TECHNICAL STANDARDS
DETAILED TECHNICAL CONDITIONS FOR THE CONSTRUCTION OF THE RAILWAY INFRASTRUCTURE OF THE SOLIDARITY TRANSPORT HUB – DESIGN GUIDELINES

VOLUME VI.2
CONTROL COMMAND AND SIGNALLING – EUROPEAN TRAIN CONTROL SYSTEM (ETCS)

Version 1.3.0, closed on 05.08.2021

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List of volumes constituting the detailed technical conditions for the construction of railway infrastructure of the Solidarity Transport Hub:

Volume A	Introduction to the STH railway standards
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Volume VI.1	Control command and signalling – basic equipment
Volume VI.2	**Control command and signalling – European Train Control System (ETCS)** It defines principles and indicates guidelines according to which, the design engineer, basing on received guidelines and data from STH infrastructure manager, prepares the design, the execution of which must be authorised by the European Railway Agency (ERA)
Volume VII.1	Fixed and wireless communication systems and data transmission
Volume VII.2	Telecommunication systems and telematics
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Volume XVIII	Security, protection and cybersecurity integrity requirements

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1) Introduction

This volume VI of the Technical Standards – Design Guidelines is one of 30 volumes containing a description of detailed technical conditions for construction of railway lines up to a speed of Vmax ≤ 350 km/h.

1.1. Technical scope

In view of its size and complexity, the rail system operating within the European Union has, from a practical point of view, to be divided into the following structural subsystems: infrastructure, trackside control command and signalling, on-board control command and signalling, energy, rolling stock and functional subsystems: operation and traffic management, maintenance and telematics applications for passenger and freight services.[1] For each of these subsystems, it is necessary to specify the essential requirements and technical specifications specifically for the components and interfaces in order to meet these essential requirements.

In addition, it should be borne in mind that the same system is divided into fixed and movable goods, which, on the one hand, include a network composed of lines, stations, terminals and all types of fixed equipment necessary to ensure safe and uninterrupted operation of the system and, on the other hand, all vehicles moving on this network. With regard to the foregoing, when considering traction vehicles, in accordance with [1], we make a reference to one subsystem (rolling stock) which is supplemented, where necessary, by other subsystems (primarily the control command and signalling subsystem that is on board the vehicle). When adopting the subsystems described this way in Directive (EU) 2016/797 of the European Parliament and of the Council of 11 May 2016 on the interoperability of the rail system within the European Union, the considerations of this volume should refer to the elements comprising the subsystem defined as follows:

- ✓ trackside control command and signalling covering any trackside equipment necessary to ensure safety and control of train movements on the network;
- ✓ on-board control command and signalling covering any on-board equipment necessary to ensure safety and control of train movements on the network.

The definition of the control-command and signalling subsystem presented above, indicated in the provisions of the Directive, in the documents implementing this document, i.e. Commission Regulations (EU) [3] as amended [4]÷[7], with the simultaneous clarification of the provision – trains authorised to travel (instead of trains) – is used in the technical specification for interoperability in the field of control-command and signalling subsystems. Changes made to [3], among others by [4] , specified in more detail the elements to which the given parts refer:

- ✓ trackside control command and signalling equipment covering train control, voice radio communication, radio data exchange, train detection;
- ✓ on-board control command and signalling equipment covering train control, voice radio communication, radio data exchange;

which changed the definition used previously in [3] , without specifying the part (trackside, on-board) to which the subsystem refers.

Additionally, the provisions of [4] that implemented the division of the Control Command and Signalling subsystem into two parts specified the scope of types of traction vehicles to be equipped with interoperable on-board equipment classified as:

- ✓ locomotives and passenger rolling stock, including thermal and electric traction units, thermal and electric passenger trains and coaches if equipped with a driver's cab;
- ✓ special vehicles, such as track machines, if fitted with a driver's cabin and intended for use in transport mode on their wheels.

The division indicated above and adopted in for the railway system was also transferred to the domestic law, which identically divides the railway system into the aforementioned subsystems in the *Railway Transport Act*[1]. In its description, this document [15] does not specify a literal definition of individual railway subsystems. Similarly, the descriptive definition dedicated to Control Command and Signalling subsystem is not specified in the documents implementing the Act[15]. However, the individual documents indicate literal references to the types of control command and signalling equipment that must be supervised by the relevant documents. Thus, in accordance with the provisions of the *Regulation of the Minister of Infrastructure and Development on the approval for operation of certain types of structures, equipment and railway vehicles* [8], the structural subsystem "control command and signalling" includes the types of control command and signalling equipment assigned to:

a. station control command and signalling equipment,
b. switching control equipment, including rail-brake,
c. line block system equipment,
d. traffic protection system for level crossings,
e. equipment for detection of emergency conditions of railway vehicles during train run and irregularities in rail car loading,
f. track and turnout occupancy control equipment:
   - track circuits,
   - axle-counters,
g. equipment for shifting or controlling the moving elements of railway turnout,
h. railway signalling device,
i. Fixed and wireless communication equipment, including for train signalling, guard and station operating control point, except for digital radio communication system (GSM-R) equipment,
j. wireless communication equipment, including train, shunting, road and maintenance equipment, except for digital radio communication system (GSM-R) equipment,
k. recorder of talks related to railway traffic operation,
l. track-vehicle impact equipment,
m. train control equipment,
n. closed circuit television system for railway traffic operation,
o. remote control command and signalling system.

In connection with the adopted industry division of this study, the reference to a part of the aforementioned sub-points will be included in the description of this volume and the other one – in the relevant dedicated industry volumes.

In addition to the groups of control command and signalling equipment types indicated in [8], in the provisions of the *Regulation of the Minister of Infrastructure and Construction on the interoperability of the rail system* [12] the terms referring to the following are introduced into formal circulation:

- ✓ ERTMS – European Rail Traffic Management System including ERTMS/ETCS and ERTMS/GSM-R systems,
- ✓ ERTMS/ETCS[1] – system that allows the driver to control the train,
- ✓ ERTMS/GSM-R[2] – designed for rail traffic, digital, terrestrial radio communication system ensuring voice communication between employees working on trains and ensuring transmission of data related to railway traffic management,

[1] According to [1], the formal name is ETCS
[2] According to [1], the formal name is GSM-R

- ✓ STM – specific transmission module that mediates between ERTMS/ETCS on-board equipment and:
  - control command system operated on Polish railway lines, belonging to the class of automatic warning systems, i.e. Automatic Train Braking (SHP) system, and,
  - RADIOSTOP function – an area braking function – operated on the Polish railway lines.

Apart from these indications of the systems to be used in connection with the implementation of an interoperable system, this document [12] also defines the interoperability constituents assigned to the control-command and signalling subsystem with regard to:

- ✓ on-board equipment:
  - p. on-board ERTMS/ETCS,
  - q. odometric equipment,
  - r. external STM interface,
  - s. cabin ERTMS/GSM-R transceiver,
  - t. GSM-R radio for ERTMS/ETCS data transmission,
  - u. ERTMS/GSM-R SIM card,
- ✓ track-side equipment:
  - v. RBC radio control command and signalling centre,
  - w. radio in-fill unit,
  - x. Eurobalise,
  - y. euroloop,
  - z. Eurobalise encoder,
  - aa. euroloop encoder.

In connection with the adopted industry division of this study, the reference to a part of the aforementioned sub-points will be included in the description of this volume and the other one – in the relevant dedicated industry volumes.

When analysing the above-mentioned terms indicating the scope of the control command and signalling subsystem area, we can generally say that the purpose of control command and signalling is to ensure safety of (railway) vehicle movements on the railway network and required efficiency in a technically justified manner. When considering the categories of lines, we take into account their division into speed categories depending on the type of rail traffic, i.e. passenger, mixed or freight traffic. Line classification is considered as a whole, i.e. the open line and operating control points, therefore in some sections a situation occurs in which the permissible speed is lower than the one assigned for the line category – this applies mainly to stations. In such cases, the track systems and signalling in the station are designed for the maximum achievable speed for a given line category. Therefore, in further analyses carried out under this volume, on the basis of the list of categories of railway lines described in Volume I.1 Railway track – Layout geometry, studies executed in relation to the issues related to control command and signalling – the European Train Control System ETCS will be carried out in areas of railway lines in accordance with the adopted category described in the table below.

Table 1. STH railway line categories

Parameter	Railway line category					
	Passenger traffic			Mixed traffic		
	CPK-P1	CPK-P2	CPK-P3	CPK-M1	CPK-M2	CPK-M3
Maximum speed of passenger trains ($v_{max,p}$) [km/h]	250 ÷ 350	200 ÷ 250	120 ÷ 200	250 ÷ 350	200 ÷ 250	120 ÷ 200
Maximum speed of freight trains ($v_{max,t}$) [km/h]	-	-	-	100 ÷ 160	100 ÷ 160	100 ÷ 160
Minimum speed (v_{min})	$min\begin{cases}0.5 \cdot V_{max}\\160\ \mathrm{km/h}\end{cases}$	0.5 v_{max}	100 km/h	100 km/h	80 km/h	80 km/h
Control system	Control command and signalling equipment related to ETCS	Control command and signalling equipment related to ETCS	Control command and signalling equipment related to ETCS	Control command and signalling equipment related to ETCS	Control command and signalling equipment related to ETCS	Control command and signalling equipment related to ETCS
Communication system	GSM-R	GSM-R	GSM-R	GSM-R	GSM-R	GSM-R

The reference to another industry volume presented above, while using the information contained therein in relation to the control command and signalling volume in relation to ETCS, is not the only one included in this document. As already mentioned above, due to the accepted industry division of this study, reference to a part of the provisions will require:

- ✓ reference to specific provisions of this volume,
- ✓ reference to specific provisions of this volume with simultaneous link to provisions included in other industry volumes,
- ✓ finding information related to the control command and signalling subsystem in other industry volumes, or
- ✓ lack of description of issues in individual industry volumes.

The above-mentioned situations also occur in relation to this volume. A preliminary analysis defining the control-command and signalling subsystem showed numerous subsections (a ÷ aa), which require a detailed description for each area. According to those provisions, due to the fact that there are no areas on the railway infrastructure of the Solidarity Transport Hub indicated in subsection b, within the scope of this volume, the content of which should be read together with the provisions of volume VI.1 Control command and signalling – basic equipment, as well as other industry volumes, issues related to this area will not be described by any requirements.

The overall thematic scopes of areas described in subsection e are presented in the description of volume VII.3 on diagnostics of rolling stock failure conditions (DSAT), while subsections i, j, k and GSM-R requirements are covered under volume VII.1 on fixed and wireless communication systems and data transmission.

