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DECISIONS

2012/88/EU:

★ **Commission Decision of 25 January 2012 on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system** *(notified under document C(2012) 172)* [1] 1

Price: EUR 4

[1] Text with EEA relevance

EN

Acts whose titles are printed in light type are those relating to day-to-day management of agricultural matters, and are generally valid for a limited period.

The titles of all other acts are printed in bold type and preceded by an asterisk.

II

(Non-legislative acts)

DECISIONS

COMMISSION DECISION

of 25 January 2012

on the technical specification for interoperability relating to the control-command and signalling subsystems of the trans-European rail system

(notified under document C(2012) 172)

(Text with EEA relevance)

(2012/88/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community [1], and in particular the second subparagraph of Article 6(1) thereof,

Whereas:

(1) Commission Decision 2006/679/EC of 28 March 2006 concerning the technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European conventional rail system [2] laid down the technical specifications for interoperability ('TSI') relating to the control-command and signalling subsystem of the trans-European conventional rail system.

(2) Commission Decision 2006/860/EC of 7 November 2006 concerning a technical specification for interoperability relating to the control-command and signalling subsystem of the trans-European high speed rail system [3] lays down the TSI relating to the control-command and signalling subsystem of the trans-European high-speed rail system.

(3) The essential requirements for both the conventional and the high-speed networks must be identical, as must their functional and technical specifications, their interoperability constituents and interfaces, and the procedures for assessing the conformity or the suitability for use of the interoperability constituents or the 'EC' verification of their control-command and signalling subsystems.

(4) The implementation strategies should remain specific to each type of network and the existing requirements for the conventional trans-European network and for the high-speed trans-European network should remain unchanged. The European railway agency ('Agency') was given a framework mandate to perform certain activities.

(5) On 31 January 2011 the Agency gave its recommendation on the technical specification for interoperability relating to the subsystems 'control-command and signalling' of the trans-European rail system [4]. This Decision is based on that recommendation.

(6) In the interest of clarity, Decisions 2006/679/EC and 2006/860/EC should therefore be replaced by this Decision.

(7) The changes introduced regarding safety requirements (Section 4.2.1 of Annex III) are based on the analysis that the text in the CCS TSIs in force leaves room for interpretations. The introduced changes have no negative impact in the overall safety level.

(8) The fitting of ERTMS/ETCS should be mandatory in the case of new installations or upgrade of the train protection part of a CCS assembly for railway infrastructure projects benefiting from EU financial support. Such fitting should in principle be carried out in the frame of the EU funded project. In certain cases, it is however necessary to grant a derogation to this implementation rule. The scope of such derogation is limited to the implementation strategy of the 'control-command and signalling TSI'.

[1] OJ L 191, 18.7.2008, p. 1.
[2] OJ L 284, 16.10.2006, p. 1.
[3] OJ L 342, 7.12.2006, p. 1.
[4] ERA/REC/2011-03/ERTMS.

(9) The Agency has listed in the technical document 'List of CCS Class B systems' the national legacy control-command and signalling systems ('Class B systems'). Those systems may still be requested on board locomotives and traction units to run on certain lines.

(10) The Class B systems significantly hamper the interoperability of locomotives and traction units but play an important role in maintaining the high level of safety of the trans-European network. For this reason, it is important to avoid creating additional obstacles to interoperability by, for example, altering these national legacy systems or by introducing new systems.

(11) To avoid creating additional obstacles to interoperability, Member States should ensure that the functionality of the legacy Class B systems and their interfaces remain as currently specified, except where modifications are needed to mitigate safety-related flaws in these systems. Member States should also ensure that systems not included in the list of Class B systems do not constitute additional barriers to interoperability.

(12) The availability of the GSM-R frequencies is essential for safe and interoperable railway operations.

(13) Decisions 2006/679/EC and 2006/860/EC should therefore be repealed.

(14) The measures provided for in this Decision are in accordance with the opinion of the Committee, referred to in Article 29(1) of Directive 2008/57/EC,

HAS ADOPTED THIS DECISION:

Article 1

1. The technical specification for interoperability ('TSI') relating to the 'track-side control-command and signalling' subsystem and 'on-board control-command and signalling subsystems' of the trans-European rail system, as set out in Annex III, is adopted.

2. The TSI set out in Annex III to this Decision shall apply to the track-side control-command and signalling subsystem as described in point 2.3 and to the on-board control-command and signalling subsystem as described in point 2.4 of Annex II to Directive 2008/57/EC.

Article 2

1. Member States shall ensure that, whenever a national protection control-command system is requested on board rolling stock to run on a given line or part of the trans-European network, this system is included in the list of Class B systems, having equal legal value as annexes to the TSI.

2. Member States shall ensure that the functionality, performance and interfaces of the Class B systems remain as currently specified, except where modifications are needed to mitigate safety-related flaws in those systems.

Article 3

Each Member State shall notify to the other Member States and to the Commission, with regard to Class B systems and to those issues identified as open points in Appendix G to the TSI adopted by this Decision, within 6 months of the notification of this Decision, the following:

(a) the list of applicable technical rules;

(b) the conformity assessment and checking procedures to be used for ensuring that the applicable technical rules are indeed applied;

(c) the bodies it appoints for carrying out those conformity-assessment and checking procedures.

If these elements have already been notified in the context of Decisions 2006/679/EC and 2006/860/EC this obligation is considered fulfilled.

Article 4

1. The Commission may grant a derogation to the obligation laid down in Section 7.3.2.4 of Annex III concerning the mandatory equipment of lines with the European Train Control System (ETCS) in the context of EU funded projects (Section 7.3.2.4), when signalling is renewed on short (less than 150 km) and discontinuous sections of a line and provided that ETCS is installed before the earlier of these two dates:

— 5 years after the end of the project,

— the time by which the section of the line is connected to another ETCS equipped line.

2. The Member State concerned shall forward a file concerning the project to the Commission. This file shall contain an economic analysis showing that there is a substantial economic and/or technical advantage in putting ERTMS into service at the earlier of the two dates mentioned in paragraph 1 rather than during the course of the EU-funded project.

3. The Commission shall examine the file sent to it and the measures proposed by the Member State and shall notify the results of its examination to the Committee referred to in Article 29 of Directive 2008/57/EC. If a derogation is granted, the Member State shall ensure that ERTMS is installed before the earlier of the two dates mentioned in paragraph 1.

Article 5

Commission Decision 2011/291/EU of 26 April 2011 concerning a technical specification for interoperability relating to the rolling stock sub-system – 'Locomotives and Passenger rolling stock' of the trans-European conventional rail system [1] is amended as follows:

(1) the second indent under the headline 'Legislative measures in force' in Section 1.4 'Referenced documents' of the Annex is replaced by 'Control-Command and Signalling TSI';

(2) Section 4.2.3.3.1 is replaced by Annex I to this Decision;

(3) Table 10 in Section 4.3.4 is replaced by Annex II to this Decision.

Article 6

The ERA technical document ERTMS/ETCS System Requirement Specification (SRS), document reference 'subset-026' in version 3.2.0, dated 22 December 2010, can be used as a basis to tender the equipment of lines with ETCS and to carry out tests, but before the entry into force of the so-called baseline 3, the fitment of trains with baseline 3 cannot be requested.

Article 7

Decisions 2006/679/EC and 2006/860/EC are hereby repealed. Their provisions shall however continue to apply in relation to maintenance of projects authorised in accordance with the TSIs annexed to those Decisions and, unless the applicant requests to apply this Decision, to projects for new, renewed or upgraded subsystems which are at an advanced stage of development or the subject of a contract in course of performance at the date of notification of the present Decision.

Article 8

This Decision shall apply 6 months after its notification to the Member States.

Article 9

This Decision is addressed to the Member States.

Done at Brussels, 25 January 2012.

For the Commission

Siim KALLAS

Vice-President

[1] OJ L 139, 26.5.2011, p. 1.

ANNEX I

'4.2.3.3.1. Rolling Stock characteristics for the compatibility with train detection systems

The set of rolling stock characteristics for compatibility with train detection target systems are given in clauses 4.2.3.3.1.1, 4.2.3.3.1.2 and 4.2.3.3.1.3.

Reference is made to clauses of the specification referenced in Annex A, Index 77 of CCS TSI'

The set of characteristics the rolling stock is compatible with shall be recorded in the rolling stock register as defined in clause 4.8 of this TSI.

4.2.3.3.1.1. ROLLING STOCK CHARACTERISTICS FOR COMPATIBILITY WITH TRAIN DETECTION SYSTEM BASED ON TRACK CIRCUITS

— Vehicle geometry

— The maximum distance between two consecutive axles is specified in the specification referenced in clause 3.1.2 of Annex A, Index 77 of CCS TSI (distance ai in Figure 1).

— The maximum distance between buffer end and first axle is specified in the specification referenced in clause 3.1.2 of Annex A, Index 77 of CCS TSI (distance b_1 in Figure 1).

— Vehicle design

— The minimum axle load in all load conditions is specified in the specification referenced in clause 3.1.7 of Annex A, Index 77 of CCS TSI.

— The electrical resistance between the running surfaces of the opposite wheels of a wheelset is specified in the specification referenced in clause 3.1.9 of Annex A, Index 77 of CCS TSI and the method to measure is specified in the same clause.

— For electric units equipped with a pantograph, the minimum impedance between pantograph and each wheel of the train is an open point in the specification referenced in clause 3.2.2 of Annex A, Index 77 of CCS TSI.

— Isolating emissions

— The limitations of use of sanding equipment are given in the specification referenced in clause 3.1.4 of Annex A, Index 77 of CCS TSI.

— The limitations of use of composite brake blocks are given in the specification referenced in clause 3.1.6 of Annex A, Index 77 of CCS TSI.

— EMC

— The requirements related to electromagnetic compatibility are open points in the specification referenced in clauses 3.2.1 and 3.2.2 of Annex A, Index 77 of CCS TSI.

— The electromagnetic interference limit levels rising from traction currents are an open point in the specification referenced in clause 3.2.2 of Annex A, Index 77 of CCS TSI.

4.2.3.3.1.2. ROLLING STOCK CHARACTERISTICS FOR COMPATIBILITY WITH TRAIN DETECTION SYSTEM BASED ON AXLE COUNTERS

— Vehicle geometry

— The maximum distance between two consecutive axles is specified in the specification referenced in clause 3.1.2, Annex A, Index 77 of CCS TSI.

— The minimum distance between two consecutive axles of the train is specified in the specification referenced in clause 3.1.2, Annex A, Index 77 of CCS TSI.

— At the end of a unit intended to be coupled, the minimum distance between end and first axle of the unit is half of the value specified in the specification referenced in clause 3.1.2, Annex A, Index 77 of CCS TSI.

— The maximum distance between end and first axle is specified in the specification referenced in clause 3.1.2, Annex A, Index 77 of CCS TSI (distance b_1 in Figure 1).

— The minimum distance between end axles of a unit is specified in the specification referenced in clause 3.1.2, Annex A, Index 77 of CCS TSI.

— Wheel geometry

— Wheel geometry is specified in the clause 4.2.3.5.2.2 of the present TSI.

— The minimum wheel diameter (speed dependant) is specified in the specification referenced in clause 3.1.3, Annex A, Index 77 of CCS TSI.

— Vehicle design

— The metal-free space around wheels is an open point in the specification referenced in clause 3.1.3.5, Annex A, Index 77 of CCS TSI.

— The characteristics of the wheel material regarding magnetic field is specified in the specification referenced in clause 3.1.3.6, Annex A, Index 77 of CCS TSI.

— EMC

— The requirements related to electromagnetic compatibility are specified in the specification referenced in clauses 3.2.1 and 3.2.2 of Annex A, Index 77 of CCS TSI.

— The electromagnetic interference limit levels rising from the use of eddy current or magnetic track brakes are an open point in the specification referenced in clause 3.2.3 of Annex A, Index 77 of CCS TSI.

4.2.3.3.1.3. ROLLING STOCK CHARACTERISTICS FOR COMPATIBILITY WITH LOOP EQUIPMENT

— Vehicle design

The metal-mass of vehicles is an open point in the specification referenced in clause 3.1.7.2 of Annex A, Index 77 of CCS TSI.'

ANNEX II

'Table 10

Interface with the control-command and signalling subsystem

Reference Conventional Rail LOC & PAS TSI		Reference Rail CCS TSI	
Parameter	Clause	Parameter	Clause
Rolling stock characteristics compatible with train detection system based on track circuits	4.2.3.3.1.1	Vehicle geometry Vehicle design Isolating emissions EMC	Specification referenced in Annex A, Index 77 of CCS TSI
Rolling stock characteristics compatible with train detection system based on axle counters	4.2.3.3.1.2	Vehicle geometry Wheel geometry Vehicle design EMC	Specification referenced in Annex A, Index 77 of CCS TSI
Rolling stock characteristics compatible with loop equipment	4.2.3.3.1.3	Vehicle design	Specification referenced in Annex A, Index 77 of CCS TSI
Emergency braking command	4.2.4.4.1	On-board ETCS functionality	4.2.2
Emergency braking performance	4.2.4.5.2	Guaranteed train braking performance and characteristics	4.2.2
External visibility	4.2.9.1.3	Visibility of track-side control-command objects	4.2.15'

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1. INTRODUCTION

1.1. **Technical scope**

This TSI concerns the Control-Command and Signalling On-board Subsystem and the Control-Command and Signalling Track-side Subsystem.

1.2. **Geographical scope**

The geographical scope of this TSI is the trans-European rail system, i.e. the trans-European conventional and high-speed rail systems as set out in points 1 and 2 of Annex I to Directive 2008/57/EC (Railway Interoperability Directive).

1.3. **Content of this TSI**

In accordance with Article 5(3) of the Railway Interoperability Directive, this TSI:

1. indicates its intended scope — Chapter 2 (Subsystem Definition and Scope);

2. lays down essential requirements for the Control-Command and Signalling Subsystems and their interfaces vis-à-vis other subsystems — Chapter 3 (The Essential Requirements of the Control-Command and Signalling Subsystems);

3. lays down the functional and technical specifications to be met by the Subsystems and their interfaces with other subsystems — Chapter 4 (Characterisation of the Subsystem);

4. determines the interoperability constituents and interfaces which must be covered by European specifications, including European standards, and which are necessary to achieve interoperability within the trans-European rail system — Chapter 5 (Interoperability Constituents);

5. states, in each case under consideration, which procedures are to be used to assess the conformity or the suitability for use of the interoperability constituents and for the 'EC' verification of the subsystems — Chapter 6 (Assessing the Conformity and/or Suitability For Use of the Constituents and Verifying the Subsystems);

6. indicates the strategy for implementing this TSI — Chapter 7 (Implementing the Control-Command and Signalling Subsystems TSI);

7. indicates the professional competences and health and safety conditions at work required for the staff operating and maintaining these subsystems and implementing the TSI — Chapter 4 (Characterisation of the Subsystem).

