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Railway applications - Classification system for railway vehicles - Part 4: Function groups

Bahnanwendungen - Kennzeichnungssystematik für Schienenfahrzeuge - Teil 4: Funktionsgruppen

Applications ferroviaires - Système de classification pour véhicules ferroviaires - Partie 4: Groupes des fonctions

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Railway applications - Classification system for railway vehicles - Part 4: Function groups

Applications ferroviaires - Système de classification pour
véhicules ferroviaires - Partie 4: Groupes des fonctions

Bahnanwendungen - Kennzeichnungssystematik für
Schienenfahrzeuge - Teil 4: Funktionsgruppen

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Contents

Page

Foreword.....	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	5
4 Symbols and abbreviations	8
5 Functional structure	9
5.1 General remarks.....	9
5.2 Classification system used for functions	9
5.3 Code letters	10
5.3.1 Code letters used to designate first level function groups.....	10
5.3.2 Code letters used to designate function groups from the first to the third level	11
5.4 Transverse functions	38
Annex A (informative) Functions on level 4 and level 5.....	40
Annex B (informative) Interrelation between EN 15380-2 and EN 15380-4.....	65
Annex C (informative) Code letters used to designate detail properties	67
Annex D (informative) Rules to define the function level.....	70
Annex E (informative) Rules to create function names.....	71
E.1 General.....	71
E.2 Function terms.....	71
E.3 Rules for creating function short names	71
Bibliography	102

Figures

Figure 1 — Precept of function group indication	10
Figure B.1 — Interrelation between Function Breakdown Structure according to EN 15380-4 and Product Breakdown Structure according to EN 15380-2	66

Tables

Table 1 — Overview of 1st level functions.....	11
Table 2 — Listing of the level functions from the 1 st level to the 3 rd level.....	12
Table 3 — Listing of the transverse functions and their levelling	38
Table A.1 — Functions on level 4 and level 5	40
Table C.1 — Classification of detail properties.....	68
Table E.1 — List of function abbreviations	73

Foreword

This document (EN 15380-4:2013) 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 July 2013, and conflicting national standards shall be withdrawn at the latest by July 2013.

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This series of European Standards "*Railway applications — Classification system for railway vehicles*" consists of the following parts:

- *Part 1: General principles;*
- *Part 2: Product groups;*
- *Part 3: Designation of installation sites and locations;*
- *Part 4: Function groups (the present document);*
- *Part 5: Systems, System groups — System requirements.*

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, 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

The Functional Breakdown Structure is used by all parties involved in the rolling stock product definition phase and the following processes to structure the functional requirements and use cases according to a standardized list of functions. It starts with the concept and spreads across the whole product life cycle. During this period, the level of detail of the structure could be adapted according to the project progress. This means that functions in a product concept catalogue mainly are described by requirements. The transfer into implementable hardware and software takes place later.

The Product Breakdown Structure (PBS) shown in EN 15380-2 and the Functional Breakdown Structure (FBS) shown in EN 15380-4 complement each other. While the PBS, consisting of the standardized list of subsystems and devices, is used for structuring system requirements and related use cases, the FBS standard describes the functions of a vehicle and is used to obtain a correlation between functional requirements and the structure of functions and the related use cases. These structures describe different views on the rolling stock product. The importance of the two structures may be different according to the users' tasks as well the project stage (see also EN 15380-1:2006, Annex C).

The FBS can also be used for specifying tasks as well as for analysing tasks.

The functional assessment supports the whole engineering process and the field of RAMS/LCC (Reliability, Availability, Maintainability, Safety/Life-Cycle Costs). Often during the project process RAMS/LCC values have to be given at a stage when insufficient information regarding the technical solution is available. (At this stage of a project, EN 15380-2 is not applicable.)

In all cases in which functionality is a key issue (e.g. safety and reliability analyses, inspections and testing, maintenance programmes, field data acquisition and related documentation), communication is based on a functional vehicle structure composed of functional groups – particularly when cross-system or interdisciplinary considerations are important.