As part of implemented studies related to the definition of requirements, in some cases, it is necessary to correlate the provisions between different industry volumes. Such situations may occur in relation to subsections d, n, for which subject areas (if envisaged on the STH infrastructure) requirements will be described in volume VI.1 Control command and signalling – basic equipment, but in relation to the whole subject matter the below specified requirements will have to be correlated with the requirements contained in the description of volume V.1 and volume V.2 concerning non-public roads and public roads. The same situation should occur in relation to the issues described in subsection s, t, u, where the description of the requirements indicated in volume VII.1 related to fixed and wireless communication systems and data transmission correlates with the provisions of this volume on control command and signalling – ETCS, and the combined description of the requirements for the on-board control-command and signalling subsystem (subsections p ÷ u) should take into account the correlation with the provisions of volume XVI related to rolling stock. Another case, which is related to the trackside

control-command and signalling subsystem, and which will not be described in this industry volume, is that described in volume XI on electromagnetic compatibility (EMC), the provisions of which will be of key importance in the indicated requirements for control command and signalling of the ETCS part not covered by the relevant specifications.

Other subsections not listed above from the indicated scope a ÷ z, are described in detail in the following subsections of this industry volume.

Additionally, the provisions in relation to the works executed in accordance with this volume do not release the design engineer from interdisciplinary co-ordination in relation to other design areas not indicated in the above-mentioned description, and they oblige to co-ordinate them in relation to the existing links to other volumes of Technical Standards, as indicated in sub-chapter 1.2.

1.2. Links to other volumes

The links between this Standards volume and other volumes are presented in Table 2.

Table 2. Links to other volumes

Volume No	Volume title	Relation content
A	Introduction to STH railway standards	
I.1	Railway track – layout geometry	Mapping of track layouts based on guidelines indicated in this volume in the designed ETCS
I.4	Railway track – gauge	Compliance with the indicated gauge guidelines for the external equipment of the designed ETCS
II.1	2 x 25 kV 50 Hz AC overhead catenary system and traction power supply	Mapping of the overhead catenary system described in this volume in the designed ETCS, including the protection of entry of vehicles powered by other voltage
II.2	3 kV DC overhead catenary system and traction power supply	Mapping of the overhead catenary system described in this volume in the designed ETCS, including the protection of entry of vehicles powered by other voltage
III.1	Engineering structures	Mapping of engineering structures described in this volume in the designed ETCS with a protection against stopping in hazardous locations
III.2	Tunnels	Mapping of engineering structures described in this volume in the designed ETCS with a protection against stopping in hazardous locations
IV	Non-OCL power engineering solutions	Inclusion of requirements for power supply of equipment according to this volume
VI.1	Control command and signalling – basic equipment	Linking requirements for basic equipment of the control command and signalling described in this volume to the designed equipment of the control command and signalling subsystem – ETCS trackside equipment
VI.1	Control command and signalling – basic equipment	Linking requirements for basic equipment of the control command and signalling (axle counters) described in this volume to the designed equipment of the control command and signalling subsystem – ETCS trackside equipment for train detection.
VI.1	Control command and signalling – basic equipment	Mapping requirements for basic equipment of the control command and signalling (indicators) described in this volume to the designed equipment of the control command and signalling subsystem – ETCS trackside equipment

Volume No	Volume title	Relation content
VII.1	Fixed and wireless communication systems and data transmission	References to this volume indicating GSM-R system requirements for fixed and wireless communication systems and data transmission, which are the basic medium for data and voice transmission in the designed ETCS
VII.3	Detection of rolling stock failure conditions (DSAT)	Mapping of inclusion of the provision of information from DSAT systems described in this volume in the designed ETCS
VIII.2	Technical buildings	Inclusion of information about the need to provide required space for the designed ETCS internal equipment in the industry designs related to the technical building volume
VIII.3	Structures	Mapping of platforms described in this volume in the designed ETCS system when trackside information is used to control the traction vehicle functions
XI	Electromagnetic compatibility (EMC)	Fulfilment of the indicated EMC guidelines in relation to the equipment of the designed ETCS, which are not covered by the TSI documents describing these issues both for the trackside control-command and signalling subsystem and for the on-board control-command and signalling subsystem
XIII	Technical support facilities	Mapping of the track layout described in this volume in the designed ETCS
XVI	Railway rolling stock	Reference in this volume to the description of the on-board control-command and signalling subsystem contained in volume VI.2 describing the ETCS as a whole
XVIII	Security, protection and cybersecurity integrity requirements	Inclusion of security and cybersecurity integrity requirements in this volume

1.3. Definitions of terms used

1) Trackside Control-Command and Signalling subsystem

Any trackside equipment necessary to ensure the safety and control of train traffic on the network.

[as defined in Directive (EU) 2016/797 of the European Parliament and of the Council]

2) On-board Control-Command and Signalling subsystem

Any on-board equipment necessary to ensure the safety and control of train traffic on the network.

[as defined in Directive (EU) 2016/797 of the European Parliament and of the Council]

3) Trackside Control-Command and Signalling subsystem

Any trackside equipment necessary to ensure the safety and traffic control of the traffic of trains authorised to run on the network.

[as defined in Commission Implementing Regulation (EU) 2019/776]

4) On-board Control-Command and Signalling subsystem

Any on-board equipment necessary to ensure the safety and control of the traffic of trains authorised to run on the network.

[as defined in Commission Implementing Regulation (EU) 2019/776]

1.4. Abbreviations of terms used

With reference to this industry volume, the provisions of individual paragraphs may include used abbreviations which are explained in the table below.

Table 3. List of abbreviations for the industry volume on control command and signalling and ETCS

Abbreviation	Explanation
CCO	Control Command On-board
CCS	Control Command and Signalling
CCT	Control Command Trackside
EMC	Electromagnetic Compatibility
ERA	European Union Agency for Railways
ERTMS	European Rail Traffic Management System
ESC	ETCS System Compatibility
ETCS	European Train Control System
ETCS-ID	ETCS identifier
FS	Full Supervision
GSM-R	Global System for Mobile Communications for Railways
IS	Isolation
LEU	Lineside Electronic Unit
LS	Limited Supervision
NL	Non Leading
NP	No Power
OS	On Sight
PS	Passive Shunting
PT	Post Trip
RAMS	Reliability, Availability, Maintainability, Safety
RBC	Radio Block Centre
RINF	Infrastructure Register
RSC	Radio System Compatibility
RV	Reversing
SB	Stand By
SE	STM European
SF	System Failure
SH	Shunting
ATS	Automatic Train Stop
SIM	Subscriber Identity Module (as a SIM card)
SN	STM National
SL	Sleeping
SR	Staff Responsible
CCS	Control Command and Signalling
STM	Specific Transmission Module
THR	Tolerable Hazard Rate
LCDWS	Level Crossing Distant Warning Signal
TR	Trip
TSI	Technical Specifications for Interoperability

2) Essential, basic and general requirements for the STH railway infrastructure

Table 4 defines the link between the detailed technical conditions and the essential, basic and general requirements for the STH infrastructure

Table 4. Essential and general requirements.

sub-chapter of this volume defining detailed technical conditions	essential requirements (Railway Interoperability Directive)						basic requirements	general requirements for the STH railway infrastructure			
	1.1. security	1.2. reliability and availability	1.3. health	1.4. environmental protection	1.5. technical compliance	1.6. accessibility	2.1. mechanical resistance and stability 2.2. fire safety 2.3. hygiene, health and the environment 2.4. safety and accessibility in use 2.5. protection against noise 2.6. energy economy and heat retention 2.7. sustainable use of natural resources	3.1. orientation towards the needs of economy	3.2. orientation towards the needs of passengers	3.3. orientation towards the needs of carriers	3.4. compatibility with the railway infrastructure connected with the STH railway infrastructure
3.1.1	1.1.1 1.1.3 1.1.5 1.1.6 1.1.8 1.1.9 1.1.10 1.1.11	1.2.1 1.2.3	1.3.1 1.3.3	1.4.1 1.4.7	-	-	-	-	-	-	-
3.1.2	1.1.1 1.1.3 1.1.5	1.2.1	-	1.4.1	-	-	-	-	-	-	-
3.1.3	1.1.1 1.1.3 1.1.5 1.1.8	1.2.1	1.3.1	1.4.1	1.5.1	-	-	-	-	-	-
3.1.4	1.1.1 1.1.3 1.1.5 1.1.8	1.2.1	1.3.1	1.4.1	1.5.1	-	-	-	-	-	-
3.1.5	1.1.1 1.1.3 1.1.5 1.1.8	1.2.1	1.3.1	1.4.1	1.5.1	-	-	-	-	-	-
3.1.6	1.1.1 1.1.3 1.1.5 1.1.8	1.2.1	1,.3.1	1.4.1	1.5.1	-	-	-	-	-	-
3.1.7	1.1.1 1.1.2 1.1.3 1.1.5	1.2.1	1,3.1	1.4.1	1.5.1	-	-	-	-	-	-
3.2.x	1.1.1 1.1.3 1.1.5 1.1.8	1.2.1	1.3.1 1.3.3	1.4.1	1.5.1		-	-	-	-	-
4.1.1	1.1.1	-	-	-	-	-	-	-	-	-	3.4.1

