



BSI Standards Publication

Railway applications — Driver's cab

Part 7: Design of displays for tram vehicles

National foreword

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

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European foreword

This document (EN 16186-7:2025) 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of an identical text or by endorsement, at the latest by May 2026, and conflicting national standards shall be withdrawn at the latest by May 2026.

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

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

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

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

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

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

Introduction

The requirements of this document have been developed taking into account the relevant regulations and the state of the art of tram vehicles.

The reasons for specifying the requirements are as follows:

- achieving harmonized and coherent presentation of information;
- defining Driver-Machine Interface ergonomics that is compatible with agreed interoperable specifications;
- to reduce the risk of incorrect operation by a driver working with different tram vehicles fitted with displays;
- facilitating tram vehicle operation with unified ergonomics, hence reducing the cost of driver training.

Information designed according to this standard is deemed to fulfil the following basic principles:

- be clear, correct and necessary;
- indicate its priority, whether by positioning, size, colour, sounds, sound levels, etc.;
- minimize confusion of the driver;
- prevent unnecessary distraction of the drivers' attention while performing their normal duties.

If a requirement contains an option, the choice of this option is purely up to the applicant.

NOTE 1 The term “option” is to be understood as a possibility that is usually expressed by the word “can”.

NOTE 2 In the context of this document, “tram vehicles” also means “tram-trains”.

1 Scope

This document is applicable to vehicles operating on tram networks.

This document specifies all necessary design rules and associated assessment criteria as well as guidance concerning the design of information and the corresponding user interfaces of driver's cabs of tram vehicles.

It considers the tasks the driver has to carry out and human factors. This document specifies how information is arranged and displayed.

All assessments based on the normative requirements of this document are applicable mainly to:

- symbols provided by Annex A;
- arrangement of screen areas conforming with Figure 1 (generic organization of information);
- colours, fonts;
- audible information.

This document is applicable to the following aspects:

- legibility and intelligibility of displayed information: general rules concerning the layout of information on the displays, including character size and spacing;
- definition of harmonized colours, symbols, etc.;
- definition of harmonized principles for the command interface (by physical or touchscreen buttons): size, symbols, reaction time, way to give feedback to the driver, etc.;
- general arrangements (dialogue structures, sequences, layout philosophy, colour philosophy), symbols, audible information, data entry arrangements.

NOTE If this document deals with how information can be given for operation and in degraded situations, it does not define operating rules and degraded situations.

This document does not request any safety requirement related with displayed information.

This document specifies minimum requirements and does not prevent innovative solutions.

Requirements describing the functions using the display are out of scope of this document.

2 Normative references

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

EN 16186-5:2021+A1:2023, *Railway applications — Driver's cabs — Part 5: External visibility for tram vehicles*

EN 16186-6:2024, *Railway applications - Driver's cab - Part 6: Integration of displays, controls and indicators for tram vehicles*

EN 17343, *Railway applications - General terms and definitions*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN ISO 9241-307:2008, *Ergonomics of human-system interaction — Part 307: Analysis and compliance test methods for electronic visual displays (ISO 9241-307:2008)*

ISO 2575:2021, *Road vehicles — Symbols for controls, indicators and tell-tales*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 17343, EN 16186-5 and EN 16186-6 and the following apply.

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

3.1

activated

put into a functional state following a validated input

3.2

authentication

process checking the identity of the user, device or any other element of the system or integrity of the stored, transmitted or retrieved/exposed data

Note 1 to entry: This can be a pre-requisite to access the system.

3.3

authorisation

process granting the access rights to a user, program or process, or an event or status of the system putting the system itself in hold condition which can be exited only by the action of authorised staff

3.4

brightness

attribute of a visual sensation according to which an area appears to emit more or less light

Note 1 to entry: The use of this term is not restricted to primary light sources.

[SOURCE: ISO 9241-302:2008 [1], definition 3.3.9, modified (Note added)]

3.5

button

operating element for interaction with the display (hard key, soft key, sensitive area)

3.5.1

enabled

put into a state where the function related to the button can be activated by pressing the button

3.5.2

pressed

put into a state where the action on the button is ongoing

3.6

Closed Circuit Television

CCTV

television allowing the transmission of images over a relatively short distance intended for a particular group of users

[SOURCE: IEC 60050-723-01-19 [2], modified “generally by cable” and examples removed]

3.7

display

hardware device or system that shows text and/or graphic information to the user

Note 1 to entry: The display optionally contains hard keys.