Functions are grouped into levels regardless of their vehicle specific technical realisation. Hence the function groups and function descriptions were developed without considering how each function may be achieved in practice. This is consistent with the EN 81346 series. This also applies when the functional vehicle breakdown structure is met in tracing vehicle properties, for example during the validation phase. Many of the required properties fixed in the product concept catalogue are realised, diagnosed and rated as functioning or malfunctioning during operation. Only afterwards is the link made to the physical structure and then to the assessment of the function of technical solutions.

There is not necessarily a simple one to one relationship between each function and its technical realisation. A system or item of equipment can contribute to different functions at the same time or in sequence. This means that an entity can be related to different functions and even from different levels (see Annex A).

Assignment of examples for well known function carriers are given for easier understanding.

1 Scope

This European Standard is concerned with the functions associated with general railway vehicles or their assemblies. It covers functionality associated with systems and equipment such as wheelsets and bogies, doors, brakes and traction.

This standard may also be applied to railway vehicles with very specific functions like track machines and snow ploughs. However, while the functions that are common with general railway vehicles are included, the functions which are specific to their work processes are not included in this standard. They will be added for these individual projects.

2 Normative references

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

EN 15663, *Railway applications — Definition of vehicle reference masses*

3 Terms and definitions

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

3.1 function

specific purpose or objective to be accomplished, that can be specified or described without reference to the physical means of achieving it

[SOURCE: IEC 61226:2009]

Note 1 to entry: A function transfers (considered as a black-box) input parameters (material, energy, information) into aim related output parameters (material, energy, information) performed by technical means and/or human beings.

3.2 transverse function

sub function which may apply to more than one higher level function

Note 1 to entry: For example, providing diagnostics or displaying information.

3.3 Functional Breakdown Structure (FBS)

hierarchical structure summarising a set of functions leading to the same general focus or service

Note 1 to entry: To define the level of a function within a FBS, see Clause 5.

3.4 function level

level of group functions of equal purpose

Note 1 to entry: Assignment to the appropriate level is described in the rules.

3.4.1 1st level function

functional domain or general focus or service for the considered (rolling stock) system

EN 15380-4:2013 (E)

Note 1 to entry: In general, the first level function encompasses a set of functions related to a same general focus or service for the considered (rolling stock) system.

EXAMPLE Provide appropriate conditions to passengers, train crew and load.

3.4.2**2nd level function**

main function which contributes to complete the first level

Note 1 to entry: In general, the 2nd level function encompasses a set of sub functions and contributes to the completion of the first level.

Note 2 to entry: If the next level of the functional domain is not related to a main function there could be a direct relation to a lower level function.

3.4.3**3rd level function**

sub function which contributes to complete the 2nd level

Note 1 to entry: In general, the 3rd level function encompasses a set level 4 functions (usually tasks) and contributes to the completion of the second level.

Note 2 to entry: If the next level of the main function is not related to a sub function there could be a direct relation to a lower level function.

3.4.4**4th level function**

function related to a task which contributes to complete the third level

Note 1 to entry: In general, the 4th level function encompasses a set of level 5 functions (usually activities) and contributes to the completion of the third level.

Note 2 to entry: If the next level of the sub function is not related to a task there could be a direct relation to lower level function (activity).

3.4.5**5th level function**

function related to an activity necessary for performing the 4th level function

3.5**requirement**

necessary condition or ability to constrain the solutions of a task or an aim

Note 1 to entry: A requirement describes for example, performance characteristics, operational conditions and quality attributes, expressed as measurable and testable technical parameters or indicators.

Note 2 to entry: Requirements are usually summarised in a specification.

Note 3 to entry: Beside requirements allocated to functions are additional requirements allocated to other features (e.g. design, manufacturing).