sub-chapter of this volume defining detailed technical conditions	essential requirements (Railway Interoperability Directive)						basic requirements	general requirements for the STH railway infrastructure			
	1.1. security	1.2. reliability and availability	1.3. health	1.4. environmental protection	1.5. technical compliance	1.6. accessibility	2.1. mechanical resistance and stability 2.2. fire safety 2.3. hygiene, health and the environment 2.4. safety and accessibility in use 2.5. protection against noise 2.6. energy economy and heat retention 2.7. sustainable use of natural resources	3.1. orientation towards the needs of economy	3.2. orientation towards the needs of passengers	3.3. orientation towards the needs of carriers	3.4. compatibility with the railway infrastructure connected with the STH railway infrastructure
4.1.2	-	-	-	-	-	-	-	-	-	-	-
4.1.3	1.1.1	-	-	-	-	-	-	-	-	-	3.4.1
4.1.4	1.1.1	-	-	-	-	-	-	-	-	-	-
4.1.5	1.1.1	-	-	-	-	-	-	-	-	-	-
4.2	-	-	-	-	-	-	-	-	-	-	3.4.1
4.3	-	-	-	-	-	-	-	-	-	-	-
4.4	-	-	-	-	-	-	-	-	-	-	3.4.1
4.5	1.1.1 1.1.8	-	-	-	-	-	-	-	-	-	-
4.6	-	-	-	-	-	-	-	-	-	-	3.4.1
5.1.1	1.1.1 1.1.5 1.1.8 1.1.9 1.1.10 1.1.11	1.2.1 1.2.3	1.3.1 1.3.3	1.4.1 1.4.7	1.5.1 1.5.4 1.5.6	-	-	-	-	-	-
5.1.2	1.1.1 1.1.5 1.1.8 1.1.9 1.1.10 1.1.11	1.2.1 1.2.3	1.3.1 1.3.3	1.4.1 1.4.7	1.5.1 1.5.4 1.5.6	-	-	-	-	-	3.4.1
5.1.3	1.1.1 1.1.5 1.1.8 1.1.9	1.2.1 1.2.3	1.3.1 1.3.3	1.4.1 1.4.7	1.5.1 1.5.2 1.5.4 1.5.6	-	-	-	-	-	-
5.1.4	-	-	-	-	-	-	-	-	-	-	-
5.1.5	-	-	-	-	-	-	-	-	-	-	-
5.2	1.1.1 1.1.8 1.1.9	1.2.1	-	-	-	-	-	-	-	-	-
5.3	1.1.1 1.1.8 1.1.9	1.2.1	-	-	-	-	-	-	-	-	-
5.4	1.1.1 1.1.8 1.1.9	1.2.1	-	-	-	-	-	-	-	-	-
5.5	1.1.1 1.1.8 1.1.9	1.2.1	-	-	-	-	-	-	-	-	-
5.6	1.1.9	-	-	-	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-	-	-	-	-
6.2	-	-	-	-	-	-	-	-	-	-	3.4.1
7.1.1	1.1.1	1.2.1	-	1.4.1	1.5.1.		-	-	-	-	-

sub-chapter of this volume defining detailed technical conditions	essential requirements (Railway Interoperability Directive)						basic requirements	general requirements for the STH railway infrastructure			
	1.1. security	1.2. reliability and availability	1.3. health	1.4. environmental protection	1.5. technical compliance	1.6. accessibility	2.1. mechanical resistance and stability 2.2. fire safety 2.3. hygiene, health and the environment 2.4. safety and accessibility in use 2.5. protection against noise 2.6. energy economy and heat retention 2.7. sustainable use of natural resources	3.1. orientation towards the needs of economy	3.2. orientation towards the needs of passengers	3.3. orientation towards the needs of carriers	3.4. compatibility with the railway infrastructure connected with the STH railway infrastructure
	1.1.4 1.1.5 1.1.6 1.1.8 1.1.9 1.1.10 1.1.11	1.2.3		1.4.2 1.4.3	1.5.4						
7.1.2	1.1.1 1.1.4 1.1.5	1.2.1	1.3.1 1.3.2	1.4.1 1.4.2 1.4.3	1.5.1 1.5.4		-	-	-	-	-
7.1.3	1.1.1 1.1.4 1.1.5	1.2.1	1.3.1 1.3.2	1.4.1 1.4.2 1.4.3	1.5.1 1.5.4		-	-	-	-	-
7.1.4	1.1.1 1.1.4 1.1.5	1.2.1	1.3.2	1.4.1 1.4.2 1.4.3	1.51. 1.5.4		-	-	-	-	-
7.1.5	1.1.1 1.1.4 1.1.5	1.2.1	1.3.2	1.4.1 1.4.2 1.4.3	1.5.1 1.5.4		-	-	-	-	-
7.1.6	1.1.1 1.1.4 1.1.5	1.2.1	-	1.4.1 1.4.2 1.4.3			-	-	-	-	-
7.2	1.1.1 1.1.4 1.1.5 1.1.8 1.1.9 1.1.10 1.1.11	1.21 1.2.3	1.3.1 1.3.2	1.4.1 1.4.2 1.4.3	1.5.4		-	-	-	-	-
7.3	-	-	-	-	-	-	-	-	-	-	-
7.4	-	-	-	-	-	-	-	-	-	-	-

Cybersecurity

Technical solutions which collect, store, process, make available or transmit data ensuring compliance with the essential requirements with respect to safety (requirements from 1.1.1. to 1.1.11. specified in Volume A of the STH railway standards) and general requirements for the STH rail infrastructure with respect to protection (requirements from 1.1.12. and 1.1.13 specified in Volume A of the STH railway standards) should be designed taking into account cybersecurity, i.e. “security of network and information systems”, which is defined in the Directive concerning measures for a high common level of security of network and information systems as follows:

> “security of network and information systems” means the ability of network and information systems to resist, at a given level of confidence, any action that compromises the availability, authenticity, integrity or confidentiality of stored or transmitted or processed data or the related services offered by, or accessible via, those network and information systems;
>
> *[as defined in Article 4 of Directive 2016/1148]*

Cybersecurity includes two types of threats resulting from unauthorised access to the systems/equipment/networks that collect, store, process, make available or transmit data:

1) physical security threats
   It is necessary to secure systems/equipment/networks against direct access which could enable causing (intentionally or unintentionally) threats to functional safety.

2) IT security threats
   It is necessary to secure systems/equipment/networks against logical access via IT systems/equipment/networks, which could enable causing (intentionally or unintentionally) threats to functional safety.

Cybersecurity defined this way applies both to information systems used for rail transport purposes and to operational systems used for rail transport purposes, but the STH railway standards do not include requirements for information systems, e.g. timetabling systems.

Physical security threats and IT security threats for operational systems for which requirements are defined in the STH railway standards should be addressed by railway operators as part of the risk assessment and by design engineers/manufacturers/contractors as part of threat control. Additionally, it is required for the applied protections to be documented and verified in accordance with the requirements included in Volume XVIII of the STH railway standards.

Cybersecurity within the scope of this volume of the STH railway standards

In the scope covered by this volume of standards, there are networks and information systems whose security could be compromised, as well as technical solutions to collect, store, process, make available or transmit data having impact on security and/or protection. Therefore, they should be protected against physical security and IT security threats in a manner compliant with the requirements of the Information Safety Management System (ISMS) implemented by the STH company.

Information Safety Management Systems (ISMS) include:

a) ensuring that unauthorised persons do not have access to cable networks and equipment (active equipment of networks, computers);
b) monitoring of the location of the above-mentioned resources via video monitoring;
c) control of access to these locations by certified locks or other physical protection mechanisms and their protection by alarm and fire protection systems in case of attempts to violate protections or fire;
d) separation of the information systems of the infrastructure manager and the carriers and the personnel using them from the systems of universal Internet access.

In order to ensure cybersecurity, networks and information systems whose security could be compromised, as well as technical solutions that collect, store, process, make available or transmit data affecting security and/or protection should comply with the requirements of the ISMS implemented by the STH company, in particular with regard to:

1. Placing all active equipment of networks and cable connections in lockable rooms or cabinets with access control, alarm and fire protection in case of an attempt to unauthorised access or fire and video monitoring thereof.
2. Ensuring for all active pieces of equipment in lockable rooms or cabinets environmental conditions required by the equipment (temperature, humidity, etc.) by the air conditioning equipment in order to ensure the continuity of operation of the systems.
3. Ensuring power supply for active equipment of networks and computers from a separate power network with uninterruptible power supply (UPS).
4. Ensuring that a fully accessible Internet connection (e.g. Wi-Fi) is completely separated from the local networks of the infrastructure manager and carriers by separating devices, cable connections and access devices (routers).
5. Protection of local (LAN) and wide (WAN) area networks in accordance with ISO 27000 series standards, generally applicable regulations (e.g. GDPR) and the Act of 5 July 2018 on the national cybersecurity system.

At the same time, it should be kept in mind that the ISMS will be subject to changes because maintaining the required level of cybersecurity is not possible by meeting requirements of the standards once since cybersecurity is a process rather than a state. In order to minimise the number and size of cyber threats, the requirements (obligations) included in the Act of 5 July 2018 on the national cybersecurity system in Chapter 3 for operators of key services, in Chapter 5 for public entities should be continuously observed in operational processes and only digital service providers fulfilling the obligations described in Chapter 4 of that Act should be used.

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3) European Train Control System (ETCS) configurations (available ETCS baselines).

In accordance with the provisions included in [12], on the effective date, the provisions concerning the reference to the current version of the technical specifications for interoperability in the field of control command and signalling subsystems have been sanctioned into the formal and legal circulation applicable in the territory of the Republic of Poland. According to the provisions of the technical specifications for interoperability relating to control command and signalling subsystems [3] as amended [4]÷[7], at the date of publication of these guidelines, it shall be possible to apply specifications listed in Annex A [3] as amended [4]÷[7] to new, upgraded or renewed Control-Command and Signalling Trackside Subsystem and Control-Command and Signalling On-board Subsystem.

In accordance with the provisions of this document, as of the date of preparation of these guidelines, for the trackside subsystem on all railway lines indicated in Table 1, i.e.: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3, the following mandatory specifications may be used:

- ✓ set of specifications No 1 (baseline 2 for ETCS and baseline 1 for GSM-R),
- ✓ set of specifications No 2 (baseline 3 release 1 for maintenance for ETCS and baseline 1 for GSM-R),
- ✓ set of specifications No 3 (baseline 3 release 2 for ETCS and baseline 1 for GSM-R),

whereas for the on-board subsystem:

- ✓ set of specifications No 2 (baseline 3 release 1 for maintenance for ETCS and baseline 1 for GSM-R),
- ✓ set of specifications No 3 (baseline 3 release 2 for ETCS and baseline 1 for GSM-R).

On the basis of the above-mentioned sets of specifications, the following configuration of the system is possible to be designed, installed and commissioned on the track side:

- ✓ level 1,
- ✓ level 1 limited supervision (LS),
- ✓ level 1 with in-fill (balise or loop or GSM-R),
- ✓ level 2,
- ✓ level 3.

In a case of on-board equipment, the following system configurations can be designed, installed and commissioned:

- ✓ enabling travel on lines equipped with level 1 (including limited supervision),
- ✓ enabling travel on lines equipped with level 1, level 1 with information in-fill (additional equipment for reading loop data or by GSM-R data radio exchange),
- ✓ enabling travel on lines equipped with level 1, level 1 with in-fill, level 2 and level 3.

Apart from system configurations described above, in order to enable traction vehicles to travel on railway lines where there are no trackside train protection facilities or where the railway lines are equipped with older systems, e.g. for the railway manager of PKP Polskie Linie Kolejowe S.A. using the automatic train braking system (SHP), system configurations were defined additionally as:

- ✓ level 0,
- ✓ NTC level.