3.8

command

action executed by the personnel on the human-machine interface

3.9

consistency

maintenance of interface design choices (codes, naming, formats, procedures, etc.) in similar contexts

Note 1 to entry: see [3].

3.10

Operational Aided System Display

OASD

display that allows the driver to enter operational related information and to get real time information (tram vehicle number, route information, driver ID, track status, electronic timetable, messages, ...)

3.11

error

discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition

Note 1 to entry: An error can be caused by a faulty item, e.g. a computing error made by faulty computer equipment.

Note 2 to entry: A human error can be seen as a human action or inaction that can produce an unintended result.

[SOURCE: EN 50129:2018 [4], 3.1.13]

3.12

event

occurrence of a state at a defined precondition and time requesting attention, e.g. alarm, authentication, authorisation, fault, warning

[SOURCE: EN 15380-4:2013 [5], 3.12, modified (“requesting attention, e.g. alarm, authentication, authorisation, fault, warning” added)]

3.13

failure

<Of an item> loss of ability to perform as required

[SOURCE: EN 50129:2018 [4], 192-03-01, modified (the Notes 1, 2 and 3 to entry have been omitted)]

3.14**fault**

<in a system> state of an item characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions

Note 1 to entry: a fault is often the result of a failure of the item itself, but can exist without prior failure (e.g. in case of a design fault).

Note 2 to entry: the fault is a state characterized by inability to perform a required function.

3.15**grid array**

area consisting of pixels which results in a visual appearance of information in certain proportions

Note 1 to entry: Form and shape of the information on the screen in this standard is based on a graphical screen with a total grid array of $1\,024 \times 768$ pixels. This ratio forms the basis for all object proportions independent of resolution and size of the screen.

3.16**hard key**

physical key with permanent marking and not part of the screen area

Note 1 to entry: This permanent marking can be alpha and/or numeric and/or a symbol.

3.17**input field**

highlighted screen area for entering data

3.18**label**

symbol or text indication on or near an indicator or a button

EXAMPLE Soft key label

3.19**luminance**

physical measurement of the stimulus which produces the sensation of brightness, in terms of the luminous intensity in a given direction (usually towards the observer), per unit area, of an emitting, transmitting or reflecting surface, expressed in candelas per square metre (cd/m^2)

Note 1 to entry: It is the luminous intensity of the light emitted or reflected in a given direction from an element of the surface divided by the area of the element projected in the same direction.

[SOURCE: ISO 11064-6:2005 [7], 3.9, modified: (cd/m^2) added, notes 2 and 3 removed.]

3.20**remedy**

help and/or explanatory information related to a technical fault

3.21**RGB**

colour scheme defined in EN 61966-2-1 [8]

3.22

screen

visual result of software, implemented on a display that is devoted to interact with the user

Note 1 to entry: A screen is a set of information made of a background, windows and symbols. This information can be for example speed, distance, pressure, temperature, electric current, real time video images, which may allow or request drivers to input data through a user interface

3.23

screen area

part of display providing the screens

3.24

sensitive area

enabled area on a touchscreen on which a physical action is possible in order to give input to the display

3.25

soft key

context-dependent key consisting of a combination of a hard key and an associated screen label (text or symbol)

Note 1 to entry: This key is for multifunctional use.

3.26

status

existent or potential state of the system or actual state at a given time t

Note 1 to entry: A status can be:

- a) ON/active/up;
- b) OFF/inactive/down;
- c) excluded/isolated/inhibited;
- d) faulty;
- e) unknown.

3.27

symbol

pictorial representation (with optional digits and letters) used for displaying information

3.28

technical and diagnostic display

TDD

device that provides information and recommendations with regard to tram vehicle and/or vehicle status, diagnostics, failure management and dedicated functions of the trainset

3.29

basic screen

screen at the root of the screen hierarchy easily accessible

Note 1 to entry: Depending on the situation, the basic screen can be different (at standstill, while running, etc.).