3.5.1**functional requirements**

specific need or capability of a FBS function

Note 1 to entry: Functional requirements and use cases first come from passenger/payload and operator requests. Later in the engineering process, functional requirements from integrators and suppliers are added. They express the requirements on a certain functionality given in the FBS regarding interoperability (with other functions), safety, operation, function/behaviour, or functional architecture/design constraints.

The functional designation is usually stated more precisely by detail properties (see also Annex D) that provide more information referring to reliability, availability, performance, quality, documentation, input, output, realtime.

These stated higher-level functional goals for ambient conditions, design features and selected target groups/target objects are “requirements to a function”.

Note 2 to entry: In the FRS associated to a function at level 2 or below, the functional requirements met by the transverse functions are listed for each transverse function.

3.5.2

system requirement

requirement on a subsystem or device

Note 1 to entry: Requirement on a subsystem or device regarding the requested technical capability, reliability, availability, maintainability, environmental impact/conditions (recyclables, emissions, EMC, climate, vibration), safety, LCC, performance, quality, documentation, realtime behaviour, physical limits (dimension, weight), electrical interface (plugs, voltage, physical layer), or mechanical interface (fixing points, fixing method).

3.6

scenario

possible transient, unsteady or steady states of the regarded system or of system-user interaction including environmental or other influences

Note 1 to entry: Operational and environmental conditions under which the system is intended to or actually functions.

3.7

use case

summary of scenarios for a single task or goal from the view of an exterior observer under defined conditions

3.8

object (unit of observation)

component, element, device, subsystem, functional unit, operating medium or system that can be observed in its own right

[SOURCE: EN 15380-2:2006]

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3.9

error

deviation from the intended design which could result in unintended system behaviour or failure

[SOURCE: EN 50129:2003]

Note 1 to entry: An error needs corrective action. It is caused by defect component and can be displayed to the driver or workshop. An error can lead to a failure.

Note 2 to entry: An error also is a discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition, e.g. a computing error made by faulty computer equipment.

3.10

fault

abnormal condition which could lead to an error in the system

Note 1 to entry: A fault can be random or systematic.

[SOURCE: EN 50129:2003, modified]

3.11

failure

deviation from the specified performance of a system

[SOURCE: EN 50129:2003]

Note 1 to entry: A failure also is a deviation from specified performance of a function.

EN 15380-4:2013 (E)

Note 2 to entry: A failure may be the consequence of a fault or error in the system.

**3.12
event**

occurrence of a state at a defined precondition and time

**3.13
monitoring**

independent real-time observation of system, consist and train states (in cases also based on combinatory logic) for manual or automatic operation

Note 1 to entry: Monitoring is often safety related, partly mission critical.

**3.14
protocol event**

recorded event which is not the result of a fault, failure or error

Note 1 to entry: A protocol event is often used to store driver actions.

**3.15
alarm**

event requiring driver interaction, with a defined priority

Note 1 to entry: The event may be generated by man or machine.

Note 2 to entry: "Man" in this specific context means passenger, train crew or maybe control operator.

**3.16
elementary function**

basic function which cannot be sub-divided

Note 1 to entry: An elementary function is not specific to a particular rail vehicle.

**3.17
function carrier**

physical unit of observation to fulfil or partly fulfil one or more required functions

Note 1 to entry: Function carriers need to be considered as black box while describing the function.

4 Symbols and abbreviations

FBS	Functional Breakdown Structure
FRS	Functional Requirement Specification
HMI	Human-Machine-Interface
PBS	Product Breakdown Structure
RAMS	Reliability, Availability, Maintainability and Safety
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
DC	Direct Current

EMC	Electromagnetic Compatibility
HVAC	Heating, Ventilation and Air Conditioning
LCC	Life Cycle Costs
RFID	Radio Frequency Identification
UWC	Universal Water Closet

5 Functional structure

5.1 General remarks

The hierarchy of the functional groups serves as a guideline when creating functional structures. Functions are realised at the technical level as hardware and software within hierarchically structured units. Although the units interact at the functional level, they may be spatially separated from one another.