3.1. Basic interoperability constituents of the Control-Command and Signalling Trackside Subsystem

Basic interoperability constituents and groups of interoperability constituents belonging to the Control-Command and Signalling Trackside Subsystem and requirements for them are indicated in Table 5.2a and Table 5.2b [3] as amended [4]÷[7].

3.1.1. Radio block centre – (RBC)

1. Minimum requirements for reliability, availability, maintainability, safety related to the Control-Command and Signalling Trackside Subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The trackside ETCS functionality (excluding communication via Eurobalise, radio in-fill and euroloop) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications indicated in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The complete specification of ETCS and GSM-R air gap interfaces for radio communication with the train only is described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. The interfaces: functional between radio block centres (RBC), technical between radio block centres (RBC), wired to radio data exchange system (GSM-R), key management system, ETCS-ID management are described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
5. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

3.1.2. Radio in-fill unit

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The trackside ETCS functionality (excluding communication via Eurobalise, euroloop and level 2 and level 3 functionality) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications as described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The complete specification of ETCS and GSM-R air gap interfaces for radio communication with the train only is described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

4. The interfaces: radio data exchange, key management system, ETCS-ID management, interlocking and encoder (LEU) are described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
5. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

3.1.3. Eurobalise

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The complete specification of ETCS and GSM-R air gap interfaces for only Eurobalise communication with the train is described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: Eurobalise encoder (LEU) is described in Annex A[3] as amended[4] -[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A as [3]amended[4] -[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

3.1.4. Euroloop

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The complete specification of ETCS and GSM-R air gap interfaces for only euroloop communication with the train is described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: the Euroloop encoder (LEU) is described in Annex A[3] as amended[4] -[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

3.1.5. LEU Eurobalise

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The trackside ETCS functionality (excluding communication via radio in-fill, euroloop and level 2 and level 3 functionality) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: Eurobalise encoder (LEU) is described in Annex A[3] as amended[4] -[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A as [3]amended[4] -[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

3.1.6. LEU Euroloop

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The trackside ETCS functionality (excluding communication via radio in-fill, euroloop and level 2 and level 3 functionality) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: the Euroloop encoder (LEU) is described in Annex A[3] as amended[4] -[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, they are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

3.1.7. Axle-counter

1. Minimum requirements relating to trackside train detection systems (only parameters relevant to axle counters) are laid down in EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. Requirements for electromagnetic compatibility (only parameters relevant to axle counters) are described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

3. Requirements for the equipment construction, among others: with reference to physical environmental conditions, are described in Annex A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. The other requirements for axle counters are described in Volume VI.1 on control command and signalling – basic equipment.

3.2. Examples of groups of interoperability constituents of the Control-Command and Signalling Trackside Subsystem

3.2.1. Group Eurobalise LEU Eurobalise

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The trackside ETCS functionality (excluding communication via euroloop and level 2 and level 3 functionality) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications as described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The complete specification of ETCS and GSM-R air gap interfaces with reference only to Eurobalise-only communication with train is described in Annex A [3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, they are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

3.2.2. Group Euroloop LEU Euroloop

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]-[7] indicating relevant documents compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
2. The trackside ETCS functionality (excluding communication via Eurobalise and level 2 and level 3 functionality) shall be implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and technical specifications as described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The complete specification of ETCS and GSM-R air gap interfaces with reference only to Eurobalise-only communication with train is described in Annex A [3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]-[7].
4. Requirements for the equipment construction, among others: with reference to physical environmental conditions, electromagnetic compatibility, are described in Annex A[3] as amended [4]-[7] and the technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]-[7].

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4) Rules for the dimensioning and engineering of the ETCS system taking into account the national variable values used in Poland ("ETCS dimensioning", "ETCS engineering").

4.1. ETCS variables

The use of ETCS variables by the infrastructure manager on its infrastructure requires, in relation to the assigned values, coordination and supervision when applying for the assignment of relevant values. The infrastructure manager is responsible for their selection and verification so that the values are not assigned in identical values for different purposes or are stored in reverse order. This value assignment may result in system operation or may be safety-related.

In accordance with Appendix A [3] as amended [4]÷[7] and technical specifications described in Table A 2.1 or Table A 2.2 or Table A 2.3 of Appendix A [3] as amended [4]÷[7], the infrastructure manager is obliged to obtain specific ETCS variables from a relevant authority. Unique values or ranges of values allocated and assigned to applicant organisations shall be supervised by the European Railway Agency (ERA).

For ETCS variables whose coordination is required at a national level, the infrastructure manager of the Member State in consultation with other entities (infrastructure managers) is responsible for the assignment of the unique values.

4.1.1. Identity number of the country or region NID_C

In order to ensure that the ETCS uses its own language to exchange data between the trackside control-command and signalling subsystem and the on-board control-command and signalling subsystem, the infrastructure manager is obliged to use, in accordance with the provisions of the documents listed in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], the assigned unique country or region identity number (NID_C).

The supervision and use of the allocated resource for all railway lines indicated in Table 1, i.e.: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3, is specified by the STH infrastructure manager in their own documents.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A., on which ETCS system will be installed, require detailed arrangements concerning indication of NID_C change location between particular infrastructure managers.

4.1.2. On-board ETCS equipment identity NID_ENGINE

In order to ensure that the ETCS system uses its own language for data exchange between the trackside control-command and signalling subsystem, for which the infrastructure manager is responsible, and the on-board control-command and signalling subsystem, for which the carrier is responsible, the STH infrastructure manager, by virtue of not being an operator and not being a rolling stock manager, shall require the carriers, when operating on railway lines indicated in Table 1, i.e. STH P1, STH P2, STH P3, STH M1, STH M2, STH M3, to run rolling stock for which the correct on-board equipment identity (NID_ENGINE) has been verified and confirmed in the approval process for the on-board control-command and signalling subsystem.

4.1.3. National system identity NID_NTC

The national system identity (NID_NTC) is a new revised name which was referred to as NID_STM in baseline 2.

The supervision and the manner of use of the allocated resource in relation to the national system in use for all railway lines indicated in Table 1, i.e: STH P1, STH P2, STH P3, STH M1, STH M2, STH m3 are specified by the STH infrastructure manager in own documents.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A., on which ETCS system will be installed, require detailed arrangements concerning indication of NID_NTC (NID_STM) change location between particular infrastructure managers.

4.1.4. Identity of user system (identity of User Design Authority) NID_XUSER

In order to ensure that the ETCS uses its own language to exchange data between the trackside control-command and signalling subsystem and the on-board control-command and signalling subsystem, in which data will be used to control the vehicle equipment, the infrastructure manager is obliged to use, in accordance with the provisions of the documents listed in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], the assigned unique identity of user system (NID_XUSER).

The supervision and the manner of use of the allocated resource in relation to the use of data for controlling non-ETCS-related equipment on traction vehicles, for all railway lines indicated in Table 1, i.e: STH P1, STH P2, STH P3, STH M1, STH M2, STH m3 are specified by the STH infrastructure manager in own documents.

4.1.5. Identity of the traction system NID_CTRACTION

The railway infrastructure accompanying the constructed railway lines managed by the STH infrastructure manager allows on the railway lines indicated in Table 1, i.e.: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3 the use of AC 2 x 25 kV overhead catenary system or, alternatively, on railway lines indicated in Table 1, i.e.: STH P2, STH P3, STH M2, STH M3 the use of DC 3 kV power supply. Therefore, the STH railway infrastructure manager, in agreement with other entities operating on the national market, should develop and request the assignment of unique values for DC 3 kV as well as AC 2 x 25 kV power supply intended to be used within STH railway infrastructure.

The supervision and the manner of use of the allocated resource in relation to the used traction system for all railway lines indicated in Table 1, i.e. STH P1, CSTH P2, STH P3, STH M1, STH M2, STH M3, is specified by the STH infrastructure manager in their own documents.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A., on which ETCS system will be installed in places of overhead catenary system change, require detailed arrangements concerning indication of appropriate NID_CTRACTION values between particular infrastructure managers.

4.2. Backward and forward compatibility of ERTMS lines

The infrastructure of railway lines equipped with trackside control-command and signalling subsystems, as designed by the STH infrastructure manager, shall take into account backward and forward compatibility of the lines. Such an approach is a key aspect of the cooperation of the installed trackside control-command and signalling subsystem of the ETCS system not only on the infrastructure managed by the STH infrastructure manager or PKP Polskie Linie Kolejowe S.A., at the point of contact between both infrastructure managers, but especially in relation to carriers operating the on-board control-command and signalling subsystem on their vehicles.

This aspect should be considered as one of the key elements by the design engineer of the ETCS system, because it may imply fitting the system, in accordance with [3] as amended [4]÷[7], with specification set no 1[3], specification set no 2, specification set no 3, which on the infrastructure side of the trackside control-command and signalling subsystem is not a limitation, but on the on-board control-command and signalling subsystem it may give rise to a serious risk that the traction vehicles with an on-board control-command and signalling subsystem built in accordance with specification set no 1 will not be able to travel on lines managed by STH with an on-board control-command and signalling subsystem built in accordance with specification set no 3.

Taking into account the above risk, in order to avoid the suspicion of an act of unfair competition by hindering carriers' access to the market, in the event that the design engineer appointed by the STH infrastructure manager uses the trackside selection recommendation as the basic set of specifications no 3, the STH infrastructure manager should define in a transparent way the information that the STH infrastructure manager makes available to all market operators in order to take appropriate countermeasures to mitigate this risk. Such information should be made available well in advance to allow third parties to prepare for travelling the traction rolling stock put into service on the railway lines managed by STH.

4.3. Harmonisation of ERTMS implementations

Trackside equipment to be installed on railway lines, assigned to the trackside control-command and signalling subsystem and including ETCS (as described in this volume) or GSM-R (as described in volume VII.1 on fixed and wireless communication systems and data transmission), shall be subject to verification of the harmonised implementation of ERTMS within the European Union. The European Railway Agency is responsible for this process.

To ensure harmonised implementation of ERTMS and interoperability at the European Union level, Article 19 of the Directive [1] requires the STH infrastructure manager, before launching each tender procedure for ERTMS trackside equipment, to obtain from the European Railway Agency confirmation that technical solutions envisaged fully comply with the provisions of the relevant technical specification for interoperability (TSI) and are therefore fully interoperable.

Such verification must be carried out in respect of individual ERTMS projects or a combination of projects, lines, groups of lines or networks.

Projects implemented at points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A., on which the ETCS system will be installed, require detailed arrangements with the infrastructure manager, who is responsible for authorising project documentation by the European Railway Agency.