In accordance with Article 5(5) of the Railway Interoperability Directive, provisions for specific cases are indicated in Chapter 7 (Implementing the Control-Command and Signalling Subsystems TSI).

This TSI also sets out, in Chapter 4 (Characterisation of the Subsystems), the operating and maintenance rules which specifically apply to the scope indicated in paragraphs 1.1 and 1.2 above.

2. SUBSYSTEM DEFINITION AND SCOPE

2.1. **Introduction**

The Control-Command and Signalling Subsystems are defined in Annex II to the Railway Interoperability Directive as 'all the equipment required to ensure safety and to command and control movements of trains authorised to travel on the network'.

The features of the Control-Command and Signalling Subsystems are:

1. the functions that are essential for the safe control of railway traffic, and that are essential for its operation, including those required for degraded modes ([1]);

2. the interfaces;

3. the level of performance required to meet the essential requirements.

2.2. **Scope**

The Control-Command and Signalling Subsystems TSI specifies only those requirements which are necessary to assure the interoperability of the trans-European rail system and compliance with the essential requirements.

The Control-Command and Signalling Subsystems include the following parts:

([1]) Degraded modes are modes of operation designed to deal with faults. They have been taken into account when designing the Control-Command and Signalling Subsystems.

1. train protection;

2. radio communication;

3. train detection.

The Class A train protection system is ERTMS/ETCS whilst the Class A radio system is GSM-R.

For Class A train detection this TSI specifies only the requirements for the interface with other subsystems.

Class B systems are a limited set of train protection legacy control-command and signalling systems that were in use before 20 April 2001. The list of Class B systems is established in the European Railway Agency technical document 'List of CCS Class B systems', ERA/TD/2011-11, version 1.0.

The requirements for the Control-Command and Signalling On-board Subsystem are specified in relation to Class A radio mobiles and train protection.

The requirements for the Control-Command and Signalling Track-side Subsystem are specified in relation to:

1. the Class A radio network;

2. Class A train protection;

3. the interface requirements for train detection systems, to ensure their compatibility with rolling stock.

2.3. **Application levels (ERTMS/ETCS)**

The interfaces specified by this TSI define the means of data transmission to, and (where appropriate) from trains. The ERTMS/ETCS specifications referenced by this TSI provide application levels from which a track-side implementation may choose the means of transmission that meet its requirements.

This TSI defines the requirements for all application levels.

A train equipped with Class A on-board train protection for a given application level must be able to operate on that level and any lower one. As a consequence:

— a train equipped with Class A on-board train protection for level 2 must be able to operate on that level and on level 1 lines,

— a train equipped with Class A on-board train protection for level 1 need not be equipped with a GSM-R data radio but must already implement all level 2 functions so as to ensure that the mere connection of a GSM-R data radio at a later stage will ensure it is equipped for level 2.

3. THE ESSENTIAL REQUIREMENTS FOR THE CONTROL-COMMAND AND SIGNALLING SUBSYSTEMS

3.1. **General**

The Railway Interoperability Directive requires that the subsystems and the interoperability constituents including interfaces meet the essential requirements set out in general terms in Annex III to the Directive.

The essential requirements are:

1. Safety;

2. Reliability and Availability;

3. Health;

4. Environmental Protection;

5. Technical compatibility.

The essential requirements for Class A systems are described below.

The requirements for Class B systems are the responsibility of the relevant Member State.

3.2. **Specific Aspects of the Control-Command and Signalling Subsystems**

3.2.1. *Safety*

Every project to which this specification is applied shall take the measures necessary to ensure that the level of risk of an incident occurring within the scope of the Control-Command and Signalling Subsystems, is not higher than the objective for the service. For this purpose Commission Regulation (EC) No 352/2009 of 24 April 2009 on the adoption of a common safety method on risk evaluation and assessment as referred to in Article 6(3)(a) of Directive 2004/49/EC of the European Parliament and of the Council [1] (Common Safety Method) applies.

To ensure that the measures taken to achieve safety do not jeopardise interoperability, the requirements of the basic parameter defined in Section 4.2.1 (Control-Command and Signalling safety characteristics relevant to interoperability) shall be respected.

For the ERTMS/ETCS Class A system the safety objective is apportioned between the Control-Command and Signalling On-board and Track-side Subsystems. The detailed requirements are specified in the basic parameter defined in Section 4.2.1 (Control-Command and Signalling safety characteristics relevant to interoperability). This safety requirement must be met together with the availability requirements as defined in Section 3.2.2 (Reliability and Availability).

3.2.2. *Reliability and Availability*

For the Class A system, the reliability and availability objectives are apportioned between the Control-Command and Signalling On-board and Track-side Subsystems. The detailed requirements are specified in the basic parameter defined in Section 4.2.1 (Control-Command and Signalling safety characteristics relevant to interoperability).

The level of risk shall be monitored as constituents of the subsystem age and wear. The requirements for maintenance stated in Section 4.5 shall be respected.

3.2.3. *Health*

In accordance with EU regulations and with national regulations that are compatible with the European legislation, care shall be taken to ensure that the materials used in and the design of the Control-Command and Signalling Subsystems do not constitute a health hazard to persons having access to them.

3.2.4. *Environmental Protection*

In accordance with EU regulations and with national regulations that are compatible with European legislation:

1. the Control-Command and Signalling equipment, if subjected to excessive heat or fire, shall not exceed limits for the emission of fumes or gases which are harmful to the environment;

2. the Control-Command and Signalling equipment shall not contain substances which may abnormally contaminate the environment during their normal use;

3. the Control-Command and Signalling equipment shall be subject to the European legislation in force controlling the limits to the emission of and the susceptibility to electromagnetic interference along the boundaries of railway property;

4. the Control-Command and Signalling equipment shall comply with existing regulations on noise pollution;

5. the Control-Command and Signalling equipment shall not give rise to any inadmissible level of vibration which could jeopardise the integrity of the infrastructure (when the infrastructure is in the correct state of maintenance).

3.2.5. *Technical Compatibility*

Technical compatibility includes the functions, interfaces and performances required to achieve interoperability.

The requirements of technical compatibility are subdivided in the following three categories:

1. The first category sets out the general engineering requirements for interoperability namely environmental conditions, internal electromagnetic compatibility (EMC) within the railway boundaries, and installation. These compatibility requirements are defined in this chapter.

2. The second category describes how the Control-Command and Signalling Subsystems have to be applied technically and what functions they have to perform to ensure interoperability. This category is defined in Chapter 4.

[1] OJ L 108, 29.4.2009, p. 4.

3. The third category describes how the Control-Command and Signalling Subsystems have to be operated in order that interoperability is achieved. This category is defined in Chapter 4.

3.2.5.1. Engineering Compatibility

3.2.5.1.1. Physical environmental conditions

Control-Command and Signalling equipment shall be capable of operating under the climatic and physical conditions which characterise the area in which the relevant part of the trans-European rail system is located.

The requirements of basic parameter 4.2.16 (Environmental conditions) shall be respected.

3.2.5.1.2. Railway Internal Electromagnetic Compatibility

In accordance with EU regulations and with national regulations that are compatible with the European legislation, the Control-Command and Signalling equipment shall neither interfere with nor be interfered with by other control-command and signalling equipment or other subsystems.

The basic parameter related for electromagnetic compatibility between rolling stock and control-command and signalling track-side equipment is described in Section 4.2.11 (Electromagnetic Compatibility).

3.2.5.2. Control-Command and Signalling Compatibility.

Chapter 4 defines the requirements for the interoperability of the Control-Command and Signalling Subsystems.

In addition, where the Control-Command and Signalling Subsystems are concerned, this TSI ensures technical interoperability between trans-European high-speed rail and conventional rail systems when both are fitted with Class A systems.

4. CHARACTERISATION OF THE SUBSYSTEMS

4.1. **Introduction**

In accordance with the relevant essential requirements, the Control-Command and Signalling Subsystems are characterised by the following basic parameters:

1. Control-Command and Signalling safety characteristics relevant to interoperability (Section 4.2.1)
2. On-board ERTMS/ETCS functionality (Section 4.2.2)
3. Track-side ERTMS/ETCS functionality (Section 4.2.3)
4. Mobile communication functions for railways – GSM-R (Section 4.2.4)
5. ERTMS/ETCS and GSM-R air gap interfaces (Section 4.2.5)
6. On-board interfaces Internal to Control-Command and Signalling (Section 4.2.6)
7. Track-side interfaces Internal to Control-Command and Signalling (Section 4.2.7)
8. Key management (Section 4.2.8)
9. ETCS-ID management (Section 4.2.9)
10. Train detection systems (Section 4.2.10)
11. Electromagnetic compatibility between rolling stock and Control-Command and Signalling track-side equipment (Section 4.2.11)
12. ERTMS/ETCS DMI (driver machine interface) (Section 4.2.12)
13. GSM-R DMI (driver machine interface) (Section 4.2.13)
14. Interface to data recording for regulatory purposes (Section 4.2.14)
15. Visibility of track-side Control-Command and Signalling objects (Section 4.2.15)
16. Environmental conditions (Sections 4.2.16)

All requirements in Section 4.2 (Functional and technical specifications of the Subsystems) to meeting these basic parameters shall be applied to the Class A system.

Requirements for Class B systems and for STMs (which enable the Class A On-board system to operate on Class B infrastructure) are the responsibility of the appropriate Member State.

This TSI is based on the principles of enabling the Control-Command and Signalling Track-side Subsystem to be compatible with TSI compliant Control-Command and Signalling On-board Subsystems. To achieve this goal:

1. functions, interfaces and performances of the Control-Command and Signalling On-board Subsystem are standardised, ensuring that every train will react in a predictable way to data received from track-side;

2. for the Control-Command and Signalling Track-side Subsystem, track-to-train and train-to-track communication are fully standardised in this TSI. The specifications referenced in the sections below allow Control-Command and Signalling track-side functionality to be applied in a flexible way, so that it can be optimally integrated into the railway system. This flexibility shall be exploited without limiting the movement of TSI-compliant on-board subsystems.

The Control-Command and Signalling functions are classified in categories indicating whether they are optional (O) or mandatory (M). The categories are defined in Annex A 4.1a for ERTMS/ETCS and Annex A 4.1b for GSM-R and these texts also state how the functions are classified.

Annex A 4.1c provides the Glossary of ERTMS/ETCS terms and definitions, which are used in the specifications referred to in Annex A.

According to Section 2.2 (Scope) the Control-Command and Signalling Subsystems include three parts.

The following table indicates which basic parameters are relevant for each subsystem and for each part.

Subsystem	Part	Basic parameters
Control-Command and Signalling On-board	train protection	4.2.1, 4.2.2, 4.2.5, 4.2.6, 4.2.8, 4.2.9, 4.2.12, 4.2.14, 4.2.16
	radio communication	4.2.4, 4.2.5, 4.2.6, 4.2.13, 4.2.14, 4.2.16
Control-Command and Signalling Track-side	train protection	4.2.3, 4.2.5, 4.2.7, 4.2.8, 4.2.9, 4.2.15, 4.2.16
	radio communication	4.2.4, 4.2.5, 4.2.7, 4.2.16
	train detection	4.2.10, 4.2.11, 4.2.16

With respect to the essential requirements set out in Chapter 3, the functional and technical specifications of the Control-Command and Signalling Subsystems are as follows.

4.2. Functional and technical specifications of the Subsystems

4.2.1. *Control-Command and Signalling safety characteristics relevant to interoperability*

This basic parameter describes the requirements for the Control-Command and Signalling On-board Subsystem and Track-side subsystem with reference to Section 3.2.1 (Safety) and Section 3.2.2 (Availability and Reliability).

In order to achieve interoperability, when implementing Control-Command and Signalling On-board and Track-side subsystems the following provisions shall be respected:

1. The design, implementation and use of a Control-Command and Signalling On-board or Track-side subsystem shall not export any requirements:

   (a) across the interface between Control-Command and Signalling On-board and Track-side subsystems in addition to the requirements specified in this TSI;

   (b) to any other subsystem in addition to the requirements specified in the corresponding TSIs.

2. The requirements set out in Sections 4.2.1.1 and 4.2.1.2 below shall be respected.

4.2.1.1. Safety

The Control-Command and Signalling On-board and Track-side subsystems shall respect the requirements for ERTMS/ETCS equipment and installations stated in this TSI.

For the hazard 'exceeding speed and/or distance limits advised to ERTMS/ETCS' the tolerable rate (THR) is 10^{-9} h^{-1} for random failures, for on-board ERTMS/ETCS and for track-side ERTMS/ETCS. See Annex A 4.2.1.a.

To achieve interoperability, the on-board ERTMS/ETCS shall fully respect all requirements specified in Annex A 4.2.1. Nevertheless, less stringent safety requirements are acceptable for track-side ERTMS/ETCS provided that, in combination with TSI-compliant Control-Command and Signalling On-board subsystems, the safety level for the service is met.

Requirements for hazards related to errors at the interface between driver and on-board ERTMS/ETCS are an open point.

4.2.1.2. Availability/Reliability

The Control-Command and Signalling On-board and Track-side subsystems shall respect the requirements stated in this TSI. The availability/reliability requirements are defined in Annex A 4.2.1.b.

The level of risk shall be controlled during the life of the assemblies. The requirements for maintenance stated in Section 4.5 (Maintenance rules) shall be respected.

4.2.2. *On-board ERTMS/ETCS functionality*

The basic parameter for ERTMS/ETCS on-board functionality describes all of the functions needed to run a train in a safe way. The primary function is to provide automatic train protection and cab signalling:

1. setting the train characteristics (e.g. maximum train speed, braking performance);

2. selecting the supervision mode on the basis of information from track-side;

3. performing odometry functions;

4. locating the train in a coordinate system based on Eurobalise locations;

5. calculating the dynamic speed profile for its mission on the basis of train characteristics and of information from track-side;

6. supervising the dynamic speed profile during the mission;

7. providing the intervention function.

These functions shall be implemented in accordance with Annex A 4.2.2.b and their performance shall conform to Annex A 4.2.2.a.

The requirements for tests are specified in Annex A 4.2.2.c.

The ETCS identities of equipment shall be managed in accordance with Section 4.2.9 (ETCS-ID management).