3.30**technical specification**

document describing specific parameters and/or product requirements, which have to be agreed by contracting parties

3.31**text**

alphanumeric information

3.32**title**

text explaining the purpose of the window or screen

3.33**Train Control and Monitoring System****TCMS**

means of controlling and monitoring functions of the train internally, whether by software or hardware, and of providing information to the driver of the status of equipment on-board the train

3.34**troubleshooting**

process of structured and intentional activities in order to cope with a technical problem with support of the diagnostic system

3.35**window**

separate visual area of the screen which displays information output and may allow input

Note 1 to entry: Usually it has a rectangular shape.

4 Abbreviations**Table 1 — Abbreviations**

ACK	Acknowledgment
CCTV	Closed Circuit Television
DAC	Driver Activity Control
HSCB	High Speed Circuit Breaker
HVAC	Heating, ventilation and air conditioning
OASD	Operational Aided System Display
PAD	Passenger Alarm Device
PAS	Passenger Alarm System
TCMS	Train Control and Monitoring System
TDD	Technical and Diagnostic Display
WSP	Wheel Slide Protection

5 Requirements for display performance requirements and principles of presenting information

5.1 General guidelines

5.1.1 Robustness

Any protection against mechanical damage should not adversely affect the visibility of any displayed information.

5.1.2 Consistency of display application

Information that requires an action from the driver shall be presented only once on only one display.

Existing information shall be consistently available for all displays where relevant. Each piece of information (e.g. time) should be only shown on one display. Synchronization of identical information on different displays shall be less than 1 s.

5.1.3 Design principles

All displays and displayed applications should be designed according to consistent principles and therefore have a common approach for the user interface.

The following principles govern graphical user interface design:

- symbols should be used consistently with their meaning (same information = same symbol);
- all driving related displayed information should be located in the preferred field of vision (see EN 16186-6:2024, Figure A.2);
- visual information requiring immediate action shall be prominently displayed;
- high priority visual information shall be accompanied by an alerting tone. The number of sounds should be minimized (see 5.3.5);

NOTE 1 High priority information is information that requires immediate action by the driver.

- each window should have an explicit title;
- numerical values should be displayed using standard units and SI standard prefixes (e.g.: voltage in V, mV, kV etc.);
- when two symbols (e.g. a needle and a figure) represent the same piece of information on a screen, the same colour shall be used for both unless they physically overlap;

NOTE 2 The symbols in Annex A follow these general rules. Further information related with the symbols is provided in Annex A.

5.1.4 Principles for the provision of information

The information provided should be adapted to the phase of driving and the state of the train. The principle of “just enough” at the right time should drive the design of the screens.

TDD displaying safety information shall be developed with the appropriate safety level, if the information is not already displayed outside the TDD.

Priority information for operations should be displayed on the TDD basic screen (see C.1 for examples).

The TDD basic screen shall be accessible easily from any screen.

The TDD basic screen shall allow access to menus and submenus adapted to the operating phase (stopping, running, etc.). For example, the coupling/uncoupling submenu shall be accessible only when stopped.

For tram-trains, the following additional information shall be displayed while driving:

- traction/dynamic brake force;
- front light selection states (dimmed headlight, full headlight ...).

For additional tram-train functions, refer to EN 16186-3:2022.

The TDD should automatically switch to the appropriate TDD basic screen when new specific conditions are met (stopping, running, etc.).

Other non-priority information can be available by navigating through submenus (see C.1 for examples).

If a system is available for continuously monitoring an element, an interface shall be provided to indicate the failure of this element to the driver if the failure impacts operations, for example for:

- exterior lights (e.g. the head, marker, tail, stop, fog, day and warning lights);
- wipers;
- direction indicators (also called trafficators).

5.1.5 Suppression of information

Information that does not affect the driving task should be suppressed unless specifically selected.

5.2 Display performance requirements and principles of presenting information

5.2.1 General

All information should be organized into functional groups that contain related items of information. Such relationships should be based on logical or functional considerations:

a) Critical information

Critical information, such as alarms, should be displayed in dedicated locations. In general, the character size and colour of a particular item of information should depend on the importance of that information.