4.4. Trackside element arrangement

The use of the trackside control-command and signalling subsystem of ETCS by the STH infrastructure manager on their railway infrastructure requires a uniform description of the way in which the elements to be implemented are to be arranged along the railway lines, as indicated in Table 1, i.e., STH P1, STH P2, STH P3, STH M1, STH M2, STH M3 and subsequent coordination with respect to successive projects ensuring a uniform approach to the system elements to be installed.

[3] Specification set not applicable to the on-board control-command and signalling subsystem

Using documents [53] published by the European Railway Agency (as a reference material) and as relevant documents according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], the trackside control-command and signalling equipment shall be located within the designed STH railway infrastructure.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A. must be designed in accordance with the relevant requirements of a given infrastructure manager.

4.4.1. Eurobalise identification (NID_BG)

1. A general criterion for assigning Eurobalise group identity numbers (NID_BG) is the use of a sequence of digits. STH infrastructure manager defines in internal documents a rule of using a number of digits (4 or 5) as a numerator for each group of eurobalises.
2. It is recommended that Eurobalises installed on the odd-numbered tracks of the STH railway infrastructure be identified by the odd number of the last digit of NID_BG.
3. It is recommended that Eurobalises installed on the even-numbered tracks of the STH railway infrastructure be identified by the even-numbered last digit of NID_BG.
4. It is recommended that Eurobalises installed on the STH railway infrastructure be identified with the number NID_BG, in the direction of increasing chainage of the railway line, for which the numbering of the Eurobalises in the group increases.
5. Each uniquely numbered Eurobalise group NID_BG must relate to a specific NID_C variable whose allocation is coordinated and supervised by an infrastructure manager.

4.4.2. Installation of balises on the railway line

1. The arrangement of a group of balises consisting of two non-switchable balises shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of the increasing chainage of the railway line according to which the numbering of the balises in the group increases.
2. The arrangement of a group of balises consisting of one switchable balise and one non-switchable balise shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of the increasing chainage of the railway line according to which the numbering of the balises in the group increases.

4.4.3. Installation of balises at signals, ETCS indicators

1. The arrangement of a group of balises consisting of one non-switchable balise at station entrance, station exit, signposting signals should be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The arrangement of a group of balises consisting of two non-switchable balises at station entry, station exit, signposting signals, taking into account a direction of movement of a traction vehicle, should be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of increasing chainage of the railway line, according to which the numbering of the balises in the group increases.

3. The arrangement of a group of balises consisting of two non-switchable balises at block signals or in their absence at W ETCS 10 indicator (according to volume VI.1 Control command and signalling – basic equipment), taking into account a direction of movement of a traction vehicle, shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of increasing chainage of the railway line according to which the numbering of the balises in the group increases.
4. The arrangement of a group of balises consisting of one switchable balise and one non-switchable balise at the level crossing distant warning signals (Top), taking into account a direction of movement of a traction vehicle, shall be planned for Vmax equal to 160 km/h in a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of increasing chainage of the railway line, according to which the numbering of the balises in the group increases.

4.4.4. Installation of balises on control command and signalling indicators

1. The arrangement of a group of balises consisting of two non-switchable balises at signal indicators (e.g. shunting limit), taking into account a direction of movement of a traction vehicle, shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] in the direction of increasing chainage of the railway line, according to which the numbering of the balises in the group increases.

4.4.5. Installation of balises on trackside control command and signalling equipment

1. The arrangement of a group of balises consisting of one non-switchable balise at a wheel sensor or insulated joint shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The arrangement of a group of balises consisting of one non-switchable balise at an impedance bond shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The arrangement of a group of balises consisting of one non-switchable balise at a derailer shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

4.4.6. Installation of balises at railway turnouts

1. The arrangement of a group of balises consisting of one non-switchable balise at a turnout shall be planned at a distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], both from the beginning of a turnout and fouling points.
2. The arrangement of a group of balises consisting of one non-switchable balise between turnouts shall be planned at half the distance as indicated in the relevant document according to the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] between the beginnings of a turnout and a distance as indicated in the relevant document according to the index of Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] after the fouling point of a turnout.

4.5. National variables

The use of the Control-Command and Signalling Trackside subsystem of ETCS by the STH infrastructure manager on their railway infrastructure requires the use of a uniform way of describing the national variables for the railway lines complying with Table 1, i.e. STH P1, STH P2, STH P3, STH M1, STH M2, STH M3 and the subsequent coordination of their use and their supervision in respect of successive projects, ensuring the use of uniform values, for the development of successive lines with Class A interoperable system.

Using the documents published by the European Railway Agency [53] (as a reference material) and as relevant documents according to index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], the STH infrastructure manager is obliged to define a uniform set of national variables to be used for the control-command and signalling trackside subsystem to be implemented on the designed STH railway infrastructure with regard to the system specifications to be implemented. In order to ensure uniformity of implementation at the national level, the STH infrastructure manager's adoption should be agreed with other managers in the country using the Class A interoperable system in commercial operation.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A. must be designed in accordance with the relevant requirements of a particular infrastructure manager and take into account the application of national variables adopted in the territory of a given infrastructure manager.

Table 5. Values of national variables

Variable	Variable designation according to SRS	Variable values adopted in NPW ERTMS [76]	Variable values for set of specifications No 1	Variable values for set of specifications No 2	Variable values for set of specifications No 3
Modification of adhesion factor by driver	Q_NVDRIVER_ADHES	„1”	Not allowed	Not allowed	Not allowed
Shunting mode speed limit	V_NVSHUNT	25 km/h	30 km/h	30 km/h	30 km/h
Staff Responsible mode speed limit	V_NVSTFF	40 km/h	40 km/h	40 km/h	40 km/h
On Sight mode speed limit	V_NVONSIGHT	20 km/h	30 km/h	30 km/h	30 km/h
Limited Supervision mode speed limit	V_NVLIMSUPERV		x	100 km/h	100 km/h
Unfitted mode speed limit	V_NVUNFIT	160 km/h	100 km/h	100 km/h	100 km/h
Release Speed	V_NVREL	0 km/h	40 km/h	40 km/h	40 km/h
Distance to be used in Roll Away protection, Reverse movement protection and Standstill supervision	D_NVROLL	5 m	2 m	2 m	2 m
Use service brake when braking to a target	Q_NVSRBKTRG	„1”	Yes	X	x
Permission to use service brake in target speed monitoring	Q_NVSBTSMPERM	x	x	Yes	Yes
Permission to release emergency brake	Q_NVEMRRLS	„1”	Only at standstill	Only at standstill	Only at standstill
Permission to use guidance curves	Q_NVGUIPERM	x	X	No	No
Permission to use the service brake feedback	Q_NVSBFBPERM	x	x	No	No
Permission to inhibit the compensation of the speed measurement inaccuracy	Q_NVINHSMICPERM	X	x	No	No
Speed limit for triggering the override function	V_NVALLOWOVTRP	0 km/h	0 km/h	0 km/h	0 km/h
Override speed limit to be supervised when the “override” function is active	V_NVSUPOVTRP	20 km/h	30 km/h	30 km/h	30 km/h
Distance for train trip suppression when override function is triggered	D_NVOVTRP	200 m	200 m	200 m	200 m
Max. time for train trip suppression when override function is triggered	T_NVOVTRP	60 s	60 s	60 s	60 s

Variable	Variable designation according to SRS	Variable values adopted in NPW ERTMS [76]	Variable values for set of specifications No 1	Variable values for set of specifications No 2	Variable values for set of specifications No 3
Change of driver ID permitted while running	M_NVDERUN	„1”	Yes	Yes	Yes
System reaction if T_NVCONTACT elapses	M_NVCONTACT	„0”	No reaction	No reaction	No reaction
Maximum time since the time-stamp in the last received message	T_NVCONTACT	∞	∞	∞	∞
Distance to be allowed for reversing in Post Trip mode.	D_NVPOTRP	0 m	200 m	200 m	200 m
Max permitted distance to run in Staff Responsible mode	D_NVSTFF	10 km	∞	∞	∞
Default location accuracy of a balise group	Q_NVLOCACC	x	x	12 m	12 m
Weighting factor for available wheel/rail adhesion	M_NVAVADH	x	x	0	0
Confidence level for emergency brake safe deceleration on dry rails	M_NVEBCL	x	x	99.99999 99 %	99.99999 99 %
Train length step used for the integrated correction factor Kr_int	L_NVKRINT	x	x	N/A	N/A
Train length dependent integrated correction factor Kr_int	M_NVKRINT*	x	x	0.9	0.9
Speed step used for the integrated correction factor Kv_int	V_NVKVINT	x	x	N/A	N/A
Speed dependent integrated correction factor Kv_int	M_NVKVINT*	x	x	0.7	0.7
Integrated correction factor for brake build up time	M_NVKTINT	x	x	1.1	1.1
Maximum deceleration value under reduced adhesion conditions (1)	A_NVMAXREDADH1	x	x	1.0 m/s^2	1.0 m/s^2
Maximum deceleration value under reduced adhesion conditions (2)	A_NVMAXREDADH2	x	x	0.7 m/s^2	0.7 m/s^2
Maximum deceleration value under reduced adhesion conditions (3)	A_NVMAXREDADH3	x	x	0.7 m/s^2	0.7 m/s^2
Lower deceleration limit to determine the set of Kv_int to be used	A_NVP12	x	x	N/A	N/A
Upper deceleration limit to determine the set of Kv_int to be used	A_NVP23	x	x	N/A	N/A

where:

"1" and "0" – denote the binary value of the parameter

x – not applicable

The default value of the correction factor Kr_int shall be valid for any train length, and likewise the default value of the correction factor Kv_int shall be valid for any brake position, speed and maximum emergency brake deceleration. This means that the Kr_int model does not contain any train length step, and that the Kv_int model is valid for all train types and does neither contain any speed step nor any pivot deceleration limit.

In establishing the values of national variables, the STH infrastructure manager may use parameters presented in Table 5. However, values indicated in the column based on [76] were proposed before the first implementation of Class A system on the territory of the Republic of Poland and have not been subject to revision with regard to the adopted values since their publication. These variables will not cover an extended range of national variables complying with specification No 2 and specification No 3.

The indication by the design engineer, as recommended for installation of ETCS on a specific line under specification No 1, must be based on national variables that are compatible with that specification and must not refer to other national variables of the national variables listed in specification No 2 and specification No 3.

The design engineer, in the absence of fixed uniform values valid for the STH infrastructure manager, may adopt default values as indicated in Table 5 for the set of specifications No 1 or specifications No 2 or specifications No 3 defined for implementation. The adoption of such a solution, e.g. with respect to a dedicated shunting speed variable, would violate the applicable provisions of national law in force at the date of approval of these standards [9]. Therefore, in a justified case, the STH infrastructure manager, in consultation with other railway managers and carriers, may apply to the competent ministry with an initiative to amend the law in relation to certain values.