The main functionality is supported by other functions, to which Annex A 4.2.2.a and Annex A 4.2.2.b also apply, together with the additional specifications indicated below:

1. Communication with the Control-Command and Signalling Track-side Subsystem.

   (a) Eurobalise data transmission. See Section 4.2.5.2 (Eurobalise communication with the train);

   (b) Euroloop data transmission. See Section 4.2.5.3 (Euroloop communication with the train). This functionality is optional on-board unless Euroloop is installed track-side in ERTMS/ETCS Level 1 and the release speed is set to zero for safety reasons (e.g. protection of danger points);

(c) Radio data transmission for radio in-fill. See Annex A 4.2.2.d, Section 4.2.5.1 (Radio communications with the train), Section 4.2.6.2 (Interface between GSM-R Radio Data Communication and ERTMS/ETCS) and Section 4.2.8 (Key Management). This functionality is optional on-board unless radio data transmission for radio in-fill is installed track-side in ERTMS/ETCS Level 1 and the release speed is set to zero for safety reasons (e.g. protection of danger points);

(d) Radio data transmission. See Section 4.2.5.1 (Radio communications with the train), Section 4.2.6.2 (Interface between GSM-R Radio Data Communication and ERTMS/ETCS) and Section 4.2.8 (Key Management). Only mandatory on-board for ERTMS/ETCS Level 2 or ETCS Level 3 applications.

2. Communicating with the driver. See Annex A 4.2.2.e and Section 4.2.12 (ERTMS/ETCS DMI).

3. Communicating with the STM. See Section 4.2.6.1 (Interface between ERTMS/ETCS and STM). This function includes:

(a) managing the STM output;

(b) providing data to be used by the STM;

(c) managing STM transitions.

4. Managing information about the completeness of the train (train integrity) — mandatory for level 3, not required for level 1 or 2.

5. Equipment health monitoring and degraded mode support. This function includes:

(a) initialising the on-board ERTMS/ETCS functionality;

(b) providing degraded mode support;

(c) isolating the on-board ERTMS/ETCS functionality.

6. Support data recording for regulatory purposes. See Section 4.2.14 (Interface to Data Recording for Regulatory Purposes).

7. Forwarding information/orders and receiving state information from rolling stock:

(a) to the DMI. See Section 4.2.12 (ERTMS/ETCS DMI);

(b) to/from the train interface unit. See Annex A 4.2.2.f.

4.2.3. *Track-side ERTMS/ETCS functionality*

This Basic parameter describes the ERTMS/ETCS track-side functionality. It contains all ERTMS/ETCS functionality to provide a safe path to a specific train.

The main functionality is:

1. locating a specific train in a coordinate system based on Eurobalise locations (levels 2 and 3);

2. translating the information from track-side signalling equipment into a standard format for the Control-Command and Signalling On-board Subsystem;

3. sending movement authorities including track description and orders assigned to a specific train.

These functions shall be implemented in accordance with Annex A 4.2.3.b and their performance shall conform to Annex A 4.2.3.a.

The requirements for tests are specified in Annex A 4.2.3.c.

The ETCS identities of equipment shall be managed in accordance with Section 4.2.9 (ETCS-ID management).

The main functionality is supported by other functions, to which Annex A 4.2.3.a and Annex A 4.2.3.b also apply, together with the additional specifications indicated below:

1. Communicating with the Control-Command and Signalling On-board Subsystem. This includes:

(a) Eurobalise data transmission. See Section 4.2.5.2 (Eurobalise communication with the train) and Section 4.2.7.4 (Eurobalise/Line-side Electronic Unit (LEU));

(b) Euroloop data transmission. See Section 4.2.5.3 (Euroloop communication with the train) and Section 4.2.7.5 (Euroloop/LEU). Euroloop is only relevant in level 1, in which it is optional;

(c) Radio data transmission for radio in-fill. See Annex A 4.2.3.d, Section 4.2.5.1 (Radio communications with the train), Section 4.2.7.3 (GSM-R/track-side ETCS functionality) and Section 4.2.8 (Key Management). Radio in-fill is only relevant in level 1, in which it is optional;

(d) Radio data transmission. See Section 4.2.5.1 (Radio communications with the train), Section 4.2.7.3 (GSM-R/track-side ETCS functionality) and Section 4.2.8 (Key Management). Radio data transmission is only relevant to levels 2 and 3.

2. Generating information/orders to the on-board ERTMS/ETCS, e.g. information related to closing/opening the air flaps, lowering/raising the pantograph, opening/closing the main power switch, changing from traction system A to traction system B. Implementation of this functionality is optional for track-side.

3. Managing the transitions between areas supervised by different Radio Block Centres (RBCs) (only relevant for levels 2 and 3). See Section 4.2.7.1 (Functional interface between RBCs) and Section 4.2.7.2 (Technical interface between RBCs).

4.2.4. *Mobile communication functions for railways GSM-R*

This basic parameter describes the radio communication functions. Such functions shall be implemented in the Control-Command and Signalling On-board and Track-side subsystems, according to the specifications indicated below.

4.2.4.1. Basic communication function

The general requirements are specified in Annex A 4.2.4.a.

In addition, the following specifications shall be respected:

1. ASCI features; Annex A 4.2.4.b;

2. SIM card; Annex A 4.2.4.c;

3. User-to-User Signalling; Annex A 4.2.4.d;

4. location-dependent addressing; Annex A 4.2.4.e.

4.2.4.2. Voice and operational communication applications

The general requirements are defined in Annex A 4.2.4.f.

The requirements for tests are specified in Annex A 4.2.4.g.

In addition, the following specifications shall be respected:

1. confirmation of high-priority calls; Annex A 4.2.4.h;

2. functional addressing; Annex A 4.2.4.j;

3. presentation of functional numbers; Annex A 4.2.4.k.

4.2.4.3. Data communication applications for ETCS

The general requirements are defined in Annex A 4.2.4.f.

The requirements for tests are specified in Annex A 4.2.4.g.

This functionality is mandatory only in the case of ETCS levels 2 and 3 and radio in-fill applications.

4.2.5. *ERTMS/ETCS and GSM-R air gap interfaces*

This basic parameter specifies the requirements for the air gap between Control-Command and Signalling Track-side and On-board subsystems and has to be taken into account in conjunction with the requirements for the interfaces between ERTMS/ETCS and GSM-R equipment, as specified in Section 4.2.6 (On-board Interfaces Internal to Control-Command and Signalling) and Section 4.2.7 (Track-side Interfaces Internal to Control-Command and Signalling).

This basic parameter includes:

1. the physical, electrical and electromagnetic values to be respected to allow safe functioning;

2. the communication protocol to be used;

3. the availability of the communication channel.

The applicable specifications are listed below.

4.2.5.1. Radio communications with the train

Class A radio communication interfaces shall operate in the GSM-R Band – see Annex A 4.2.5.a.

The protocols shall comply with Annex A 4.2.5.b.

Where radio in-fill is implemented, the requirements stated in Annex A 4.2.5.c shall be respected.

4.2.5.2. Eurobalise communication with the train

Eurobalise communication interfaces shall comply with Annex A 4.2.5.d.

4.2.5.3. Euroloop communication with the train

Euroloop communication interfaces shall comply with Annex A 4.2.5.e.

4.2.6. *On-Board Interfaces Internal to Control-Command and Signalling*

This Basic Parameter consists of three parts.

4.2.6.1. ERTMS/ETCS and Class B train protection

Where ERTMS/ETCS and Class B train protection functions are installed on-board, the transitions between them can be managed with a standardised interface as specified in Annex A 4.2.6.a.

Annex A 4.2.6.b specifies the K-interface (to allow certain STMs to read information from Class B balises through the ERTMS/ETCS on-board antenna) and Annex A 4.2.6.c the G interface (air gap between ETCS on-board antenna and Class B balises).

Implementation of Interface 'K' is optional, but if done it must be in accordance with Annex A 4.2.6.b.

Furthermore, if Interface 'K' is implemented, the on-board transmission channel functionality must be able to handle the properties of Annex A 4.2.6.c.

If the transitions between ERTMS/ETCS and Class B train protection on-board are not managed using the standardised interface specified in Annex A 4.2.6.a, steps must be taken to ensure that the method used does not impose any additional requirements on the Control-Command and Signalling Track-side Subsystem.

4.2.6.2. Interface between GSM-R Radio Data Communication and ERTMS/ETCS

The requirements for the interface between the Class A radio and the on-board ERTMS/ETCS functionality are specified in Annex A 4.2.6.d.

Where radio in-fill is implemented the requirements stated in Annex A 4.2.6.e shall be respected.

4.2.6.3. Odometry

The interface between the odometry function and on-board ETCS shall meet the requirements of Annex A 4.2.6.f. This interface contributes to this Basic Parameter only when odometry equipment is supplied as a separate interoperability constituent (see Section 5.2.2, Grouping of interoperability constituents).

4.2.7. *Track-side Interfaces Internal to Control-Command and Signalling*

This Basic Parameter consists of five parts.

4.2.7.1. Functional interface between RBCs

This interface defines the data to be exchanged between neighbouring RBCs to allow the safe movement of a train from one RBC area to the next:

1. information from the 'Handing Over' RBC to the 'Accepting' RBC;

2. information from the 'Accepting' RBC to the 'Handing Over' RBC.

The requirements are specified in Annex A 4.2.7.a.

4.2.7.2. RBC/RBC

This is the technical interface between two RBCs. The requirements are specified in Annex A 4.2.7.b.

4.2.7.3. GSM-R/track-side ETCS

This is the interface between the Class A radio system and the track-side ETCS functionality. The requirements are specified in Annex A 4.2.7.c.

4.2.7.4. Eurobalise/LEU

This is the interface between Eurobalise and the LEU. The requirements are specified in Annex A 4.2.7.d.

This interface contributes to this basic parameter only when Eurobalise and LEU are supplied as separate interoperability constituents (see Section 5.2.2, Grouping of interoperability constituents).

4.2.7.5. Euroloop/LEU

This is the interface between Euroloop and the LEU. The requirements are specified in Annex A 4.2.7.e.

This interface contributes to this Basic Parameter only when Euroloop and LEU are supplied as separate interoperability constituents (see Section 5.2.2, Grouping of interoperability constituents).

4.2.8. *Key Management*

This basic parameter specifies requirements for the management of cryptographic keys used for the protection of data transmitted via radio.

The requirements are specified in Annex A 4.2.8.a. Only requirements related to the interfaces of Control-Command and Signalling equipment fall within the scope of this TSI.

4.2.9. *ETCS-ID Management*

This basic parameter concerns the ETCS-identities (ETCS-IDs) for equipment in Control-Command and Signalling Track-side and On-board Subsystems.

The requirements are specified in Annex A 4.2.9.a.

4.2.10. *Track-side Train Detection Systems*

This basic parameter specifies the interface requirements between the track-side train detection systems and rolling stock.

The interface requirements to be respected by the train detection systems are specified in Annex A 4.2.10.a.

4.2.11. *Electromagnetic Compatibility between Rolling Stock and Control-Command and Signalling track-side equipment*

This basic parameter specifies the interface requirements for electromagnetic compatibility between rolling stock and track-side Control-Command and Signalling equipment.

The interface requirements to be respected by the train detection system are specified in Annex A 4.2.11.a

4.2.12. *ERTMS/ETCS DMI (Driver Machine Interface)*

This basic parameter describes the information provided from ERTMS/ETCS to the driver and entered into the on-board ERTMS/ETCS by the driver. See Annex A 4.2.12.a.

It includes:

1. ergonomics (including visibility);

2. ERTMS/ETCS functions to be displayed;

3. ERTMS/ETCS functions triggered by driver input.

4.2.13. *GSM-R DMI (Driver-Machine Interface)*

This basic parameter describes the information provided from GSM-R to the driver and entered into the GSM-R on-board by the driver. See Annex A 4.2.13.a.

It includes:

1. ergonomics (including visibility);

2. GSM-R functions to be displayed;

3. call-related information outgoing;

4. call-related information incoming.

4.2.14. *Interface to Data Recording for Regulatory Purposes*

This basic parameter describes:

1. data exchange between the on-board ERTMS/ETCS and the rolling stock recording device;

2. communication protocols;

3. physical interface.

See Annex A 4.2.14.a.

4.2.15. *Visibility of track-side Control-Command and Signalling objects*

This basic parameter describes:

1. the characteristics of retro-reflecting signs to ensure correct visibility;

2. the characteristics of interoperable marker boards.

See Annex A 4.2.15.a.

In addition, the installation of track-side Control-Command and Signalling objects shall be compatible with the driver's field of view and the infrastructure requirements.

4.2.16. *Environmental conditions*

The environmental conditions mandated in the specifications referenced in this TSI shall be respected.

4.3. **Functional and technical specifications of the interfaces to other Subsystems**

4.3.1. *Interface to the Traffic Operation and Management Subsystem*

Interface with Traffic Operation and Management TSI			
Reference CCS TSI		Reference Traffic Operation and Management TSI	
Parameter	Clause	Parameter	Clause
Operating rules (normal and degraded conditions)	4.4	Rule book Operating rules	4.2.1.2.1 4.4
Visibility of track-side Control-Command and Signalling objects	4.2.15	Signal and line-side marker sighting	4.2.2.8
Train braking performance and characteristics	4.2.2	Braking performance	4.2.2.6
Use of sanding equipment On-board flange lubrication Use of composite brake blocks	4.2.10	Rule book	4.2.1.2.1
Interface to Data Recording for Regulatory Purposes	4.2.14	Data recording on-board	4.2.3.5
ETCS DMI	4.2.12	Train running number	4.2.3.2.1
GSM-R DMI	4.2.13	Train running number	4.2.3.2.1

4.3.2. *Interface to the Rolling Stock Subsystem*

Interface with Rolling Stock TSIs				
Reference CCS TSI		Reference Rolling Stock TSIs		
Parameter	Clause	Parameter		Clause
Compatibility with track-side train detection systems: vehicle design	4.2.10	Rolling stock characteristics to be compatible with train detection systems based on track circuits	HS RS TSI wheelset location axle load sanding electrical resistance between wheels LOC & PAS TSI Wagon TSI	 4.2.7.9.2 4.2.3.2 4.2.3.10 4.2.3.3.1 4.2.3.3.1.1 4.2.3.2
		Rolling stock characteristics to be compatible with train detection systems based on axle counters	HS RS TSI wheelset geometry wheels LOC & PAS TSI Wagon TSI	 4.2.7.9.2 4.2.7.9.3 4.2.3.3.1.2 4.2.3.3.1