Expanding the functions, elementary functions and characteristic features is possible within the scope of this standard. Whether it is necessary to make use of this option will depend on the specific application being considered.

Changing the existing functional levels shall be avoided.

Functional units can be associated with several functions. A single function can be distributed over several functional units.

The FBS is organised in such a way that the whole driver interface functionality is described under HE "Allow proper control". This driver interface functionality does not contain any control functionality itself. It only provides information to the driver, including the status signals from other functionalities.

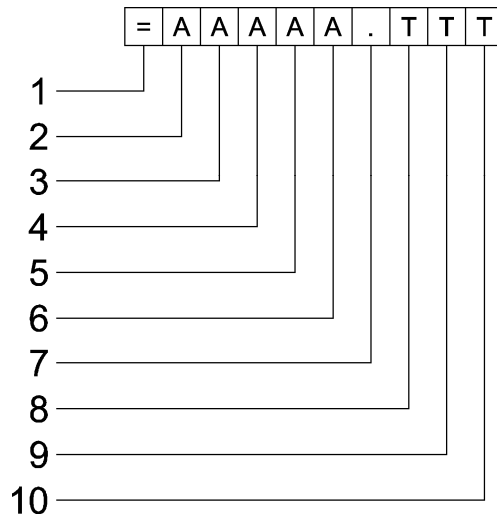
5.2 Classification system used for functions

Functions are designated using letters of the alphabet only, as set out in Table 1, Table 2 and Table 3. The use of the letters I and O, as well as special characters and separators, have not been used.

The first level functions, functions on lower levels and transverse functions are coded in their respective levels using a single letter. If transverse functions are applicable for each function several lines with related transverse function can be added in following way = AAAAA.TTT, AAAAA.TTT, where AAA is the identifier for FBS and TTT is the identifier for transverse function found in Table 3. If a transverse function is not used the identifier for FBS is = AAAAA.

The classification systems can be used either in whole or in part. As a minimum it is recommended to use it from level 1 to level 5.

EN 15380-4:2013 (E)

**Key**

- 1 sign "function" according to EN 81346-1
- 2 level 1 function according to 5.3.1
- 3 level 2 function according to 5.3.2
- 4 level 3 function according to 5.3.2
- 5 level 4 function according to Annex A
- 6 level 5 function according to Annex A
- 7 separator between function and transverse function
- 8 level 1 transverse function according to 5.4
- 9 level 2 transverse function according to 5.4
- 10 level 3 transverse function according to 5.4

Figure 1 — Precept of function group indication

5.3 Code letters**5.3.1 Code letters used to designate 1st level function groups**

The first level functions are specified using the letters as listed in Table 1.

Table 1 — Overview of 1st level functions

Indication of 1 st level function	1 st level function
B	Carry and protect passenger, train crew and load
C	Provide appropriate conditions to passenger, train crew and load
D	Provide access and loading
E	Connect vehicles and/or consists
F	Provide energy
G	Accelerate, maintain speed, brake and stop
H	Provide train communication, monitoring and control
J	Support and guide the train on the track
K	Integrate the vehicle into the complete system railway

5.3.2 Code letters used to designate function groups from the 1st to the 3rd level

The functions and function levels are specified using the letters as shown in Table 2.

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Table 2 — Listing of the level functions from the 1st level to the 3rd level (1 of 26)