The design engineer, on the basis of the values of national variables adopted by the STH infrastructure manager and the infrastructure manager's defined parameters reflecting the traffic regulations, takes the responsibility, when designing a Class A interoperable system to be installed, that wrongly chosen values of national variables, e.g. release speed, maximum time since the time-stamp in the last received message, maximum permitted distance to travel in Staff Responsible (SR) mode, affect the fluidity of railway traffic on the designed railway lines.

4.6. ERTMS compatibility

Taking account of different feasibility and status of migration to fully compliant control-command and signalling subsystems, infrastructure managers and carriers must foresee in their work that checks are carried out to demonstrate technical compatibility between control-command and signalling on-board and trackside subsystems. The need for such checks is seen as a countermeasure to increase confidence in the technical compatibility between control-command and signalling subsystems.

In view of the above, the STH infrastructure manager, in addition to meeting the requirements indicated in sub-chapter 4.3, at the engineering stage, according to the technical documentation [52] of the European Railway Agency, is obliged to take into account and implement in its further work the obligation to submit to the Agency the definitions of the necessary checks to be performed on the constructed railway lines compliant with Table 1, i.e: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3. Such checks, commonly referred to as ESCs, must be demonstrated for the Class A interoperable system implemented (ETCS – described in this Volume) and for the Class A system for communication (GSM-R) implemented, commonly referred to as RSC, the description of which is given in Volume VII.1 on fixed and wireless communication systems and data transmission.

The ETCS System Compatibility (ESC) Tests developed by the STH infrastructure manager will address the recording of technical compatibility between the control-command and signalling on-board subsystem and part of the control-command and signalling trackside subsystem within a given area of use.

The ESC type prepared by the STH infrastructure manager will denote a value assigned in order to record the technical compatibility between the control-command and signalling on-board subsystem and a given section within the area of use. All sections of the Union railway network that will require a series of the same checks to demonstrate ETCS compatibility shall be marked by the STH infrastructure manager with the same type of ESC.

The complete list of checks to be performed on the railway network shall be submitted by the STH infrastructure manager to the European Railway Agency, which shall set up and manage in a technical document [52] under its supervision the set of checks to demonstrate the technical compatibility of an on-board subsystem with the trackside subsystem.

The STH infrastructure manager is required to classify railway lines equipped with Class A interoperable system according to ESC types and list them in the Register of Infrastructure (RINF).

Areas identified by the STH infrastructure manager that need to be changed are reported by the infrastructure manager to the European Railway Agency, which updates the technical document under its supervision.

Points of contact between railway lines managed by the STH infrastructure manager and railway lines managed by PKP Polskie Linie Kolejowe S.A. must take into account such checks in accordance with ESC classification of a given infrastructure manager.

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5) Traffic-aware system configurations

5.1. ETCS level on STH lines

As of the date of preparation of these guidelines, for the trackside subsystem on all the railway lines indicated in Table 1, i.e. STH P1, STH P2, STH P3, STH M1, STH M2, STH M3, the STH infrastructure manager may instruct the design engineer to design Class A interoperable system equipment by using one of the following sets of available mandatory specifications:

- ✓ set of specifications No 1 (baseline 2 for ETCS and baseline 1 for GSM-R),
- ✓ set of specifications No 2 (baseline 3 release 1 for maintenance for ETCS and baseline 1 for GSM-R),
- ✓ set of specifications No 3 (baseline 3 release 2 for ETCS and baseline 1 for GSM-R).

On the basis of the above-mentioned set of specifications, the design engineer, upon the STH infrastructure manager's request, is able to design the following system configurations for installation and commissioning on the track side:

- ✓ level 1,
- ✓ level 1 limited supervision (LS),
- ✓ level 1 with in-fill (balise or loop or GSM-R),
- ✓ level 2,
- ✓ level 3.

For a selected set of specifications and level, the design engineer in accordance with the relevant documents according to the indexes in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] draws up a design for a specific railway line managed by STH or constituting a point of contact between STH infrastructure managers and PKP Polskie Linie Kolejowe S.A.

5.1.1. Installation of ETCS on STH railway lines

The design documentation prepared for the ETCS system must be co-ordinated with the design documentation prepared for the control command and signalling equipment (taking into account the requirements of Volume VI.1 for control command and signalling – basic equipment).

The STH infrastructure manager, when making a decision indicating to the design engineer the level of the ETCS, which is recommended for a specific railway line, shall, for the decision taken, oblige the design engineer to correlate their works additionally with the requirements of the implemented Class A communication system (GSM-R), the description of which is included in Volume VII.1 concerning fixed and wireless communication systems and data transmission, as well as other documents describing how and where this system will be used in relation to voice communication or voice communication together with data exchange.

5.1.1.1.Passenger railway lines of STH P1 category

The STH infrastructure manager for railway lines included in the STH P1 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the

necessary design documentation. For such lines, the indication recommended by the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 2 including trackside signals, level 2 without trackside signals, level 3.

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A [3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A [3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A [3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.1.2.Passenger railway lines of STH P2 category

The STH infrastructure manager for railway lines included in the STH P2 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the necessary design documentation. For such lines, the recommendation of the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 2 including trackside signals, level 2 without trackside signals.

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A[3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A[3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A[3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.1.3.Passenger railway lines of STH P3 category

The STH infrastructure manager for railway lines included in the STH P3 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the necessary design documentation. For such lines, the recommendation of the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 2 including trackside signals, level 2 without trackside signals.

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A[3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in

Table A 2.2 of Annex A[3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A[3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.1.4.Mixed traffic railway lines of STH M1 category

The STH infrastructure manager for railway lines included in the STH M1 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the necessary design documentation. For such lines, the recommendation of the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 2 including trackside signals, level 2 without trackside signals (assuming that only vehicles equipped with on-board control command and signalling subsystem are allowed to enter a specific railway line).

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A[3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A[3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A[3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.1.5.Mixed traffic railway lines of STH M2 category

The STH infrastructure manager for railway lines included in the STH M2 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the necessary design documentation. For such lines, the recommendation of the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 2 including trackside signals, level 2 without trackside signals (assuming that only vehicles equipped with on-board control command and signalling subsystem are allowed to enter a specific railway line).

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A[3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A[3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A[3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.1.6.Mixed traffic railway lines of STH M3 category

The STH infrastructure manager for railway lines included in the STH M3 category will indicate to the design engineer the appropriate ETCS level, for which the design engineer will prepare the necessary design documentation. For such lines, the indication recommended by the STH infrastructure manager should be based on the selection of a specific ETCS level, i.e. level 2 including trackside signals.

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A[3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A[3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A[3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager.

In the designed area, in accordance with the provisions of applicable requirements for control command and signalling equipment, the design engineer must design the equipment so that in case of failure of trackside equipment, it is possible to run traction vehicles on a specific railway line using the operating mode on a non-equipped line (UN) (level 0) or using a class B system (NTC level), if its use is specified in the guidelines of Volume VI.1 for control command and signalling – basic equipment at speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

5.1.2. Installation of the system at the point of contact of railway managers

The STH infrastructure manager for the railway lines being points of contact between the railway lines managed by them and the railway lines managed by PKP Polskie Linie Kolejowe S.A. shall indicate to the design engineer the appropriate level of the ETCS, for which the design engineer shall prepare the necessary design documentation. For such lines, the indication recommended by the STH infrastructure manager should be based on the selection of a specific ETCS level from the scope – level 1, level 1 limited supervision, level 2 – and such recommendation should also be based on the provisions approved at the national level, indicated in the strategic documents recorded in [55], as amended[57] and [58], the validity of which should be confirmed by PKP Polskie Linie Kolejowe S.A.

Since numerous identified limitations exist in the available specification compliant with the indexes in Table A 2.1 of Annex A [3] as amended [4]-[7] and the availability of control command and signalling – trackside equipment available on the market meeting the requirements compliant with the indexes in Table A 2.2 of Annex A [3] as amended [4]-[7], taking into account further development of equipment made in accordance with the documents in the indexes in Table A 2.3 of Annex A [3] as amended [4]-[7], set of specifications No 2 constitutes the starting point for the baseline of the relevant recommendation for the STH infrastructure manager. The STH infrastructure manager for the recommended set of specifications for lines in contact with railway lines managed by PKP Polskie Linie Kolejowe S.A. is obliged to obtain acceptance of the use of proposed solutions on the infrastructure of PKP Polskie Linie Kolejowe S.A.

The design documentation prepared for the ETCS system must be co-ordinated with the design documentation prepared for the control command and signalling equipment (taking into account the requirements of Volume VI.1 for control command and signalling – basic equipment) and in the area of the railway line, which is supervised by PKP Polskie Linie Kolejowe S.A., it must meet the requirements of this railway manager and their documents indicated in the sub-chapter 8.6, with reference to the relevant volume [64]. In both areas the design engineer must, in accordance with the infrastructure manager's requirements for control-command and signalling equipment, design the equipment in such a way that in case of failure of the trackside equipment, it is possible for traction vehicles to travel on the specific railway line using a non-equipped line (UN) mode of operation (level

0) or using a class B system (NTC level) at the speeds of moving traction vehicles resulting from the applicable traffic regulations or approved internal instructions of the STH infrastructure manager.

Additionally, the STH infrastructure manager, when making a decision indicating to the design engineer the level of the ETCS, which is recommended for a specific railway line, shall, for the decision taken, oblige the design engineer, after taking into account the provisions of the above-mentioned strategic documents, to correlate their works additionally with the requirements of the implemented Class A communication system (GSM-R), the description of which is included in Volume VII.1 concerning fixed and wireless communication systems and data transmission, as well as other documents describing how and where this system will be used in relation to voice communication or voice communication together with data exchange.

5.1.3. System commissioning on railway lines

When designing the ETCS system planned to be installed and commissioned on railway lines managed by STH, the design engineer should perform works in relation to ETCS so that they are closely connected with the designed control command and signalling equipment dedicated to the basic equipment described in Volume VI.1 concerning control command and signalling – basic equipment, and the commissioning of the CCS equipment of the basic layer takes place at the same time as the commissioning of the installed ETCS system designed in accordance with these guidelines, together with the relevant equipment of the GSM-R system described in Volume VII.1 fixed and wireless communication systems and data transmission.