Interface with Rolling Stock TSIs				
Reference CCS TSI		Reference Rolling Stock TSIs		
Parameter	Clause	Parameter		Clause
		Rolling stock characteristics to be compatible with loop equipment	HS RS TSI	None
			LOC & PAS TSI	4.2.3.3.1.3
			Wagon TSI	None
Electromagnetic compatibility between rolling stock and Control-Command and Signalling track-side equipment	4.2.11	Rolling stock characteristics to be compatible with train detection systems based on track circuits	HS RS TSI	4.2.6.6.1
			LOC & PAS TSI	4.2.3.3.1
			Wagon TSI	None
		Rolling stock characteristics to be compatible with train detection systems based on axle counters	HS RS TSI	4.2.6.6.1
			LOC & PAS TSI	4.2.3.3.2
			Wagon TSI	None
Train braking performance and characteristics	4.2.2	Emergency braking performance	HS RS TSI Emergency braking Service braking	 4.2.4.1 4.2.4.4
			LOC & PAS TSI Emergency braking Service braking	 4.2.4.5.2 4.2.4.5.3
			Wagon TSI	4.2.4.1.2
Position of Control-Command and Signalling on-board antennas	4.2.2	Kinematic gauge	HS RS TSI	4.2.3.1
			LOC & PAS TSI	4.2.3.1
			Wagon TSI	None
Isolation of on-board ERTMS/ETCS functionality	4.2.2	Operating rules	HS RS TSI	4.2.7.9.1
			LOC & PAS TSI	4.2.12.3
			Wagon TSI	None
Data interfaces	4.2.2	Monitoring and diagnostic concepts	HS RS TSI	4.2.7.10
			LOC & PAS TSI	4.2.1.1
			Wagon TSI	None
Visibility of track-side Control-Command and Signalling objects	4.2.15	External visibility Head lights	HS RS TSI	4.2.7.4.1.1
			LOC & PAS TSI	4.2.7.1.1
			Wagon TSI	None

Interface with Rolling Stock TSIs				
Reference CCS TSI		Reference Rolling Stock TSIs		
Parameter	Clause	Parameter		Clause
		Driver's external field of view	HS RS TSI line of sight windscreen	 4.2.2.6 b 4.2.2.7
			LOC & PAS TSI line of sight windscreen	 4.2.9.1.3.1 4.2.9.2
			Wagon TSI	None
Interface to data recording for regulatory purposes	4.2.14	Recording device	HS RS TSI	4.2.7.10
			LOC & PAS TSI	4.2.9.6
			Wagon TSI	None
Commands to rolling stock equipment	4.2.2 4.2.3	Phase separation	HS RS TSI	4.2.8.3.6.7
			LOC & PAS TSI	4.2.8.2.9.8
			Wagon TSI	None
Emergency braking command	4.2.2	Emergency braking command	HS RS TSI	None
			LOC & PAS TSI	4.2.4.4.1
			Wagon TSI	None

4.3.3. *Interfaces to Infrastructure Subsystem*

Interface with Infrastructure TSI				
Reference CCS TSI		Reference Infrastructure TSI		
Parameter	Clause	Parameter		Clause
Train detection systems (space for installation)	4.2.10	Minimum infrastructure gauge	HS	4.2.3
		Structure gauge	CR	4.2.4.1
Eurobalise communication (space for installation)	4.2.5.2	Minimum infrastructure gauge	HS	4.2.3
		Structure gauge	CR	4.2.4.1
Euroloop communication (space for installation)	4.2.5.3	Minimum infrastructure gauge	HS	4.2.3
		Structure gauge	CR	4.2.4.1

Interface with Infrastructure TSI				
Reference CCS TSI		Reference Infrastructure TSI		
Parameter	Clause	Parameter		Clause
Visibility of track-side Control-Command and Signalling objects	4.2.15	Minimum infrastructure gauge	HS	4.2.3
		Structure gauge	CR	4.2.4.1

4.3.4. *Interfaces to Energy Subsystem*

Interface with Energy TSI				
Reference CCS TSI		Reference Energy TSI		
Parameter	Clause	Parameter		Clause
Commands to rolling stock equipment	4.2.2 4.2.3	Phase separation sections	HS ENE TSI	4.2.21
		System separation sections		4.2.22
		Phase separation sections	CR ENE TSI	4.2.19
		System separation sections		4.2.20

4.4. **Operating rules**

The rules for operating a railway service with ERTMS/ETCS are specified in the Traffic Operation and Management TSI.

4.5. **Maintenance rules**

The maintenance rules of the subsystems covered by this TSI shall ensure that the values quoted in the basic parameters indicated in Chapter 4 are maintained within the required limits throughout the lifetime of the subsystems. However, during preventative or corrective maintenance, the subsystem may not be able to respect the values quoted in the basic parameters; the maintenance rules shall ensure that safety is not prejudiced during these activities.

The entity in charge of the Control-Command and Signalling Subsystems shall set up maintenance rules to achieve the above objectives. To assist with the preparation of these rules, the following requirements shall be respected.

4.5.1. *Responsibility of the manufacturer of equipment*

The manufacturer of equipment incorporated in the subsystem shall specify:

1. all maintenance requirements and procedures (including health monitoring, diagnosis of events, test methods and tools and also the required professional competence) necessary for achieving essential requirements and values quoted in the mandatory requirements of this TSI throughout the equipment life-cycle (transport and storage before installation, normal operation, failures, repair work, checking and maintenance, decommissioning, etc.);

2. the health and safety risks that may affect the public and the maintenance staff;

3. the conditions for first line maintenance, i.e. the definition of Line Replaceable Units (LRUs), the definition of approved compatible versions of hardware and software, the procedures for replacing failed LRUs, and the conditions for storing LRUs and for repairing failed LRUs;

4. the checks to be carried out if equipment is subject to exceptional stress (e.g. adverse environmental conditions or abnormal shocks);

5. the checks to be carried out when maintaining equipment other than Control-Command and Signalling equipment and which influences the Control-Command and Signalling Subsystems (e.g. changing the wheel diameter).

4.5.2. *Responsibility of the applicant for subsystem verification*

The applicant shall:

1. ensure that the maintenance requirements as described in Section 4.5.1 (Responsibility of the Manufacturer of Equipment) are defined for all components within the scope of this TSI regardless of whether or not they are interoperability constituents;

2. complete the above requirements taking into account the risks arising from interactions between different components of the subsystem and interfaces to other subsystems.

4.6. **Professional competences**

The manufacturers of the equipment and of the subsystem shall provide information sufficient to define the professional competences required for the installation, final inspection and maintenance of the Control-Command and Signalling Subsystems. See Section 4.5 (Maintenance rules).

4.7. **Health and safety conditions**

Care shall be taken to ensure health and safety for maintenance and operations staff, in accordance with EU regulations and the national regulations that are compatible with the European legislation.

Manufacturers shall indicate the risks for health and safety that arise from using and maintaining their equipment and subsystems. See Section 4.4 (Operating rules) and Section 4.5 (Maintenance rules).

4.8. **Registers**

The data to be provided for the registers provided for in Articles 34 and 35 of Directive 2008/57/EC are those indicated in Commission Implementing Decision 2011/665/EU [1] and Commission Implementing Decision 2011/633/EU [2].

5. INTEROPERABILITY CONSTITUENTS

5.1. **Definition**

According to Article 2(f) of the Railway Interoperability Directive, interoperability constituents are 'any elementary component, group of components, subassembly or complete assembly of equipment incorporated or intended to be incorporated into a subsystem, upon which the interoperability of the rail system depends either directly or indirectly. The concept of a constituent covers both tangible objects and intangible objects such as software.'

5.2. **List of interoperability constituents**

5.2.1. *Basic interoperability constituents*

The basic interoperability constituents in the Control-Command and Signalling Subsystems are defined in:

1. Table 5.1.a for the Control-Command and Signalling On-board Subsystem;

2. Table 5.2.a for the Control-Command and Signalling Track-side Subsystem.

5.2.2. *Grouping of interoperability constituents*

The functions of basic interoperability constituents may be combined to form a group. This group is then defined by those functions and by its remaining external interfaces. If a group is formed in this way, it shall be considered as an interoperability constituent.

1. Table 5.1.b lists the groups of interoperability constituents of the Control-Command and Signalling On-board Subsystem.

[1] OJ L 264, 8.10.2011, p. 32.
[2] OJ L 256, 1.10.2011, p. 1.

2. Table 5.2.b lists the groups of interoperability constituents of the Control-Command and Signalling Track-side Subsystem.

5.3. **Constituents' performance and specifications**

For each basic interoperability constituent or group of interoperability constituents, the tables in Chapter 5 describe:

1. in column 3, the functions and interfaces. Note that some interoperability constituents have functions and/or interfaces that are optional;

2. in column 4, the mandatory specifications for the conformity assessment of each function or interface (where applicable) by reference to the relevant section of Chapter 4.

Table 5.1.a

Basic interoperability constituents in the Control-Command and Signalling On-board Subsystem

N	Interoperability constituent IC	Characteristics	Specific requirements to be assessed by reference to Chapter 4
1	ERTMS/ETCS on-board	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		On-board ETCS functionality (excluding odometry)	4.2.2
		ERTMS/ETCS and GSM-R air gap interfaces	4.2.5
		— RBC (levels 2 and 3)	4.2.5.1
		— Radio in-fill unit (optional level 1)	4.2.5.1
		— Eurobalise air gap	4.2.5.2
		— Euroloop air gap (optional level 1)	4.2.5.3
		Interfaces	
		— STM (implementation of interface K optional)	4.2.6.1
		— ERTMS/ETCS GSM-R on-board	4.2.6.2
		— Odometry	4.2.6.3
		— Key management system	4.2.8
		— ETCS ID Management	4.2.9
		— ERTMS/ETCS Driver-Machine Interface	4.2.12
		— Train interface	4.2.2
		— On-board recording device	4.2.14
		Physical environmental conditions	4.2.16
2	Odometry equipment	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		On-board ERTMS/ETCS functionality: only Odometry	4.2.2
		Interfaces — On-board ERTMS/ETCS	4.2.6.3
		Environmental conditions	4.2.16
3	Interface of External STM	Interfaces — On-board ERTMS/ETCS	4.2.6.1
4	GSM-R voice cab radio Note: SIM card, antenna, connecting cables and filters are not part of this interoperability constituent	Reliability, Availability, Maintainability, Safety (RAMS) Note: no requirement for safety	4.2.1 4.5.1
		Basic communication functions	4.2.4.1
		Voice and operational communication applications	4.2.4.2

N	Interoperability constituent IC	Characteristics	Specific requirements to be assessed by reference to Chapter 4
		Interfaces	
		— GSM-R air gap	4.2.5.1
		— GSM-R Driver-Machine Interface	4.2.13
		Environmental conditions	4.2.16
5	GSM-R ETCS Data only Radio Note: SIM card, antenna, connecting cables and filters are not part of this interoperability constituent	Reliability, Availability, Maintainability, Safety (RAMS) Note: no requirement for safety	4.2.1 4.5.1
		Basic communication functions	4.2.4.1
		ETCS data communication applications	4.2.4.3
		Interfaces	
		— On-board ERTMS/ETCS	4.2.6.2
		— GSM-R air gap	4.2.5.1
		Environmental conditions	4.2.16
6	GSM-R SIM card	Basic communication functions	4.2.4.1
		Environmental conditions	4.2.16

Table 5.1.b

Groups of interoperability constituents in the Control-Command and Signalling On-board Subsystem

This table is an example to show the structure. Other groups are allowed

N	Group of Interoperability constituents	Characteristics	Specific requirements to be assessed by reference to Chapter 4
1	ERTMS/ETCS on-board Odometry equipment	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		On-board ERTMS/ETCS functionality	4.2.2
		ERTMS/ETCS and GSM-R air gap interfaces	4.2.5
		— RBC (levels 2 and 3)	4.2.5.1
		— Radio in-fill unit (optional level 1)	4.2.5.1
		— Eurobalise air gap	4.2.5.2
		— Euroloop air gap (optional level 1)	4.2.5.3
		Interfaces	
		— STM (implementation of interface K optional)	4.2.6.1
		— On-board ERTMS/ETCS – GSM-R	4.2.6.2
		— Key management system	4.2.8
		— ETCS-ID Management	4.2.9
		— ERTMS/ETCS Driver Machine Interface	4.2.12
		— Train interface	4.2.2
		— On-board recording device	4.2.14
		Physical environmental conditions	4.2.16

Table 5.2.a

Basic interoperability constituents in the Control-Command and Signalling Track-side Subsystem

N	Interoperability constituent IC	Characteristics	Specific requirements to be assessed by reference to Chapter 4
1	RBC	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		Track-side ERTMS/ETCS functionality (excluding communication via Eurobalises, radio in-fill and Euroloop)	4.2.3
		ERTMS/ETCS and GSM-R air gap interfaces: only radio communication with train	4.2.5.1
		Interfaces — Neighbouring RBC — ERTMS/ETCS GSM-R track-side — Key management system — ETCS-ID Management	 4.2.7.1, 4.2.7.2 4.2.7.3 4.2.8 4.2.9
		Environmental conditions	4.2.16
2	Radio in-fill unit	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		Track-side ERTMS/ETCS functionality (excluding communication via Eurobalises, Euroloop and level 2/3 functionality)	4.2.3
		ERTMS/ETCS and GSM-R air gap interfaces: only radio communication with train	4.2.5.1
		Interfaces — ERTMS/ETCS- GSM-R track-side — Key management system — ETCS-ID Management — Interlocking and LEU	 4.2.7.3 4.2.8 4.2.9 4.2.3
		Environmental conditions	4.2.16
3	Eurobalise	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		ERTMS/ETCS and GSM-R air gap interfaces: only Eurobalise communication with train	4.2.5.2
		Interfaces — LEU – Eurobalise	 4.2.7.4
		Environmental conditions	4.2.16
4	Euroloop	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		ERTMS/ETCS and GSM-R air gap interfaces: only Euroloop communication with train	4.2.5.3

N	Interoperability constituent IC	Characteristics	Specific requirements to be assessed by reference to Chapter 4
		Interfaces — LEU – Euroloop	4.2.7.5
		Environmental conditions	4.2.16
5	LEU Eurobalise	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		Track-side ERTMS/ETCS functionality (excluding communication via radio in-fill, Euroloop and level 2 and level 3 functionality)	4.2.3
		Interfaces — LEU – Eurobalise	4.2.7.4
		Environmental conditions	4.2.16
6	LEU Euroloop	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		Track-side ERTMS/ETCS functionality (excluding communication via radio in-fill, Eurobalise and level 2 and level 3 functionality)	4.2.3
		Interfaces — LEU – Euroloop	4.2.7.5
		Environmental conditions	4.2.16

Table 5.2.b

Groups of interoperability constituents in the Control-Command and Signalling Track-side Subsystem

This table is an example to show the structure. Other groups are allowed

N	Group of interoperability constituents	Characteristics	Specific requirements to be assessed by reference to Chapter 4
1	Eurobalise LEU Eurobalise	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1
		Track-side ERTMS/ETCS functionality (excluding communication via Euroloop and level 2 and level 3 functionality)	4.2.3
		ERTMS/ETCS and GSM-R air gap interfaces: only Eurobalise communication with train	4.2.5.2
		Environmental conditions	4.2.16
2	Euroloop LEU Euroloop	Reliability, Availability, Maintainability, Safety (RAMS)	4.2.1 4.5.1

N	Group of interoperability constituents	Characteristics	Specific requirements to be assessed by reference to Chapter 4
		Track-side ERTMS/ETCS functionality, (excluding communication via Eurobalise and level 2 and level 3 functionality)	4.2.3
		ERTMS/ETCS and GSM-R air gap interfaces: only Euroloop communication with train	4.2.5.3
		Environmental conditions	4.2.16

6. ASSESSING THE CONFORMITY AND/OR SUITABILITY FOR USE OF THE CONSTITUENTS AND VERIFYING THE SUBSYSTEMS

6.1. **Introduction**

6.1.1. *General principles*

Fulfilment of the essential requirements set out in Chapter 3 of this TSI shall be ensured through compliance with the basic parameters specified in Chapter 4.

