a display is acceptable.

1.6 Self-contrast

Visual bands consisting of two separate colours that have a minimum difference in LRV of 60 points can be considered to be adequate to achieve contrast against varying lighting conditions and backgrounds.

Regarding stainless steel grab-poles, grab-rails and handrails (including bends in that rail or pole) the use of stainless steel with a surface finish of K300 to K500 is sufficient for the item to be considered as a self contrasting pole (when the lighting is in accordance with the requirements of the TSI).

2. Readability of a typeface

Written information should use Sans Serif fonts, in mixed case (i.e. not in capital letters only). Descenders (i.e. part of any of the characters g, j, p, q or y which protrudes below the level of the baseline as shown in the figure below) and ascenders (i.e. part of any of the characters b, d, f, h, i, j, k, l or t which protrudes above the x-height of the characters as shown in the figure below) should not be compressed. Descenders should have a minimum size ratio of 20% to the upper case characters.



Figure 11: typeface - definitions

3. Palm operation

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

The design need is that passengers with painful conditions, which affect their joints such as arthritis, may be unable to exert any force with the tip of a single finger and they are likely to experience discomfort or pain if they do. Many will not be able to unclench their fingers to do this or perform any pulling action.

Assessment of palm operation of a control device can be done by pulling or pushing the device depending on its normal mode of operation with a clenched fist or hand (without extending fingers) as per the definition above.

The following figure represents a device that can be used to represent a clenched fist when assessing any need to pull or push a control, control device or component. The representative clenched fist will be manufactured from aluminium and attached to a force meter for the tests.

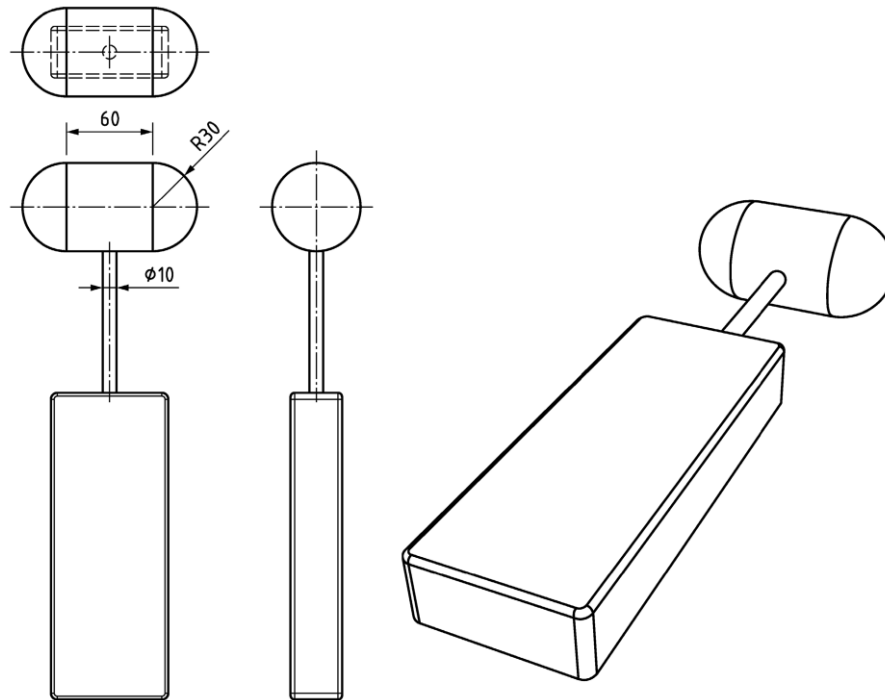


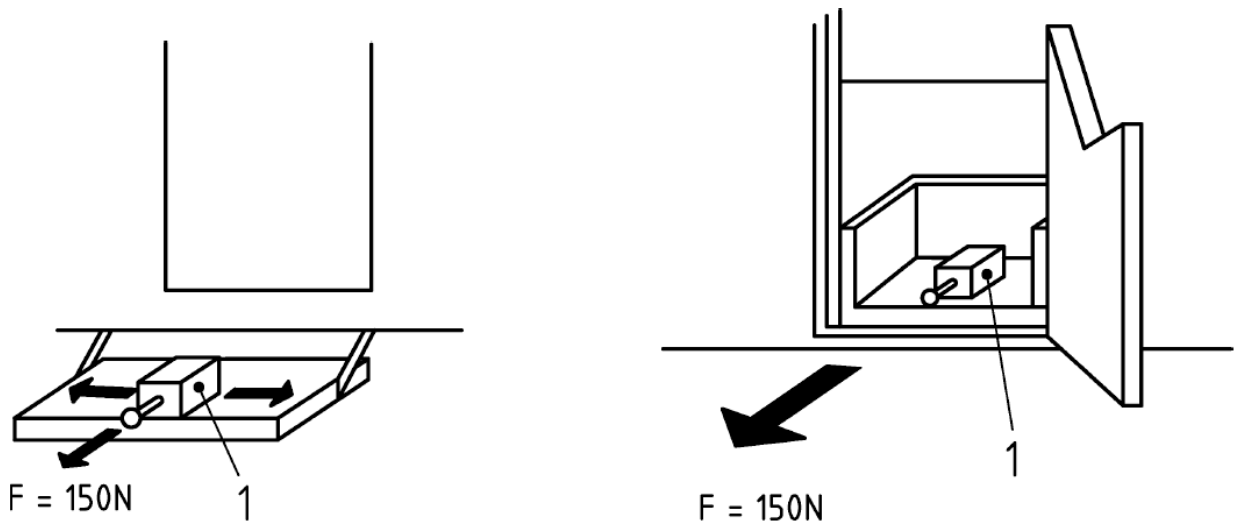
Figure 12: clenched fist device attached to a force meter