However, with respect to the railway lines constituting points of contact between the railway lines managed by the STH infrastructure manager and the railway lines managed by PKP Polskie Linie Kolejowe S.A., the STH infrastructure manager should enable the design engineer to carry out works in such a manner that at the first stage of handover of the railway line for operation this line operates using the control command and signalling equipment described in Volume VI.1 on control command and signalling – basic equipment, and at the next stage(s) commissioning of the ETCS system described in this Volume together with GSM-R system adapted to the needs of specific railway lines as described in Volume VII.1 concerning fixed and wireless communication systems and data transmission.

5.1.4. Determination of the area of full supervision

In order to eliminate the technical risk of the configuration of the ETCS, it is recommended that the design engineer adopts the principle of determining boundaries of the area of full system supervision at operating control points and not at a specific point on a railway open line.

Due to the fact that various configurations of such boundaries are possible, one of possible situations should be adopted for the designed railway lines for which STH is the infrastructure manager.

A similar principle should also be applied for the designed railway lines at the point of contact of infrastructure managers of STH and PKP Polskie Linie Kolejowe S.A.

5.1.4.1.Boundary for Case 1

One of possible configurations for the implementation of the boundaries of ETCS full supervision area is their location on operating control points in accordance with a mirror image (at both ends), where points of entry to a specific system level are in the same chainage of the railway line as points of exit from the system and transition to the national system. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both ends.

5.1.4.2.Boundary for Case 2

Another possible configuration for the implementation of the boundaries of ETCS full supervision area is their location on operating control points in accordance with a mirror image (at both ends), where the points of entry to a specific system level are in different chainage of the railway line than points of exit from the system and transition to the national system, i.e. areas of exit are within the area. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both boundary ends determined by the chainage of entry to ETCS, and the information provided is complemented in a description by the design engineer with a location of the chainage concerning the exit from the system included in the area of full supervision.

5.1.4.3.Boundary for Case 3

The other possible configuration for the implementation of the boundaries of ETCS full supervision area is their location on operating control points in accordance with a mirror image (at both ends), where the points of entry to a specific system level are in different chainage of the railway line than points of exit from the system and transition to the national system, i.e. areas of exit are outside the area. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both boundary ends determined by the chainage of entry to ETCS, and the information provided is complemented in a description by the design engineer with a location of the chainage relating to the exit from the system outside the area of full supervision.

5.1.4.4.Boundary for Case 4

A separate possible configuration for the implementation of the boundaries of ETCS full supervision area is their location on operating control points which is no longer in accordance with a mirror image (at both ends), where the points of entry to a specific system level are in different chainage of the railway line than points of exit from the system and transition to the national system, i.e. points of exit are on one side inside and on the other side outside the area. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both boundary ends determined by the chainage of entry to ETCS, and the information provided is complemented in a description by the design engineer with a location of the chainage concerning the exit from the system located on one side inside the area and on the other side outside the area of full supervision.

5.1.4.5.Boundary for Case 5

Another situation for which the area of ETCS full supervision should be defined is the location on operating control points in accordance with a mirror image (at both ends), where on one side there is one situation described in sub-chapters 5.1.4.1÷5.1.4.4and on the other side trains are passed between neighbouring RBCs. Such a place within the RBC area that has taken over train supervision should include a contractual common border area where the vehicle is logged off from the other RBC. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both boundary ends determined by the chainage of entry to ETCS and, on the other side, the initialisation of supervision by individual RBCs. The information provided is complemented in a description by the design engineer with a location of the chainage concerning the exit from the system located on one side inside or outside the area and with the information concerning the chainage for which supervision is exercised in the border area by neighbouring RBCs.

5.1.4.6.Boundary for neighbouring RBCs

Another situation for which the area of ETCS full supervision should be defined is the location on operating control points in accordance with a mirror image (at both ends), where trains area passed between neighbouring RBCs . Such a place within the RBC area that has taken over train supervision should include a contractual common border area where the vehicle is logged off from the other RBC. With this configuration, the total chainage of the area of full supervision of the Class A interoperable system is counted between both boundary ends determined by the chainage of the initialisation of

supervision by individual RBCs. The information provided is complemented in a description by the design engineer with information concerning the chainage for which supervision is exercised in the border area by neighbouring RBCs.

5.1.5. System programming language

Regardless of the transmission medium used, i.e. by radio using GSM-R, or by air gap using balises or cable loop, the information transmitted between trackside and on-board equipment is programmed using the ETCS language.

This language is based on variables, packages, messages and telegrams, the content of which, in accordance with the guidelines received from the STH infrastructure manager, is included by the design engineer in the developed design of ETCS.

Due to the fact that many variables (see Table 5) do not have defined values, the STH infrastructure manager is obliged to provide them to the design engineer, having determined them (obligatorily) at international level in relation to the identifiers indicated in the sub-chapter 4.1.1, 4.1.4, 4.1.5 or at national level (with infrastructure managers, carriers) in relation to the variables listed in Table 5.

Variables received from the STH infrastructure manager will be used by the design engineer to encode individual data values in ETCS, which as a variable has a specific type/meaning.

Table 6. Classification of variables

Prefix	Meaning of the variable
A_	Acceleration
D_	Distance
G_	Gradient
L_	Length
M_	Miscellaneous
N_	Number
NC_	Class Number
NID_	Identity Number
Q_	Qualifier
T_	Time
V_	Speed
X_	Text

A list of many variables as part of works performed by the design engineer is grouped into one unit referred to as a package of a specific structure with a defined intrinsic value.

The list of variables and packages used by the design engineer for a design of a specific railway line is described in detail in a relevant document compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

5.2. Design of ETCS installation on the railway line

5.2.1. Track layout mapping in ETCS

The design engineer, based on input data received from the STH infrastructure manager, on the basis of the executed track layout developed on the basis of the guidelines included in Volume I.1 on railway track concerning track layout geometry, using the guidelines included in Volume I.4 on railway track describing the gauge issues, Volume II.1 and II.2 referring to the overhead catenary system and 2 x 25 kV AC and 3 kV DC traction power supply, Volume III.1 and III.2 concerning engineering structures and tunnels, Volume VI.1 describing control command and signalling with regard to basic equipment, Volumes VII.1 and VII.3 describing fixed and wireless communication systems and data transmission as well as detection of rolling stock failure conditions, shall develop a design for ETCS installation on the designed railway line.

The developed design for the railway line indicated in Table 1, i.e.: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3 or at the point of contact with the infrastructure manager of PKP Polskie Linie

Kolejowe S.A. shall be prepared in accordance with the set of specifications indicated by the STH infrastructure manager and relevant documentation in accordance with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

The design engineer, taking into account the power supply requirements for control command and signalling equipment according to the provisions of Volume IV: Non-OCL power engineering, shall coordinate the fulfilment of the power supply requirements for CCS equipment and ETCS with the design of the base layer control command and signalling equipment.

As part of the design works, for the designed equipment to be installed in technical buildings, as part of the design coordination, the design engineer shall agree, in accordance with the requirements of Volume VIII.2, the necessary area required for the designed internal equipment of ETCS.

5.2.2. Using variables in the system

For a set of specifications indicated by the STH infrastructure manager, for ETCS to be installed, the design engineer shall, with reference to the relevant documentation compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7] taking into account the programming language described in sub-chapter 5.1.5, include all packages required for a given railway line for the exchange of information between trackside equipment and on-board equipment as well as on-board equipment and trackside equipment.

5.2.3. Mapping of indicators in ETCS

While preparing the design documentation for the railway lines on which ETCS will be installed, the design engineer shall include the encoding of the signalling system applicable at the STH railway manager as well as at contact lines of the infrastructure manager of PKP Polskie Linie Kolejowe S.A. and indicators applicable at both infrastructure managers. Signalling planned for installation as well as indicators in ETCS must be compliant with the description included in Volume VI.1: control command and signalling – basic equipment.

5.2.4. Mapping of system boundaries for subsequent projects

For a set of specifications, indicated by the STH infrastructure manager, for ETCS to be installed for the railway line indicated in Table 1, i.e.: STH P1, STH P2, STH P3, STH M1, STH M2, STH M3, the design engineer, with the participation of the STH infrastructure manager acting as an integrator, with reference to the relevant documentation compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [4], designs interconnections of individual investment tasks executed on the STH infrastructure.

Due to the fact that the entire railway network of STH is equipped with ETCS, it is not planned to design entry and exit transitions from the system. All designed transitions shall include only and exclusively indication of transitions between different levels of ETCS, in accordance with applicable legal requirements [3] as amended [4]÷[7], and in the case of technical support facilities described in Volume XIII, application of appropriate mode of operation of traction vehicles.

5.2.5. Mapping of system boundaries for projects on points of contact of infrastructure managers

The design engineer, taking into account provisions of sub-chapter 0, for the set of specifications indicated by the STH infrastructure manager for ETCS to be installed for the railway line on a point of contact with the infrastructure manager of PKP Polskie Linie Kolejowe S.A., in consultation with PKP Polskie Linie Kolejowe S.A., with the participation of the STH infrastructure manager acting as an integrator, with reference to the relevant documentation compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], designs the interconnections of individual investment tasks executed on points of contact of both infrastructure managers.

For the contact lines between infrastructure managers, all designed transitions shall include indications of both the entry and exit transitions from the system and indications of the transitions between different levels of ETCS, in accordance with applicable legal requirements [3] as amended [4]÷[7] and the levels expected to be used at infrastructure managers with whose infrastructure the connection is made.

5.3. Mapping of data related to the rolling stock in the system

For a set of specifications indicated by the STH infrastructure manager, for ETCS to be installed, the design engineer shall, with reference to the relevant documentation compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], taking into account the programming language described in sub-chapter 5.1.5, include in the prepared design documentation all variables and packages available for the given specification, with reference to the designed railway line, which will enable the trackside equipment to issue commands to the on-board equipment to control other equipment installed on the traction rolling stock. This may apply, for example, to unlocking of train doors at the correct platform edge, platform height, to controlling of ventilation dampers, etc., which will be compliant with the requirements of Volume I.1 on railway track concerning track layout geometry, Volume III.1 and III.2 concerning engineering structures and tunnels, Volume VIII.3 concerning structures with respect to platforms,

The scope of such information that can be used in ETCS, shall be agreed and approved by the design engineer during the design phase with the STH infrastructure manager, using the user ID indicated in sub-chapter 4.1.4 and received from the STH infrastructure manager.