This compliance shall be demonstrated by:

1. assessing the conformity of the interoperability constituents specified in Chapter 5 (see Section 6.2);

2. verifying the subsystems (see Section 6.3).

In certain cases, however, some of the essential requirements may be met by national rules, because of:

1. the use of Class B systems;

2. open points in the TSI;

3. derogations pursuant to Article 9 of the Railway Interoperability Directive;

4. specific cases described in Section 7.2.9.

In such cases, assessment of conformity with those rules shall be carried out under the responsibility of the Member States concerned according to notified procedures.

6.1.2. *Principles for testing ERTMS/ETCS and GSM-R*

A Control-Command and Signalling On-board Subsystem covered by an 'EC' declaration of verification should be able to run on every Control-Command and Signalling Track-side Subsystem covered by an 'EC' Declaration of verification, under the conditions specified in this TSI, with no additional verifications.

Achievement of this goal is facilitated by:

1. rules for the design and installation of the Control-Command and Signalling On-board and the Track-side subsystems;

2. test specifications to prove that the Control-Command and Signalling On-board and Track-side Subsystems comply with the requirements of this TSI and are mutually compatible.

To make the conformity assessment of ERTMS/ETCS and GSM-R equipment more effective and to help achieve the goal mentioned above, each Member State shall make available to the Commission the operational test scenarios for checking the ERTMS/ETCS and GSM-R part of the Control-Command and Signalling Track-side Subsystem and its interaction with the corresponding part of the Control-Command and Signalling On-board Subsystem. The test scenarios in question:

1. shall be consistent with the specifications referenced in this TSI and provide a technical description of functions and performances (e.g. reaction times) where these are relevant for the interaction between on-board and track-side subsystems;

2. shall be submitted in a standard format. See Annex A 4.2.2.c;

3. shall, unless otherwise specified in Annex A 4.2.2.c, cover at least the start of mission, the transition between levels, transition between modes that may be used on the line, the main identified degraded situations, the sending of emergency messages and any other relevant aspects specific to the line.

The European Railway Agency:

1. shall make a preliminary publication of the operational test scenarios, allowing all interested parties to comment on the consistency of the test scenarios with the specifications referenced in this TSI and their impact on other implementations or developments. The period for comments shall be defined with each publication and shall not exceed 6 months;

2. if the comments are negative, shall coordinate the efforts of the parties involved, in order to find an agreement, e.g. by changing the operational test scenarios;

3. shall progressively build and make publicly available a database of test scenarios that have successfully passed the step described above and representing the situations which occur in different implementations;

4. shall use the abovementioned data base to assess whether further mandatory test specifications are needed and whether it is necessary to draw up additional engineering rules for the Control-Command and Signalling On-board and Track-side subsystems.

6.2. Interoperability constituents

6.2.1. *Assessment procedures for Control-Command and Signalling Interoperability Constituents*

Before placing on the market an interoperability constituent and/or groups of interoperability constituents the manufacturer or his authorised representative established within the European Union shall draw up an 'EC' declaration of conformity in accordance with Article 13(1) and Annex IV to the Railway Interoperability Directive.

The assessment procedure shall be carried out using one of the modules specified in Section 6.2.2 (Modules for Control-Command and Signalling Interoperability Constituents).

An 'EC' declaration of suitability for use is not required for Control-Command and Signalling interoperability constituents, because they have to fully comply with all the relevant basic parameters. This compliance is demonstrated by the 'EC' Declaration of conformity and is sufficient for placing them on the market [1].

6.2.2. *Modules for Control-Command and Signalling Interoperability Constituents*

For assessing interoperability constituents within the Control-Command and Signalling Subsystems, the manufacturer or his authorised representative established within the European Union, may choose:

1. either the type-examination procedure (Module CB) for the design and development phase in combination with the production quality management system procedure (Module CD) for the production phase; or

2. the type-examination procedure (Module CB) for the design and development phase in combination with the product verification procedure (Module CF); or

3. the full quality management system with design examination procedure (Module CH1).

In addition, for checking the SIM card Interoperability Constituent, the manufacturer or his representative may choose module CA.

The modules are described in detail in Commission Decision 2010/713/EU of 9 November 2010 on modules for the procedures for assessment of conformity, suitability for use and 'EC' verification to be used in the technical specifications for interoperability adopted under Directive 2008/57/EC of the European Parliament and of the Council [2].

The following clarifications apply to the use of some of the modules:

1. with reference to Chapter 2 of the 'Module CB', 'EC'-type examination must be carried out through a combination of production type and design type;

2. with reference to Chapter 3 of the 'Module CF' (product verification) statistical verification is not allowed, i.e. all interoperability constituents must be individually examined.

[1] Checking that an Interoperability Constituent is used appropriately is part of the overall EC verification of Control-Command and Signalling On-board and Track-side Subsystems, as explained in 6.3.3 and 6.3.4.
[2] OJ L 319, 4.12.2010, p. 1.

6.2.3. *Assessment requirements*

Independently of the selected module:

1. the requirements stated in Section 6.2.4.1 of this TSI shall be respected for the 'On-board ERTMS/ETCS' interoperability constituent;

2. the activities shown in Table 6.1 shall be carried out when assessing the conformity of an interoperability constituent or a group of interoperability constituents as defined in Chapter 5 of this TSI. All verifications shall be carried out by reference to the applicable table in Chapter 5 and the basic parameters indicated there.

Table 6.1

Aspect	What to assess	supporting evidence
Functions, interfaces and performances	Check that all mandatory functions, interfaces and performances as described in the basic parameters referenced in the relevant table of Chapter 5 are implemented and that they comply with the requirements of this TSI	Design documentation and running of test cases and test scenarios, as described in the basic parameters referenced in the relevant table of Chapter 5
	Check which optional functions and interfaces as described in the basic parameters referenced in the relevant table of Chapter 5 are implemented and that they comply with the requirements of this TSI	Design documentation and running of test cases and test scenarios, as described in the basic parameters referenced in the relevant table of Chapter 5
	Check which additional functions and interfaces (not specified in this TSI) are implemented and that they do not lead to conflicts with implemented functions specified in this TSI	Impact analysis
Environment	Check compliance with mandatory environmental conditions, where specified in the basic parameters referenced in the relevant table of Chapter 5	Tests, to ensure that the requirements of the basic parameters referenced in the relevant table of Chapter 5 are satisfied
	In addition, check that the interoperability constituent functions correctly in the environmental conditions for which it is designed	Tests according to the applicant's specifications
Reliability, Availability, Maintainability, Safety (RAMS)	Check compliance with the safety requirements described in the basic parameters referenced in the relevant table of Chapter 5, i.e.: 1. respect for quantitative Tolerable Hazard Rates (THRs) caused by random failures; 2. the development process is able to detect and eliminate systematic failures.	1. Calculations for the THRs caused by random failures, based on supportable sources of reliability data. 2.1. The manufacturer's quality and safety management throughout design, manufacturing and testing conforms to a recognised standard (see Note). 2.2. The software development life-cycle, the hardware development life-cycle and the integration of hardware and software have each been undertaken in accordance with a recognised standard (see Note).

Aspect	What to assess	supporting evidence
		2.3. The safety verification and validation process has been undertaken in accordance with a recognised standard (see Note) and respects the safety requirements described in the basic parameters referenced in the relevant table of Chapter 5. 2.4. The functional and technical safety requirements (correct operation under fault-free conditions, effects of faults and of external influences) are verified in accordance with a recognised standard (see Note). *Note*: The standard shall satisfy at least the following requirements: 1. be widely acknowledged in the railway domain. If this is not the case, the standard will have to be justified and be acceptable to the notified body; 2. be relevant for the control of the considered hazards in the system under assessment; 3. be publicly available for all actors who want to use it. See Annex A, Table A 3.
	Check that the quantitative reliability target indicated by the applicant is met	Calculations
	Check compliance with maintenance requirements – Section 4.5.1	Document check

6.2.4. *Special issues*

6.2.4.1. The on-board ERTMS/ETCS

Particular attention shall be given to assessing the conformity of the on-board ERTMS/ETCS interoperability constituent, since it is complex and plays a key role in achieving interoperability.

Regardless of whether module CB or CH1 is chosen, the Notified Body shall check that a specimen of the interoperability constituent has passed the full set of mandatory test sequences referenced in Section 4.2.2 (on-board ERTMS/ETCS functionality) and that these tests were carried out in a laboratory accredited to carry out this type of tests in accordance with Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation (EEC) No 339/93 [1].

In addition, to increase confidence that the on-board ERTMS/ETCS can be correctly operated with different track-side applications, it is recommended that the on-board ERTMS/ETCS be tested using scenarios from the data base managed by the Agency and which are not part of the mandatory test specifications; see Section 6.1.2 (Principles for testing ERTMS/ETCS and GSM-R). The documentation accompanying the certificate shall indicate the database scenarios against which the interoperability constituent has been checked.

[1] OJ L 218, 13.8.2008, p. 30.

6.2.4.2. The Specific Transmission Module (STM)

Each Member State shall be responsible for verifying that STMs conform to its national requirements.

Verification of the STM interface to the on-board ERTMS/ETCS requires a conformity assessment carried out by a Notified Body.

6.2.4.3. Content of the 'EC' Declaration of conformity

The 'EC' Declaration of conformity specified in Annex IV to the Railway Interoperability Directive shall include the following details concerning the interoperability constituent:

1. which optional and additional functions are implemented;

2. the applicable environmental conditions.

6.3. **Control-Command and Signalling Subsystems**

6.3.1. *Assessment procedures for Control-Command and Signalling Subsystems*

This chapter deals with the 'EC' declaration of verification for the Control-Command and Signalling On-board Subsystem and the 'EC' declaration of verification for the Control-Command and Signalling Track-side Subsystem.

At the request of the applicant the Notified Body shall carry an 'EC' verification of a Control-Command and Signalling On-board or Track-side Subsystem in accordance with Annex VI to the Railway Interoperability Directive.

The applicant shall draw up the 'EC' declaration of verification for the Control-Command and Signalling On-board or Track-side Subsystem in accordance with Article 18(1) and Annex V to the Railway Interoperability Directive.

The content of the 'EC' declaration of verification shall conform to Annex V to the Railway Interoperability Directive.

The assessment procedure shall be carried out by using one of the modules as specified in Section 6.3.2 (Modules for Control-Command and Signalling Subsystems).

The 'EC' declarations of verification for a Control-Command and Signalling On-board Subsystem and of a Control-Command and Signalling Track-side Subsystem, together with the certificates of conformity, shall be deemed sufficient to ensure that the subsystems are compatible under the conditions specified in this TSI.

6.3.2. *Modules for Control-Command and Signalling Subsystems*

All modules indicated below are specified in the Decision 2010/713/EU.

6.3.2.1. On-board Subsystem

For verifying the Control-Command and Signalling On-board Subsystem, the applicant may choose either:

1. the type-examination procedure (Module SB) for the design and development phase in combination with the production quality management system procedure (Module SD) for the production phase; or

2. the type-examination procedure (Module SB) for the design and development phase in combination with the product verification procedure (Module SF); or

3. the full quality management system with design examination procedure (Module SH1).

6.3.2.2. Track-side Subsystem

For verifying the Control-Command and Signalling Track-side Subsystem, the applicant may choose either:

1. the unit verification procedure (Module SG); or

2. the type-examination procedure (Module SB) for the design and development phase in combination with the production quality management system procedure (Module SD) for the production phase; or

3. the type-examination procedure (Module SB) for the design and development phase in combination with the product verification procedure (Module SF); or

4. the full quality management system with design examination procedure (Module SH1).

6.3.2.3. Conditions for using modules for On-board and Track-side Subsystems

With reference to Section 4.2 of Module SB (type-examination), design review is requested.

With reference to Section 4.2 of Module SH1 (full quality management system with design examination), a type test is required.

6.3.3. *Assessment requirements for an On-board Subsystem*

Table 6.2 shows the checks that must be carried out when verifying a Control-Command and Signalling On-board Subsystem and the basic parameters that must be respected.

Independently of the module chosen:

1. verification shall demonstrate that the Control-Command and Signalling On-board Subsystem complies with basic parameters when it is integrated into the vehicle;

2. the functionality and performances of interoperability constituents already covered by their EC Declaration of conformity do not require additional verifications.