Other information should be limited in order not to overload or to distract the driver.

b) Audible information

Audible information may be used for prompting the user that input is required but, in general, audible information should be reserved for feedback or critical information.

c) Menus

If a menu structure is provided to locate different functions, the menu should:

- facilitate a selection of quick and easy options relevant for the operational task;
- provide a selection facility which allows the choice of a desired option accurately and unambiguously.

d) Feedback and response times

Visual, audio or tactile feedback should be provided at all times.

The response time of the system to an input should be rapid enough not to be perceived as a delay in the workflow.

If the response time of the system is by design longer than 600 ms for a function, and if there is no other feedback from the system, then an information should be displayed (e.g. "Wait" symbol in Table A.2 or text). If there is still no feedback from the system after a reasonable amount of time, the waiting information should disappear and the function should be ready for use again.

5.2.2 Time to change screens

Notwithstanding the processing time of the application, the maximum time to change screens should not exceed 1 s.

5.2.3 Display response time

The time between the reception of new data and the update of the screen display image should not exceed 200 ms.

5.2.4 Degradation of displays

The system shall provide feedback to enable detection of malfunction that will have an impact on the reliability of the information displayed (e.g. frozen image displayed on the screen). The time information (in s) displayed on the different screens may be used as a means to detect failures.

5.2.5 No reverse impact of a display failure

The failure of one display shall not impair the function of any other display.

5.2.6 Design of screen area

The screen area shall meet the requirements of pixel failure type 2 and shall be designed in accordance with EN ISO 9241-307:2008, Table 63.

5.2.7 Data consistency

If displays are connected by data communication, data shall be available in a consistent way for all displays.

5.3 Principles for warnings

5.3.1 Content of warnings

The content of warnings should include information on:

- a) title of the warning, its form, what it indicates and what response it requires;
- b) the level of priority;
- c) any coding systems that are employed.

Audible warning signals inside the cab should be distinctive and have loudness and sound qualities, according to their functions, urgency and importance. This principle applies for all applications in the cab.

Visual warnings inside the cab should be distinctive and have light intensities, according to their functions, urgency and importance. This principle applies for all applications in the cab.

5.3.2 Priority levels

If different levels of priority are used, e.g. high, medium, low, warnings shall be displayed accordingly.

Each level of priority shall be defined.

If different levels of audible signals are used (e.g. High, medium or low), they should be sounded accordingly.

EXAMPLE For example, four different sounds can be created, each associated with conditions which lead to specific actions required from the driver:

- conditions that require the train to be stopped immediately;
- conditions that require the train to be stopped at the next station or at another safe place;
- conditions that require action but not the requirement to stop the train;
- conditions that allow traction.

5.3.3 Warning design

The design of warnings should be consistent:

- a) The same type of event occurring should always provide the same type of warning.
- b) A specific type of warning should always require specific response(s).

5.3.4 Numbers of visual warnings

The average rate of warnings displayed in normal operation conditions should be less than one in 10 min. When driving, only 2 types of warnings are allowed to be displayed; one is for immediate stop and one is for stopping at the next station or at another safe place. Other warnings can be available at standstill.

For tram-trains, EN 16186-3:2022, 5.1.4.4 applies.

5.3.5 Principles for audible signals

Audible signals should meet all the following requirements:

- as far as practicable, be consistent in their meaning;
- be distinguishable from each other;
- be audible from all applicable driving positions and in all driving conditions;
- not cause drivers audible discomfort when sounding;
- use the selected language, if language selection is provided.

At least two different audible signals should be provided, one which requires immediate stop and one which requires stopping at the next safe place.

At most seven different audible signals should be provided. For tram-trains, the number of audible signals can be higher.

The same signal can be associated with several events if also associated with a symbol.

NOTE Either a noise or a recorded/synthesized voice is acceptable.

More information on audible signals is available in A.3.

5.4 Information on languages

5.4.1 Language selection

If the information can be displayed or sounded in different languages, the possibility to select a language shall be provided.

5.4.2 Simultaneous language selection

As an option, the selection of a language in one display may change the language in all displays accordingly.

5.5 Tram-trains

For tram-trains running on heavy rail networks, EN 16186-3:2022 applies.