5.4. Mapping of data related to the infrastructure in the system

For a set of specifications indicated by the STH infrastructure manager, for ETCS to be installed, the design engineer shall, with reference to the relevant documentation compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], taking into account the programming language described in sub-chapter 5.1.5, include in the prepared design documentation all variables and packages available for the given specification, with reference to the designed railway line, which will enable the trackside equipment to provide the on-board equipment with information relevant for the passage of the traction rolling stock on a particular railway line. This may apply, for example, to all information related to the track layout geometry (gradient), speed limits, places of prohibited stopping of a traction vehicle, information on voice communication channels, text information on a condition of a vehicle from devices for detection of rolling stock failure conditions, etc., which information shall be compliant with the requirements of Volume I.1 on railway track concerning track layout geometry, Volume II.1 and II.2 referring to the overhead catenary system and 2 x 25 kV AC and 3 kV DC traction power supply, Volume III.1 and III.2 concerning engineering structures and tunnels, Volumes VII.1 and VII.3 describing fixed and wireless communication systems and data transmission as well as detection of rolling stock failure conditions.

The scope of such information that can be used in ETCS shall be agreed and approved by the design engineer during the design phase with the STH infrastructure manager during the design phase.

5.5. Mapping of overhead catenary system in the system

For a set of specifications indicated by the STH infrastructure manager, for ETCS to be installed, the design engineer shall, with reference to the relevant documentation compliant with the index in Table A 2.1 or Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7], taking into account the programming language described in sub-chapter 5.1.5, include in the prepared design documentation all variables and packages available for the given specification, with reference to the designed railway line, which will enable the trackside equipment to provide the on-board equipment with information

relevant to the traction rolling stock and to give commands to the on-board equipment to control other equipment installed on the traction rolling stock. This may apply, for example, to all information related to the power supply system of the overhead catenary system, prevention of entry of unauthorised rolling stock to the railway line, lowering/lifting of a pantograph, each without current consumption, etc., which information shall be compliant with the requirements of Volume II.1 and II.2 referring to the overhead catenary system and 2 x 25 kV AC and 3 kV DC traction power supply, Volume VI.1 describing control command and signalling with regard to basic equipment (indicators).

The scope of such information that can be used in ETCS, shall be agreed and approved by the design engineer during the design phase with the STH infrastructure manager, using the traction system ID(s) indicated in sub-chapter 4.1.5 and received from the STH infrastructure manager.

5.6. Compliance with safety, security and cybersecurity requirements

Control command and signalling equipment and systems, for which requirements are indicated in Volume VI.1 on control command and signalling – basic equipment and ETCS described in this volume, meeting the specified safety standards defined in RAMS standards (PN-EN 50xxx, in accordance with Table A 3 of Annex A [3], as amended [4]÷[7]), including systems using data transmission that is safe from the point of view of control command and signalling, must be built using closed networks (i.e. protected against physical access) in accordance with the recommendations of PN-EN 50159:2011. Cybersecurity requirements will therefore not apply to networks that are safe from the point of view of control command and signalling and ETCS, whereas CENELEC requirements resulting from PN-EN 50XXX series of standards will apply to data transmission safety.

6) Interfaces of the basic equipment for control command and signalling with the ETCS equipment

6.1. Interfaces of the basic equipment for control command and signalling with the ETCS equipment on STH railway lines

The STH infrastructure manager for the railway lines under their management shall, in accordance with the provisions of point 5.1.3, plan parallel construction and putting into service of the basic equipment for control command and signalling as described in Volume VI.1 and of the ETCS system. Due to the lack of formal standardisation of the interface between the above-mentioned groups of equipment, the design engineer shall take into account in this respect a solution developed as optimum by the manufacturer of the above-mentioned groups of equipment, whereas it is recommended to prefer solutions based on a common data transmission bus, which ensure the highest integration of equipment and, at the same time, the lowest delays in signal transmission.

6.2. Interfaces of the basic equipment for control command and signalling with the ETCS equipment at points of contact between railway managers.

The STH infrastructure manager for points of contact between railway lines under their management and railway lines under the management of PKP Polskie Linie Kolejowe S.A. shall make appropriate arrangements in the scope of interfaces between the basic equipment for control command and signalling as described in Volume VI.1 and the ETCS equipment. In a case of installation of the basic equipment for control command and signalling by the STH infrastructure

manager on the operating control point being a point of contact between the STH railway network and the railway network managed by PKP Polskie Linie Kolejowe S.A., the design engineer is obliged to take into account such a technical solution as regards the interface of this equipment to the ETCS equipment in order to ensure:

- ✓ possibly uniform way of equipping the STH infrastructure with the ETCS system,
- ✓ opening of the interface for the current or future equipment of the infrastructure managed by PKP Polskie Linie Kolejowe S.A. with ETCS in accordance with a standard adopted by that infrastructure manager in that scope.

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7) Standards for the vehicle part (interfaces of the control-command and signalling subsystem and rolling stock subsystem)

Since the STH infrastructure manager will not act as a carrier nor be the owner of traction vehicles travelling on their network, and the interoperability constituents listed below (sub-chapter 7.1) as well as an illustrative group of constituents (sub-chapter 7.2) relate to the control-command and signalling trackside subsystem for which carriers are responsible, the following points do not constitute requirements for signalling, control-command and signalling and railway traffic operation management. However, for interoperable lines, the infrastructure manager shall require their use by carriers.

Basic interoperability constituents and groups of interoperability constituents belonging to the control-command and signalling trackside subsystem and their requirements are indicated in Table 5.1a and Table 5.1b [3] as amended [4]÷[7].

7.1. Basic interoperability constituents of the control-command and Signalling trackside subsystem

7.1.1. On-board ETCS

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The on-board ETCS functionality (except odometry) is implemented and deployed in accordance with Annex A of the decision [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: functional interface for ETCS and GSM-R air gap transmission between the radio block centre (RBC) (radio data transmission – optional), radio information upgrade device (optional function), Eurobalise wireless transmission, Euroloop air gap transmission (optional function) is described in Annex A [3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. Interfaces: the function interface between the Specific Transmission Module (STM) (implementation of Interface K is optional), GSM-R radio for ETCS data transmission, odometry, key management system, ETCS-ID management, ETCS driver/machine interface, train interface, on-board recording equipment is described in Annex A [3] as amended [4]÷[7] and in technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
5. Requirements for the equipment construction, i.a.: with reference to physical environmental conditions, electromagnetic compatibility, flammability are described in Annex A[3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]÷[7].

7.1.2. Odometry equipment

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

2. The on-board ETCS functionality for odometry only is implemented and deployed in accordance with Annex A of the decision [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex [3] as amended [4]÷[7].
3. Interfaces: functional interface between the on-board ETCS is described in Annex A [3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. Requirements for the equipment construction, i.a.: with reference to physical environmental conditions, electromagnetic compatibility, flammability are described in Annex A[3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]÷[7].

7.1.3. Interface to the external Specific Transmission Module (STM)

1. Interfaces: functional interface between the on-board ETCS is described in Annex A [3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

7.1.4. Cabin GSM-R transceiver

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The basic communication functions are implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. The voice communication functions are implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. Interfaces: the functional interface between GSM-R air gap transmission, the GSM-R driver/machine interface is described in Annex A [3] as amended [4]÷[7] and in technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
5. Requirements for the equipment construction, i.a.: with reference to physical environmental conditions, electromagnetic compatibility, flammability are described in Annex A[3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]÷[7].

7.1.5. GSM-R radio for ETCS data transmission

1. Minimum requirements for reliability, availability, maintainability, safety related to the trackside control command and signalling subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The basic communication functions are implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

3. Data transmission for ETCS is implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

5. The interfaces: functional interface between on-board ETCS, GSM-R air gap transmission is described in Annex A [3] as amended [4]÷[7] and in technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
6. Requirements for the equipment construction, i.a.: with reference to physical environmental conditions, electromagnetic compatibility, flammability are described in Annex A[3] as amended [4]÷[7] and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A[3] as amended [4]÷[7].

7.1.6. GSM-R SIM card

1. The basic communication functions are implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. Requirements for the equipment construction are described in Annex A [3] as amended [4]÷[7] and in technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

7.2. Example of a group of interoperability constituents of the control-command and signalling trackside subsystem

7.2.1. Group On-board ETCS Odometry equipment

1. Minimum requirements for reliability, availability, maintainability, safety related to the control command and signalling trackside subsystem are presented in the EU Commission Regulation [3] as amended [4]÷[7] indicating relevant documents compliant with the index in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
2. The on-board ETCS functionalities are implemented and deployed in accordance with Annex A [3] as amended [4]÷[7] and with technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
3. Interfaces: functional interface for ETCS and GSM-R air gap transmission between the radio block centre (RBC) (radio data transmission – optional), radio information upgrade device (optional function), Eurobalise wireless transmission, Euroloop air gap transmission (optional function) is described in Annex A [3] as amended [4]÷[7]. and the technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
4. Interfaces: the function interface between the Specific Transmission Module (STM) (implementation of Interface K is optional), GSM-R radio for ETCS data transmission, key management system, ETCS-ID management, ETCS driver/machine interface, train interface, on-board recording equipment is described in Annex A [3] as amended [4]÷[7] and in technical specifications as described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].
5. Requirements for the equipment construction, i.a.: with reference to physical environmental conditions, electromagnetic compatibility, flammability are described in Annex A [3] as amended [4]÷[7] and in technical specifications described in Table A 2.2 or Table A 2.3 of Annex A [3] as amended [4]÷[7].

7.3. On-board equipment to allow rolling stock to travel on other infrastructure managers' lines (Class B systems)

When travelling on a line which is equipped with both systems, Class A i.e. ETCS and Class B (e.g. automatic train stop system, Radiostop, etc.), a train that is also equipped with both Class A and Class B systems may use the Class B system as an emergency solution. Fitting the Class B system in addition to Class A is not a requirement for compatibility of a vehicle with lines where Class B systems are installed alongside Class A systems.

7.4. Vehicle compatibility in ERTMS

Taking account of different feasibility and status of migration to fully compliant control-command and signalling subsystems, checks are carried out to demonstrate technical compatibility between control-command and signalling on-board and trackside subsystems.

7.4.1. Compatibility of ETCS

Compatibility of ETCS (ESC) means the recording of technical compatibility between ETCS on-board and ETCS trackside parts of command control signalling subsystems within a given area of use. ESC type means a value assigned to record the technical compatibility between ETCS on-board equipment and a given section within an area of use. All sections of the Union network that require a series of the same checks to demonstrate ETCS compatibility shall be assigned the same type of ESC.

7.4.2. Radio System Compatibility

Radio System Compatibility (RSC) means the recording of technical compatibility between on-board voice radio communication or radio data exchange systems and the trackside parts of GSM-R within control-command and signalling subsystems. RSC type means a value assigned to record the technical compatibility between voice radio communication or radio data exchange and a given section within an area of use. All sections of the Union network that require a series of the same checks to demonstrate radio system compatibility shall be assigned the same type of RSC.

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