Table 6.2

Aspect	What to assess	supporting evidence
Use of interoperability constituents	Check whether the interoperability constituents to be integrated into the subsystem are all covered by an 'EC' Declaration of conformity and a corresponding certificate.	Existence and content of documents
	Check restrictions on the use of Interoperability Constituents against the characteristics of the subsystem and of the environment	Analysis by document check
	For interoperability constituents that have been certified against older versions of the CCS TSI, check that the certificate still ensures compliance with the requirements of the TSI currently in force.	Impact analysis by document checks
Integration of interoperability constituents in the subsystem	Check the correct installation and functioning of the internal interfaces of the subsystem – Basic parameters 4.2.6	Checks according to specifications
	Check that additional functions (not specified in this TSI) do not impact the mandatory ones	Impact analysis
	Check that the values of ETCS IDs are within the allowed range – Basic parameter 4.2.9	Check of design specifications
Integration with rolling stock	Check the correct installation of equipment – Basic Parameters 4.2.2, 4.2.4, 4.2.14 and conditions for installation of equipment, as specified by the manufacturer	Results of checks (according to specifications referenced in the Basic Parameters and the manufacturer's installation rules)
	Check that the Control-Command and Signalling On-board Subsystem is compatible with the rolling stock environment	Document check (certificates of interoperability constituents and possible integration methods checked against characteristics of rolling stock)

Aspect	What to assess	supporting evidence
	Check that parameters (e.g. braking parameters) are correctly configured and that they are within the allowed range	Document check (values of parameters checked against characteristics of rolling stock)
Integration with Class B	Check that the external STM is connected to on-board ERTMS/ETCS with TSI-compliant interfaces	Nothing to test: there is a standard interface already tested at interoperability constituent level. Its functioning has already been tested when checking the integration of interoperability constituents in the subsystem
	Check that Class B functions implemented in the on-board ERTMS/ETCS – Basic parameter 4.2.6.1 – create no additional requirements for the Control-Command and Signalling Track-side Subsystem due to transitions	Nothing to test: everything has already been tested at interoperability constituent level
	Check that separate Class B equipment which is not connected to the on-board ERTMS/ETCS – Basic Parameter 4.2.6.1 – creates no additional requirements for Control-Command and Signalling Track-side Subsystem due to transitions	Nothing to test: no interface [1]
	Check that separate Class B equipment connected on-board ERTMS/ETCS using (partly) non-TSI compliant interfaces – basic parameter 4.2.6.1 – creates no additional requirements for the Control-Command and Signalling Track-side Subsystem due to transitions. Also check that ERTMS/ETCS functions are not affected	Impact analysis
Integration with Control-Command and Signalling Track-side Subsystems	Check that Eurobalise telegrams can be read (scope of this test is limited to checking that the antenna has been appropriately installed. The tests already carried out at Interoperability Constituent level should not be repeated) – Basic Parameter 4.2.5	Test using a certified Eurobalise: the ability to read correctly the telegram is the supporting evidence.
	Check that Euroloop telegrams (if applicable) can be read – Basic Parameter 4.2.5	Test using a certified Euroloop: the ability to read correctly the telegram is the supporting evidence.
	Check that the equipment can handle a GSM-R call for voice and data (if applicable) – Basic Parameter 4.2.5	Test with a certified GSM-R network. The ability to set up, maintain and disconnect a connection is the supporting evidence.
Reliability, Availability, Maintainability, Safety (RAMS)	Check that the equipment complies with safety requirements – Basic Parameter 4.2.1	Application of procedures specified in the Common Safety Method

Aspect	What to assess	supporting evidence
	Check that the quantitative reliability target is met – Basic Parameter 4.2.1	Calculations
	Check the compliance with requirements about maintenance – Section 4.5.2	Documents check
Integration with Control-Command and Signalling Track-side Subsystems and other subsystems: tests under operational conditions	Test the behaviour of the subsystem under as many different operational conditions as reasonably possible (e.g. line gradient, train speed, vibrations, traction power, weather conditions, design of Control-Command and Signalling track-side functionality). The test must be able to verify: 1. that odometry functions are correctly performed – basic parameter 4.2.2 2. that the on-board Control-Command and Signalling Subsystem is compatible with the rolling stock environment – basic parameter 4.2.16 These tests must also be such as to increase confidence that there will be no systematic failures. The scope of these tests excludes tests already carried out at earlier stages: tests performed on the interoperability constituents and tests performed on the subsystem in a simulated environment shall be taken into account. Tests under operational conditions are not necessary for on-board GSM-R voice equipment.	Reports of test runs. Note: Indicate in the certificate which conditions have been tested, which standards have been applied and the criteria for considering the tests terminated

([1]) In this case, the assessment of the management of transitions shall be according to national specifications.

6.3.4. *Assessment requirements for a Track-side Subsystem*

The purpose of assessments carried out within the scope of this TSI is to verify that the equipment complies with the requirements stated in Chapter 4.

However, for the design of the ERTMS/ETCS part of the Control-Command and Signalling Track-side Subsystem, application-specific information is needed; This should include:

1. line characteristics such as gradients, distances, positions of route elements and Eurobalises/Euroloops, locations to be protected, etc;

2. the signalling data and rules to be handled by the ERTMS/ETCS system.

This TSI does not cover checks to assess whether the application-specific information is correct:

Regardless of the module chosen:

1. Table 6.3 shows the checks that must be carried out to verify a Control-Command and Signalling Track-side Subsystem and the basic parameters that must be respected;

2. functionality and performances that have already been checked at the level of the interoperability constituents do not require additional verification.

Table 6.3

Aspect	What to assess	supporting evidence
Use of interoperability constituents	Check that all interoperability constituents to be integrated into the subsystem are covered by an EC declaration of conformity and the corresponding certificate.	Existence and content of documents
	Check restrictions on the use of interoperability constituents against the characteristics of the subsystem and of the environment	Impact analysis by documents check
	For interoperability constituents that have been certified against older versions of the Control-Command and Signalling TSI, check that the certificate still ensures compliance with the requirements of the TSI currently in force	Impact analysis by comparison of specifications referenced in the TSI and certificates of the interoperability constituents
Use of train detection systems	Check that the selected types comply with Control-Command and Signalling TSI requirements – Basic parameters 4.2.10, 4.2.11	Document check
Integration of interoperability constituents in the subsystem	Check that the internal interfaces of the subsystem have been installed properly and function properly – Basic parameters 4.2.5, 4.2.7	Checks according to specifications
	Check that additional functions (not specified in this TSI) do not impact the mandatory ones	Impact analysis
	Check that the values of ETCS IDs are within the allowed range – Basic Parameter 4.2.9	Check of design specifications
Integration with infrastructure	Check that the equipment has been properly installed – Basic parameters 4.2.3, 4.2.4 and conditions for installation specified by the manufacturer	Results of checks (according to specifications referenced in the basic parameters and manufacturer's installation rules)
	Check that the Control-Command and Signalling Track-side subsystem equipment is compatible with the track-side environment	Document check (certificates of interoperability constituents and possible methods of integration checked against track-side characteristics)
Integration with track-side signalling	Check that all functions required by the application are implemented in accordance with specifications referenced in this TSI – Basic parameter 4.2.3	Document check (applicant's design specification and certificates of interoperability constituents)
	Check the correct configuration of parameters (Eurobalise telegrams, RBC messages, marker boards positions, etc.)	Document check (values of parameters checked against characteristics of track-side and of signalling)

Aspect	What to assess	supporting evidence
	Check that the interfaces are correctly installed and function properly.	Design verification and tests according to information supplied by the applicant
	Check that the Control-Command and Signalling Track-side subsystem operates correctly according to information at the interfaces with track-side signalling (e.g. appropriate generation of Eurobalise telegrams by a LEU or of message by RBC)	Design verification and tests according to the information supplied by the applicant
Integration with Control-Command and Signalling On-board Subsystems and with rolling stock	Check the GSM-R coverage – Basic Parameter 4.2.4	On-site measurements
	Check the compliance of the train detection systems with the requirements of this TSI – Basic Parameter 4.2.10	On-site measurements
	Check that the train detection systems comply with the requirements of this TSI – Basic parameters 4.2.10 and 4.2.11	Check evidence from existing installations (for systems already in use); perform tests according to standards for new types
	Check that all functions required by the application are implemented in accordance with specifications referenced in this TSI – basic parameters 4.2.3, 4.2.4 and 4.2.5	Reports of tests of the operational scenarios specified in Section 6.1.2 with different certified Control-Command and Signalling On-board Subsystems. The report shall indicate which operational scenarios have been tested, which on-board equipment has been used and whether tests have been performed in laboratories, test lines or real implementation.
Reliability, Availability, Maintainability, Safety (RAMS)	Check compliance with safety requirements – Basic Parameter 4.2.1	Application of procedures specified in the Common Safety Method
	Check that quantitative reliability targets are respected – Basic Parameter 4.2.1	Calculations
	Check the compliance with requirements about maintenance – Section 4.5.2	Document check
Integration with Control-Command and Signalling On-board Subsystems and rolling stock: tests under operational conditions	Test the behaviour of the subsystem under such different operational conditions as reasonably feasible (e.g. train speed, number of trains on the line, weather conditions). The test must be able to verify: 1. the performance of train detection systems – Basic parameters 4.2.10, 4.2.11,	Reports of test runs. Note: Indicate in the certificate which conditions have been tested, which standards have been applied and the criteria for considering the tests terminated.

Aspect	What to assess	supporting evidence
	2. that the Control-Command and Signalling Track-side subsystem is compatible with track-side environment – Basic parameter 4.2.16 These tests will also increase confidence in the absence of systematic failures. The scope of these tests excludes tests already done in previous steps: tests performed at the level of interoperability constituents and tests performed on the subsystem in a simulated environment shall be taken into account.	

6.4. **Provisions for partial conformity**

6.4.1. *Introduction*

Pursuant to Article 18(4) of the Railway Interoperability Directive, 'the Notified Body may issue Intermediate Statement Verifications (ISVs) to cover certain stages of the verification procedure or certain parts of the subsystem'.

As pointed out in Section 2.2 (Scope) of this TSI, the Control-Command and Signalling Subsystems include three parts, which are specified in Section 4.1 (Introduction).

Section 6.4.2 deals with the verification of these parts of the Control-Command and Signalling Subsystems.

Section 6.4.3 deals with the verification of partial conformity of Control-Command and Signalling Subsystems when there are restricted conditions of use of its interoperability constituent(s).

6.4.2. *Assessment of parts of Control-Command and Signalling Subsystems*

Assessing whether a Control-Command and Signalling Track-side or On-board Subsystem complies with the requirements of this TSI is a process that may be performed in successive steps – one for each of the three parts. At each step, the assessor checks only whether that particular part complies with the TSI requirements.

Regardless of which module is chosen, the Notified Body shall verify that:

1. the TSI requirements for the part in question have been respected;

2. the TSI requirements already assessed are not prejudiced.

Functions already assessed and unchanged and which are not affected by this step do not need to be checked again.

6.4.3. *Partial conformity of Control-Command and Signalling Subsystems due to restricted conditions of use of its interoperability constituent(s)*

A partial certificate of conformity for an interoperability constituent can be issued even if some function, interface or performance has not been implemented, provided that:

1. The non-implemented function, interface or performance is not required for integrating the interoperability constituent into a subsystem because of specific conditions of use, for example [1]:

   (a) the on-board ERTMS/ETCS interface to STM if the interoperability constituent is intended for installation on vehicles where no external STM is needed;

   (b) the RBC interface to other RBCs, if the RBC is intended for use in an application where no neighbouring RBCs are planned.

2. The certificate indicates which functions, interfaces or performance are not implemented and states the corresponding restrictions on the use of the interoperability constituent. This information will make it possible to identify the conditions under which the interoperability constituent can be used and the restrictions that will apply to the interoperability of a subsystem incorporating it.

[1] The procedures described in this Chapter do not prejudice the possibility of grouping constituents together.

In any event, the conditions for issuing such certificates with restrictions shall be coordinated between the Notified Bodies and the Agency in a working group set up pursuant to Article 21a(5) of Regulation (EC) No 881/2004 of the European Parliament and of the Council of 29 April 2004 establishing a European Railway Agency (Agency Regulation) [1].

When the interoperability constituent is integrated into a Control-Command and Signalling On-board or Track-side Subsystem, if the missing functions, interfaces, or performances do not allow to assess whether the subsystem fully complies with the requirements of this TSI, only an Intermediate Statement of Verification may be issued. It shall indicate which requirements have been assessed and shall state the corresponding restrictions on the use of the subsystem and its compatibility with other subsystems.

7. IMPLEMENTING THE TSI CONTROL-COMMAND AND SIGNALLING

7.1. **Introduction**

This chapter outlines the strategy and the associated technical measures for implementing the TSI, and in particular the conditions for migrating to Class A systems.

Account must be taken of the fact that the implementation of a TSI occasionally has to be coordinated with the implementation of other TSIs.

7.2. **Generally applicable rules**

7.2.1. *Upgrading or renewing the Control-Command Track-side Subsystem or parts of it*

Upgrading or renewing the Control-Command and Signalling Track-side Subsystem may concern any or all of the following:

1. Train protection

2. Radio communication

3. Train detection

These different parts of the Control-Command and Signalling Track-side Subsystem may therefore be upgraded or renewed separately if interoperability is not jeopardised. The work involved will concern:

1. GSM-R functions and interfaces

2. ERTMS/ETCS functions and interfaces

3. Train detection system compatibility with rolling stock

See Chapter 4.1 (Introduction) for the definition of the basic parameters for each part.

7.2.2. *Legacy systems*

Member States shall ensure that the functionality of the legacy systems and their interfaces remains unchanged, except where modifications are needed to mitigate safety-related flaws in these systems.

7.2.3. *Availability of Specific Transmission Modules*

If lines that fall within the scope of this TSI are not equipped with Class A train protection systems, the Member State shall make every effort to ensure the availability of an external Specific Transmission Module (STM) for its legacy Class B train protection system or systems.

In this context, due regard is to be given to ensuring an open market for STMs under fair commercial conditions. If, for technical or commercial reasons [2] the availability of an STM cannot be ensured, the Member State concerned shall inform the Committee of the underlying reasons for the problem and of the mitigation measures that it intends to put into place in order to allow operators — and in particular foreign operators — access to its infrastructure.

7.2.4. *Additional Class B equipment on a line equipped with Class A*

On a line equipped with ERTMS/ETCS and/or GSM-R, additional Class B equipment may be installed in order to allow the operation of rolling stock not compatible with Class A during the migration phase. Class B equipment may be used on-board as a fallback arrangement for a Class A system. However an infrastructure manager is not entitled to require the interoperable trains running on such a line to have Class B systems on board.

[1] OJ L 164, 30.4.2004, p. 1.

[2] E.g. the feasibility of the external STM concept cannot be technically guaranteed or potential issues relating to the ownership of the intellectual property rights of the Class B systems prevent the timely development of an STM product.

In addition, track-side shall support transitions between Class A and Class B without imposing on the Control-Command and Signalling On-board Subsystem requirements additional to those specified in this TSI.

7.2.5. *Rolling stock with Class A and Class B equipment*

Rolling stock may be equipped with both Class A and Class B systems to enable operation on several lines.

The Member State concerned may restrict the use of an on-board Class B system on lines where the corresponding system is not installed track-side.

When running on a line which is equipped with both Class A and Class B systems, a train that is also equipped with both Class A and Class B systems may use the Class B systems as a fallback arrangement. This cannot be a requirement for interoperability.

The Class B train protection systems may be implemented:

1. using an STM operating via the standard interface ('external STM'); or

2. integrated within the ERTMS/ETCS equipment or connected via a non-standard interface; or

3. independently from the ERTMS/ETCS equipment, for example via a system that enables switching between equipment. The Railway Undertaking must then ensure that the transitions between Class A and Class B train protection are carried out in conformity with the requirements of this TSI and with the national rules for the Class B system.

7.2.6. *Conditions for mandatory and optional functions*

Depending on the characteristics of the Control-Command and Signalling Track-side Sub-system and its interfaces with other sub-systems, some track-side functionalities not classified as mandatory may necessarily have to be implemented in certain applications to comply with the essential requirements.

The track-side implementation of national or optional-functions must not prevent the use of that infrastructure by a train that complies only with the mandatory requirements of the On-board Class A system except as required for the following on-board optional functions:

— an ETCS Level 3 Track-side application requires train integrity supervision on board,

— an ETCS Level 1 Track-side application with in-fill requires corresponding in-fill functionality on board if the release speed is set to zero for safety reasons (e.g. protection of danger points),

— when ETCS requires data transmission by radio, the data transmission services of GSM-R must fulfil the ETCS data transmission requirements,

— an on-board assembly, which incorporates a KER STM, may make it necessary to implement the K-interface.