Level				Function (level 1 to level 3)	Example / explanation
1	2	3			
B				Carry and protect passengers, train crew and load	ride comfort is not considered here; the load shall be defined according to design mass calculation in EN 15663
B	B			Arrange interior space	interior design
B	B	B		Provide floor and flooring	non slip floor covering
B	B	C		Provide roof and roofing	
B	B	D		Provide partitioning	interior and exterior walls or screens, interior doors
B	B	E		Provide lining and panelling	ceilings and wall coverings
B	B	F		Provide acoustic/thermal insulation	
B	B	G		Provide luggage storage space in the vehicle	space for hand luggage, travel luggage, bicycles, prams and pushchairs and cloakroom facilities
B	B	H		Carry and secure accompanying object	luggage racks, cycle rack stands, lockers
B	B	J		Provide access to upper levels and user zones	staircases
B	C			Carry and enclose the load	(including people and equipment)
B	C	B		Fasten equipment / load	attachments
B	C	C		Enclose the load	encase the load to be transported
B	C	D		Carry and Protect the load	carbody structure to support normal structural loads
B	C	E		Protect installed equipment / components	
B	D			Protect in case of crash	
B	D	B		Absorb crash energy	energy dissipation in vehicle structure, crash safety
B	D	C		Protect driver, crew and passengers inside their compartments	against intrusions, against pitch on the desk, against structural deformations
B	D	D		Limit deceleration	
B	D	E		Prevent vehicle override	equipment to prevent vehicle override during head-on collisions
B	E			Protect against fire	
B	E	B		Manage / Provide smoke detection	by smoke detectors
B	E	C		Manage / Provide fire detection	
B	E	D		Manage signalling of fire	management of fire alert (system), fire warning (system), notification of fire
B	E	E	a	Manage / Provide-fire extinguishment	
B	E	E	a	Manage automatic fire extinguish system	
B	E	E	a	Monitor volume of extinguishing agent	
B	E	E	a	Provide manual fire extinguish facilities	

C				Provide appropriate conditions to passenger, train crew and load	includes equipment for service, comfort and climatisation; the load shall be defined according to design mass calculation in EN 15663
C	B			Provide safe and comfortable sitting, lying and standing positions	seats, couchettes, measures taken to ensure safe standing room
C	B	B		Provide support for standing	support straps, handles and rails, occupant restraint systems
C	B	C	a	Provide seating possibilities	seats, benches, stools
C	B	C	a	Provide ergonomic seating conditions	
C	B	C	a	Provide adjustments of position	

Table 2 — Listing of the level functions from the 1st level to the 3rd level (2 of 26)

Level				Function (level 1 to level 3)	Example / explanation
1	2	3			
C	B	C	a	Provide storage space in the back of the seat	
C	B	C	a	Provide tables	
C	B	D	a	Provide lying possibilities	
C	B	D	a	Provide ergonomic lying conditions	
C	B	D	a	Provide adjustments of lying positions	
C	B	D	a	Provide storage space at the table position	
C	C			Provide external view	
C	C	B	a	Ensure outside passenger view	by windows
C	C	B	a	Ensure outside view	
C	C	B	a	Protect passenger against sun	
C	C	C	a	Provide external view for train operation	by outside mirror or cameras (in any weather / light conditions)
C	C	C	a	Clean the windscreen	
C	C	C	a	Defrost the windscreen	
C	C	C	a	Protect against blinding	
C	C	C	a	Avoid condensation	
C	C	C	a	Provide rear view	
C	C	C	a	Provide view in the darkness	by illumination of the track and reflective signals by headlights
C	D			Provide interior lighting	
C	D	B	a	Provide workplace lighting	
C	D	B	a	Provide desk lighting	
C	D	B	a	Provide timetable lighting	
C	D	B	a	Provide "background" lighting	
C	D	C	a	Provide common interior lighting	
C	D	C	a	Provide interior standard lighting	
C	D	C	a	Provide reduced mode lighting	
C	D	C	a	Provide atmosphere lighting	
C	D	D	a	Provide emergency lighting	
C	D	D	a	Provide guidance to exit	
C	D	D	a	Provide backup lighting	
C	D	E	a	Provide special/individual lighting	
C	D	E	a	Provide reading lighting	lighting at the seat
C	D	E	a	Provide working lighting	
C	D	E	a	Provide sanitary (make-up) lighting	
C	D	E	a	Provide advertisement lighting	
C	E			Provide proper climate	