4. Slip resistance of boarding aids and rolling stock access steps

This test method is to determine the slip resistance of the surface of entrance steps, separate, attachable or integral, ramps and lifts.

4.1 Preparation and procedure

1. Place the step (separate, attachable or integral) in an horizontal position $\pm 2^\circ$ (3,5 %) (See Figure below);
2. Carry out the test at an ambient temperature of $15^\circ\text{C} \pm 10^\circ\text{C}$;
3. Roughen the surface of the rubber sole of the friction test piece once before each test by placing it on a sheet of grade 60 to 63 emery paper and pull it, at a constant rate of (150 ± 10) mm/s, a distance of 300 mm across the surface of the emery paper;
4. Spray evenly the top surface of the tread to be tested with a minimum of 1 l of drinking water immediately prior to carrying out procedures 5) and 6);
5. Place the friction test piece upon the step;
6. Apply a horizontal force of 150 N for approximately 10 s, using a load cell, to the friction test piece during which there shall be no visually discernible movement of the friction test piece;
7. The above procedure 5) and 6) shall be carried out as many times as necessary to test the complete surface of the tread(s) of the step(s).



Key

1 Friction test piece

Figure 13: Friction Test Piece shown on an external or moveable step and an integral step

4.2 Expression of results

The item under assessment shall be considered to have passed the test and, in case of a rolling stock, for its step(s) to be suitably slip resistant in accordance with the requirements if during the test there was no visually discernible movement of the friction test piece.

4.3 Test Report

A test report shall be prepared stating whether the item under assessment passed or failed the test.

The report shall state the following, if applicable:

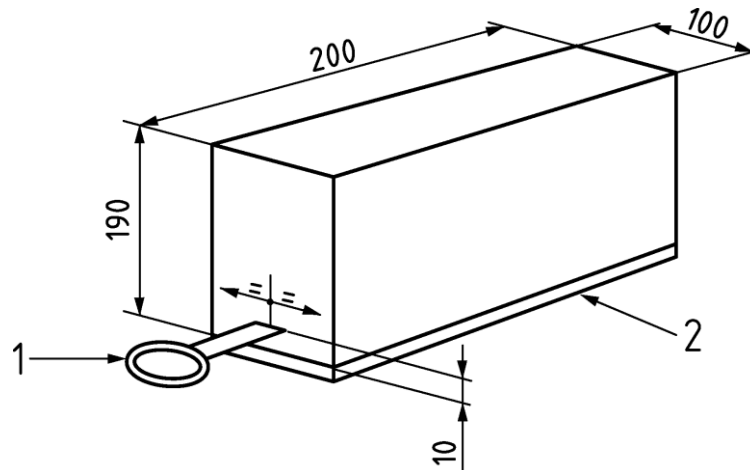
- the approximate degree of movement of the friction test piece on the step;
- the position of the friction test piece on the step when movement was discerned.

4.4 Friction test piece

The friction test piece is comprised of a 30 kg steel block, 200 mm long, 100 mm wide approximately 190 mm deep (depending on the density of the steel) with an 8 mm thick rubber sole bonded to its base. The rubber sole shall be as specified in ISO 4649:2010. A typical friction test piece is shown in the figure below.

Dimensions in millimetres





Key

- 1 Pulling hook securely attached
- 2 8 mm rubber sole

Figure 14: friction test piece

5. Stowing a baby nappy changing table (Interoperability Constituent)

Assessment should be shown to be within the normal reach of the agreed design range (e.g. 5%ile female to 95%ile male in a wheelchair) demonstrated by 3D model/drawing and relevant anthropometric data or within the reach envelopes as described in Figure L.1 of the PRM TSI.

Assessment of the stowing operation: the force required to stow the baby changing table shall not exceed 25 N. Stowing that baby changing table with only one hand should be possible.