7.2.7. *GSM-R specific implementation rules*

7.2.7.1. Track-side installations

The fitting of GSM-R is mandatory when:

1. installing for the first time the radio part of a Control-Command and Signalling Track-side Subsystem;

2. upgrading the radio part of a Control-Command and Signalling Track-side Subsystem already in service in such a way that it changes the functions or the performance of the subsystem. This does not include the modifications deemed necessary to mitigate safety-related defects in the legacy installation.

7.2.7.2. On-board installations

The fitting of GSM-R in rolling stock intended for use on a line including at least one section equipped with Class A interfaces (even if superimposed to a Class B system), is mandatory when:

1. installing for the first time the radio part of a Control-Command and Signalling On-board Subsystem;

2. upgrading the radio part of a Control-Command and Signalling On-board Subsystem already in service in such a way that it changes the functions or the performance of the subsystem. This does not apply to modifications deemed necessary to mitigate safety-related defects in the legacy installation.

7.2.8. *Train detection systems specific implementation rules*

In the context of this TSI, train detection system means the equipment installed track-side, which detects the presence or absence of vehicles either on an entire line of route or on a local section of it.

Track-side systems (e.g. interlocking or level crossing control systems) which use information from detection equipment are not considered parts of the train detection system.

This TSI specifies the requirements for the interface with rolling stock only to the extent necessary to ensure compatibility between TSI-compliant rolling stock and the infrastructure.

Implementing a train detection system that is compliant with the requirements of the Control-Command and Signalling Subsystems TSI can be done independently of the installation of ERTMS/ETCS or GSM-R, but can be dependent on the Class B signalling systems or on special requirements, e.g. for level crossing equipment.

The requirements of this TSI relating to train detection systems shall be respected when:

1. upgrading the train detection system;

2. renewing the train detection system, provided that respecting the requirements of this TSI does not imply unwanted modifications or upgrades of other track-side or on-board systems;

3. renewing the train detection system, where this is required by the upgrade or renewal of track-side systems that use information from the train detection system;

4. removing Class B train protection systems (where the train detection and train protection systems are integrated).

In the migration phase care shall be taken to ensure that installing a TSI compliant train detection system has a minimal negative impact on the existing non-TSI compliant rolling stock.

To achieve this, it is recommended that the Infrastructure Manager selects a TSI compliant train detection system that, at the same time, is compatible with the non-TSI compliant rolling stock already operating on that infrastructure.

7.2.9. *Specific cases*

7.2.9.1. Introduction

The following special provisions are permitted in the specific cases below.

These specific cases belong to two categories: the provisions apply either permanently (case 'P') or temporarily (case 'T').

In this TSI, temporary case 'T3' is defined as temporary cases which will still exist after 2020.

The specific cases set out in Sections 7.2.9.2 to 7.2.9.7 should be read in conjunction with the relevant sections of Chapter 4 and/or specifications referenced there.

The specific cases replace the corresponding requirements set out in Chapter 4.

Where the requirements set out in the relevant section of Chapter 4 are not subject to a specific case, those requirements have not been duplicated in Sections 7.2.9.2 to 7.2.9.7 and continue to apply unmodified.

7.2.9.2. Belgium

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems	T3	Applicable on HS L1
Index 77, Section 3.1.2.4: The distance between first and last axle L – (b_1 + b_2) (Figure 1) is at least 15 000 mm		This Specific Case is linked with the use of TVM

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.8: The weight of an isolated vehicle or a trainset is at least 40 t. If the weight of an isolated vehicle or a trainset is inferior to 90 t, the vehicle should have a system ensuring the shunting which has an electrical basis superior or equal to 16 000 mm	T3	Applicable on HS L1, L2, L3, L4 This Specific Case is linked with the use of TVM

7.2.9.3. United Kingdom

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.2.4: The distance between first and last axle L – (b_1 + b_2) (Figure 1) is at least 15 000 mm	T3	Applicable on High-Speed L 1 This Specific Case is linked with the use of TVM
4.2.10 – Track-side Train Detection Systems Index 77, Section 3.1.4.1: In addition to the requirements in Section 3.1.4.1, sanding for traction purposes on multiple units: (a) is not permitted ahead of the leading axle below 40 km/h; and (b) is only permitted where it can be demonstrated that at least a further six axles of the multiple unit are beyond the laying position.	T3	
4.2.12 ERTMS/ETCS DMI (Driver Machine Interface) Index 51: It is permissible to use an alphanumeric keyboard to enter the train running number if support for alphanumeric train running numbers is required by the technical rule notified for this purpose.	T3	This specific case is needed as soon as the open point related to the DMI specification is closed. There is no impact on interoperability
4.2.12 ERTMS/ETCS DMI (Driver Machine Interface) Index 51: It is permissible for the ETCS DMI to display dynamic train speed information in miles per hour (and indicate 'mph') when operating on parts of the GB mainline network.	T3	This specific case is needed as soon as the open point related to the DMI specification is closed. There is no impact on interoperability

7.2.9.4. France

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.2.4: The distance between first and last axle L – (b_1 + b_2) (Figure 1) is at least 15 000 mm	T3	This Specific Case is linked with the use of TVM

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.9: The electrical resistance between the running surfaces of the opposite wheels of a wheelset does not exceed 0,05 Ohm, measured by a voltage between 1,8 VDC and 2,0 VDC (open circuit). In addition, the electrical reactance between the running surfaces of the opposite wheels of a wheelset does not exceed f/100 mOhm when f is between 500 Hz and 40 kHz, under a measuring current of at least 10 ARMS and open voltage of 2 VRMS.	T3	This specific case may be revised when the open point related to the frequency management for track circuits is closed
4.2.10 – Track-side Train Detection Systems Index 77, Section 3.1.8: The weight of an isolated vehicle or a trainset is at least 40 t. If the weight of an isolated vehicle or a trainset is inferior to 90 t, the vehicle should have a system ensuring the shunting which has an electrical basis superior or equal to 16 000 mm.	T3	This Specific Case is linked with the use of TVM
4.2.10 – Track-side Train Detection Systems Index 77, Section 3.1.3.2: Dimension D (Figure 2) is not less than: 450 mm independently of the speed	5 years	

7.2.9.5. Poland

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.9: The electrical resistance between the running surfaces of the opposite wheels of a wheelset does not exceed 0,05 Ohm, measured by a voltage between 1,8 VDC and 2,0 VDC (open circuit). In addition, the electrical reactance between the running surfaces of the opposite wheels of a wheelset does not exceed f/100 mOhm when f is between 500 Hz and 40 kHz, under a measuring current of at least 10 ARMS and open voltage of 2 VRMS.	T3	This specific case may be revised when the open point related to the frequency management for track circuits is closed

7.2.9.6. Lithuania, Latvia

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.3.4: The range of the dimension S_h (Figure 2) is not less than 26,25 mm	T3	This specific case is needed as long as ČME locomotives operate on Lithuania 1 520 mm network

7.2.9.7. Sweden

Specific case	Category	Notes
4.2.4 Mobile communication functions for railways – GSM-R Index 65, statement 4.2.3: It is permissible to put in service on-board Control-Command and Signalling Subsystems including 2 Watt GSM-R voice cab radios and ETCS data only radios. The subsystems shall be able to operate in networks with -82 dBm.	P	No impact on inter-operability

7.2.9.8. Luxembourg

Specific case	Category	Notes
4.2.10 Track-side Train Detection Systems Index 77, Section 3.1.2.4: 1. The output of the sanding devices fitted to the vehicle shall not exceed 0,3 l per minute per rail. 2. The sanding in the stations identified in the infra-structure register is prohibited. 3. The sanding in the area of switches is prohibited. 4. For emergency braking, no restrictions shall apply	T3	

7.3. **Rules for ERTMS**

7.3.1. *The ERTMS European Deployment Plan*

This section outlines the strategy (ERTMS European Deployment Plan) for implementing the TSI. It specifies the stages to be completed in order to make a gradual transition from the existing situation to the final situation in which compliance with the TSIs shall be the norm.

The ERTMS European Deployment Plan does not apply to lines located in the territory of a Member State when its rail network is separated or isolated by the sea or separated as a result of special geographical conditions or of different track gauge from the rail network of the rest of the Community.

7.3.2. *ERTMS Track-side Implementation*

The aim of the ERTMS European Deployment Plan is to ensure that locomotives, railcars and other railway vehicles equipped with ERTMS can gradually have access to an increasing number of lines, ports, terminals and marshalling yards without needing national equipment in addition to ERTMS.

This does not mean that existing Class B systems have to be removed from the lines included in the plan. However, by the date specified in the implementation plan, locomotives, railcars and other railway vehicles equipped with ERTMS must be given access to lines included in the deployment plan without requiring those vehicles to be equipped with a Class B system.

Terminal areas such as ports, or specific lines in a port, which are not equipped with a Class B system fulfil the requirements set out in Section 7.3.2.2 provided railway vehicles are given access to these terminal areas without any requirement as regards equipment with an Automatic Train Protection system being imposed.

A line consisting of two or more tracks shall be considered equipped as soon as two of the tracks are equipped so as to allow traffic in both directions. When there is more than one line on a section of a corridor, at least one of the lines on this section must be equipped and the whole corridor shall be considered equipped as soon as at least one line is equipped over the whole length of the corridor.

7.3.2.1. Corridors

The six corridors described in Section 7.3.4 shall be equipped with ERTMS according to the timetable indicated in that section [1].

[1] Section 7.3.4 lays down the deadlines for equipping these corridors, with a view to building a consistent ERTMS network step by step. In a number of cases, there are voluntary agreements on an earlier deadline.

7.3.2.2. Connection to the main European ports, marshalling yards, freight terminals and freight transport areas

The ports, marshalling yards, freight terminals and freight transport areas listed in 7.3.5 shall be linked to at least one of the six corridors specified in 7.3.4 at the date and under the conditions specified in 7.3.5.

7.3.2.3. High-speed network

It is mandatory to fit ERTMS/ETCS track-side when:

1. installing for the first time the train protection part of a Control-Command and Signalling Track-side Subsystem (with or without a Class B system); or

2. upgrading the existing train protection part of a Control-Command and Signalling Track-side Subsystem, where this would change the functions, performance and/or interoperability-relevant interfaces (air gaps) of the existing legacy system. This does not apply to modifications deemed necessary to mitigate safety-related defects in the legacy installation.

It is recommended that ERTMS/ETCS be installed whenever the infrastructure or energy sub-system of a section of line already in service is to be upgraded, renewed or maintained, provided the installation of ERTMS/ETCS on that section of line represents less than 10 % of the total upgrade/renewal/maintenance investment.

7.3.2.4. EU-funded projects

Without prejudice to Sections 7.3.2.1, 7.3.2.2 and 7.3.2.3, in the case of railway infrastructure projects receiving financial support from European Regional Development Funds and/or Cohesion Funds (Council Regulation (EC) No 1083/2006 of 11 July 2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund ([1])) and/or the TEN-T funds (Decision No 1692/96/EC of the European Parliament and of the Council ([2])) the fitting of ERTMS/ETCS is mandatory when:

1. installing for the first time the train protection part of a Control-Command and Signalling Subsystem; or

2. upgrading the train protection part of a Control-Command and Signalling Subsystem already in service, where this changes the functions or the performance of the subsystem.

7.3.2.5. Notification

For each corridor section described in 7.3.4, Member States shall either notify to the Commission a detailed timeline for equipping that corridor section with ERTMS or confirm that the corridor section is already equipped. The information shall be notified to the Commission no later than 3 years before the deadline for equipping that corridor section, as specified in 7.3.4.

For each port, marshalling yard, freight terminal or freight transport area listed in 7.3.5, Member States shall notify the specific lines to be used to connect it with one of the corridors listed in 7.3.4. This information shall be notified to the Commission no later than 3 years before the date specified in 7.3.5 and shall indicate the deadline for equipping this port, marshalling yard, freight terminal or freight transport area. If necessary, the Commission may request adjustments, in particular to ensure consistency between equipped lines at the borders. Member States shall either notify to the Commission a detailed timeline for equipping these specific lines with ERTMS or confirm that these specific lines are already equipped. This information shall be notified to the Commission no later than 3 years before the date specified in 7.3.5 and shall indicate the deadline for equipping this port, marshalling yard, freight terminal or freight transport area.

The detailed timelines shall in particular indicate the date by which the tender for equipping of the line will be concluded, the procedures put in place in order to ensure interoperability with the neighbouring countries on the corridor and the main milestones relating to the project. Every 12 months, Member States shall inform the Commission of the progress made in equipping these lines sending an updated timeline.

7.3.2.6. Delays

When a Member State reasonably expects delays in fulfilling the deadlines laid down in this Decision, it shall immediately inform the Commission. It shall send the Commission a file containing a technical description of the project and an up-to-date implementation plan. The file shall also explain the reasons for the delay and shall indicate the corrective measures the Member State has taken.

([1]) OJ L 210, 31.7.2006, p. 25.
([2]) OJ L 228, 9.9.1996, p. 1.

A deadline extension of no more than 3 years can be granted to a Member State when the delay is due to causes beyond the Member State's reasonable control such as failure of suppliers or problems regarding the authorisation process due to the absence of appropriate test vehicles. Such an extension can be advocated by a Member State only when the following conditions are fulfilled:

1. the notifications, if needed, referred to in Section 7.3.2.5 were received in time and were comprehensive;

2. the file referred to in Section 7.3.2.6, first paragraph, contains clear evidence that the causes for the delay were beyond the Member State's control;

3. a competent authority is responsible for coordinating on-board and track-side suppliers and for integrating and testing of products;

4. appropriate use has been made of existing laboratories;

5. evidence is given that appropriate measures have been taken to minimise the additional delay.

The Commission shall examine the file sent to it and the measures proposed by the Member State and shall notify the result of its examination to the committee referred to in Article 29 of Directive 2008/57/EC.

7.3.3. *ERTMS – On-board implementation*

New locomotives, new railcars and other new railway vehicles able to run without traction equipped with a driving cab, ordered after 1 January 2012 or put into service after 1 January 2015, shall be equipped with ERTMS.

This requirement does not apply to new shunting locomotives or to other new locomotives, new railcars and other new railway vehicles equipped with a driving cab, if they are designed exclusively for national service or regional border crossing service. Member States may however introduce additional requirements at national level, in particular with a view to:

1. allowing only ERTMS equipped locomotives to access ERTMS-equipped lines, so that existing national systems can be decommissioned;

2. requesting that new shunting locomotives and/or other new railway vehicles equipped with a driving cab, even if designed exclusively for national service or regional border crossing service, be equipped with ERTMS.