6 Requirements for the design of information

6.1 General

6.1.1 General design of displayed information

EN 894-2:1997+A1:2008, 4.2.1 shall apply.

6.1.2 Common user interface

The same type of display interface should be used in a cab for all displays. For example displays with touchscreen and displays without touchscreen should not be mixed in a cab.

This could not apply to existing systems, e.g. integrations of new displays in existing driver's cab.

6.1.3 Prioritization of information

Prioritization of displayed information can be achieved by adopting the following rules:

- when running in driving mode, the sum of information such as symbols, text messages and physical values (e.g. voltage and pressure) displayed simultaneously on a single display should be within the constraints of 5.1.4;
- status of equipment not in nominal state and having an impact on the driver's tasks should be displayed;
- if an information is already available on the driver's desk, it has lower priority to appear on a display.

6.1.4 Display of indicators

Any indicator should be displayed for at least 2 s, except when a user action leads to deletion of the indicator.

6.1.5 Audible and/or visual warnings

When a system and/or function intervenes with a driver's task, an audible and/or visual warning shall be given by the display, for example a fire detection

6.1.6 Use of information

The use of symbols, standardized text messages and audible information shall comply with the requirements of this document and should comply with Annex A.

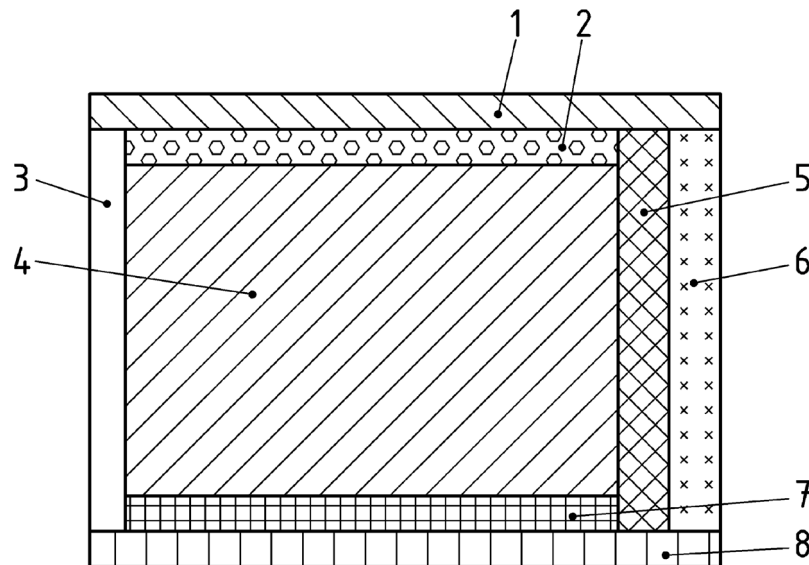
6.2 Screen organization and dimensions

6.2.1 Organization of screen information

The screen shall be organized as shown in Figure 1.

Use of optional areas and size of all areas in Figure 1 shall depend on the specific requirements of the applications using the display. Touchscreen buttons, if any, can be placed on the entire screen. If hard keys are used, Annex B should apply. TDD information should be structured according to Annex C.

For tram-trains, EN 16186-3:2022, Annex E, Annex F and Annex H shall also apply.



Key

- 1 Option: Headline (text)
- 2 Option: Status line (additional status line, preferably text)
- 3 Option: Function (soft keys¹)
- 4 Application-specific organization of information (graphic and/or text information)
- 5 Option: Status (additional status line, preferably symbols)
- 6 Option: Function (soft keys³) or status (additional status line, preferably symbols)
- 7 Option: Bottom status line(s): Symbols and text
- 8 Option: Function (soft key labels or touchscreen buttons)

Figure 1 — Display screen organization

6.2.2 Screen size

The diagonal of the screen shall be at least 10,4". The ratio should be 4:3 or 16:9 or 16:10.

6.2.3 Combination of screens

The visual appearance of displayed information shall be kept even if it is provided by a combination of screens.

6.2.4 Minimum resolution

The minimum resolution of each display shall be based on a minimum total grid array of 1 024 × 768 pixels.

¹ Preferably for navigation and validation (acknowledgement).