7.3.3.1. High-speed network

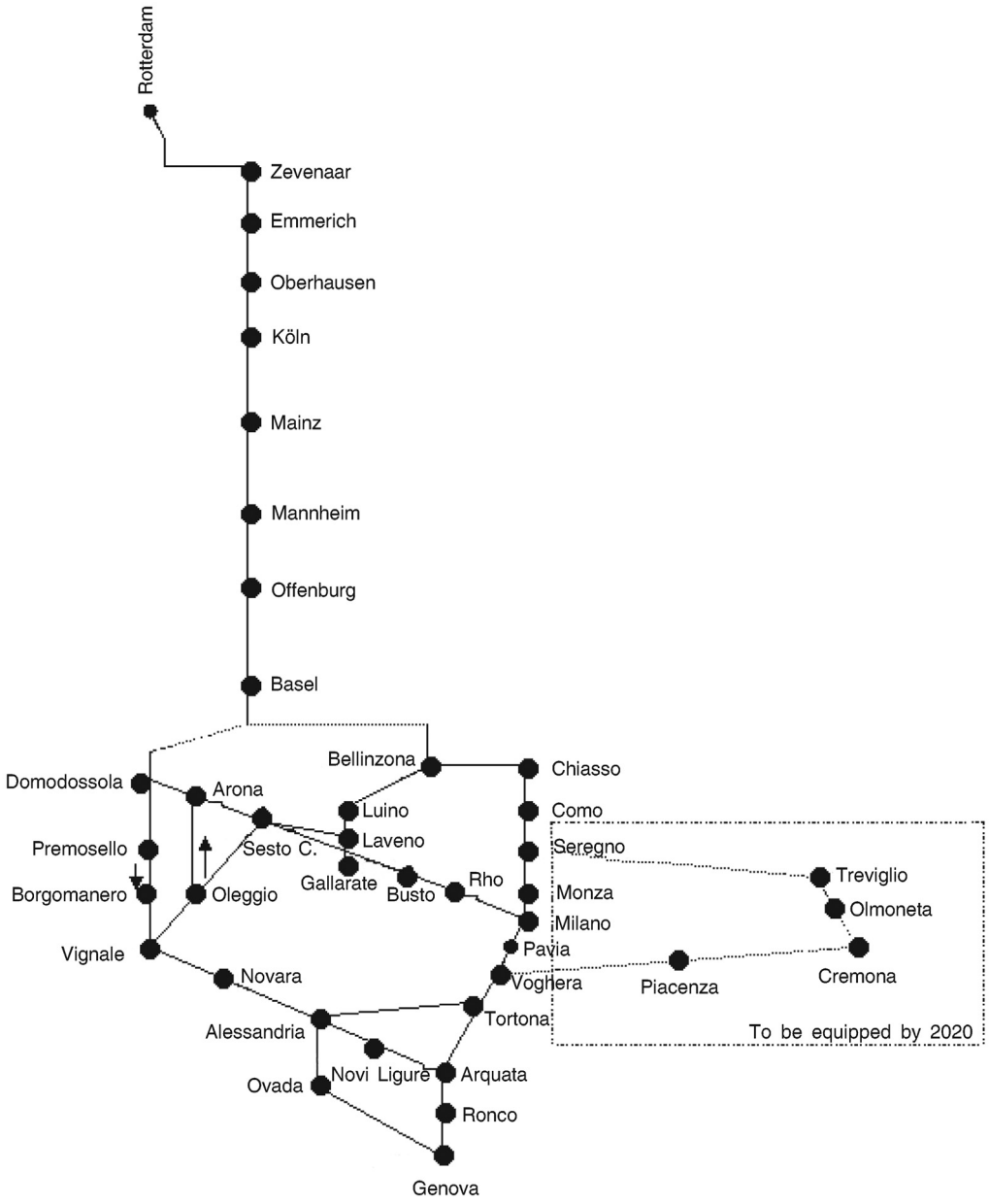
It is mandatory to fit ERTMS/ETCS on board when:

1. installing any new train protection part of a Control-Command and Signalling On-board Subsystem; or

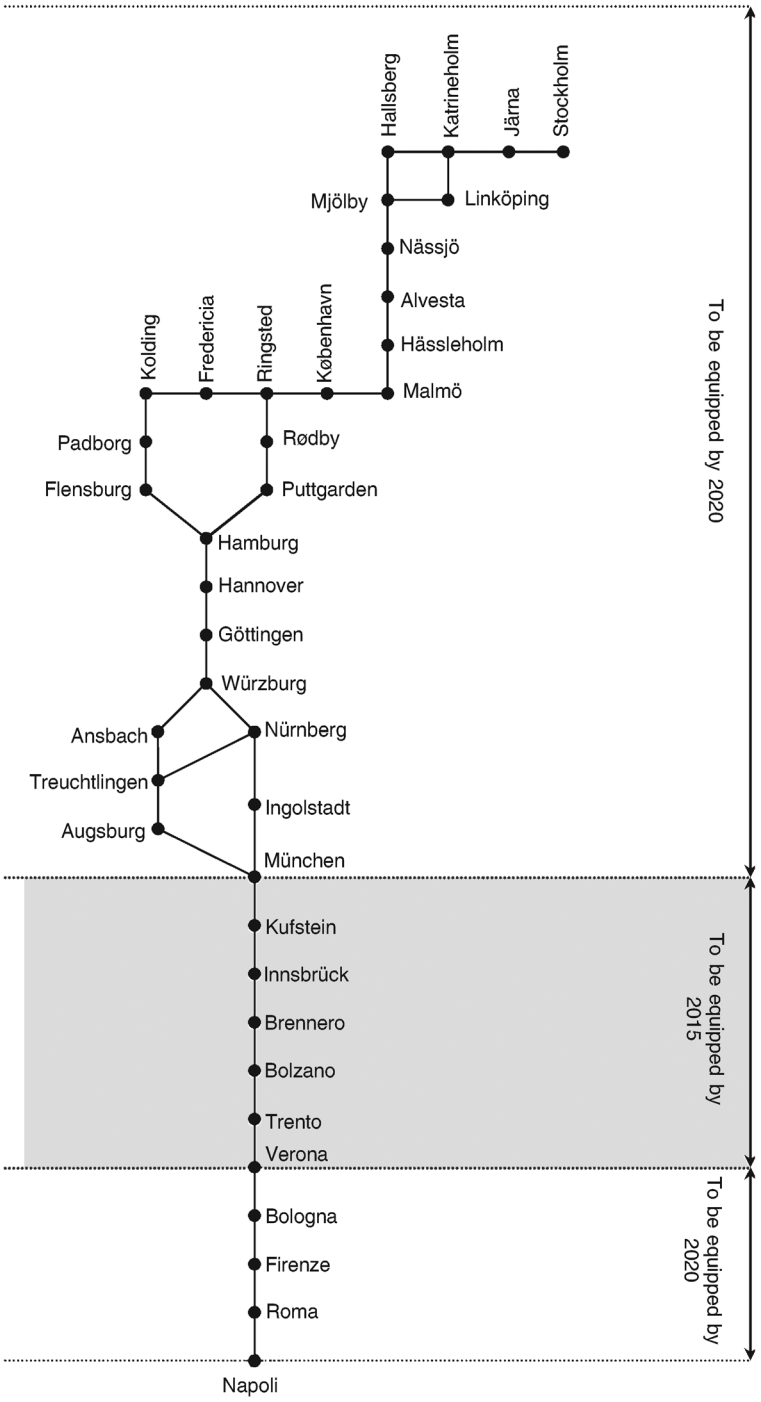
2. upgrading any existing train protection part of a Control-Command and Signalling On-board Subsystem, where this would change the functions, performances and/or interoperability-relevant interfaces of the existing legacy system. This does not apply to modifications deemed necessary to mitigate safety related defects in the legacy system.

7.3.4. *Specific lines constituting the corridors*

Corridor A – to be equipped by 2015

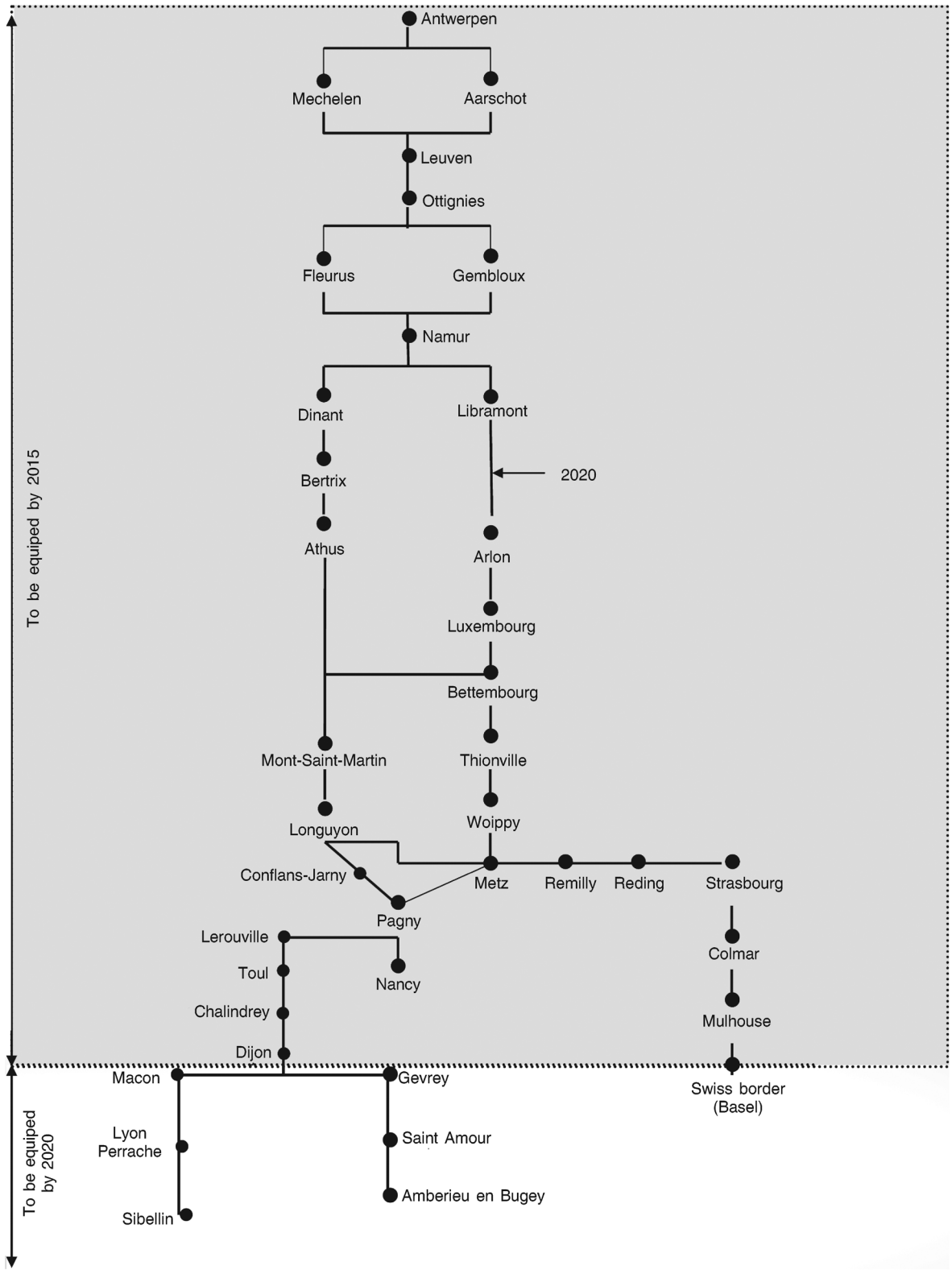


Corridor B [1]



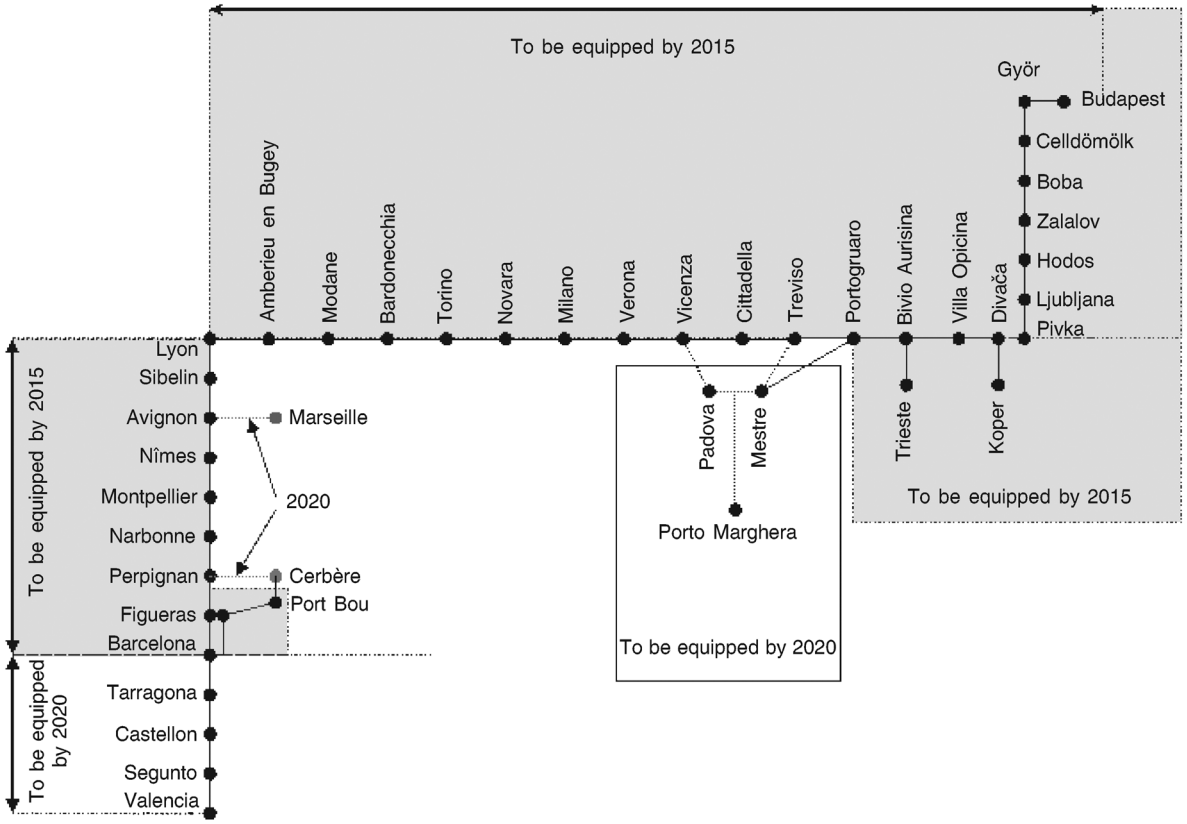
[1] Without prejudice of the legislation applicable to the trans-European high-speed network, links can be provided through stretches of high-speed lines, provided paths are allocated to freight trains. At least one ERTMS-equipped link will be provided by 2020 between Denmark and Germany (Flensburg-Hamburg or Rødby-Puttgarden) but not necessarily two. The Brenner base tunnel will be equipped with ERTMS once the infrastructure work is completed (target date 2020).

Corridor C [1]



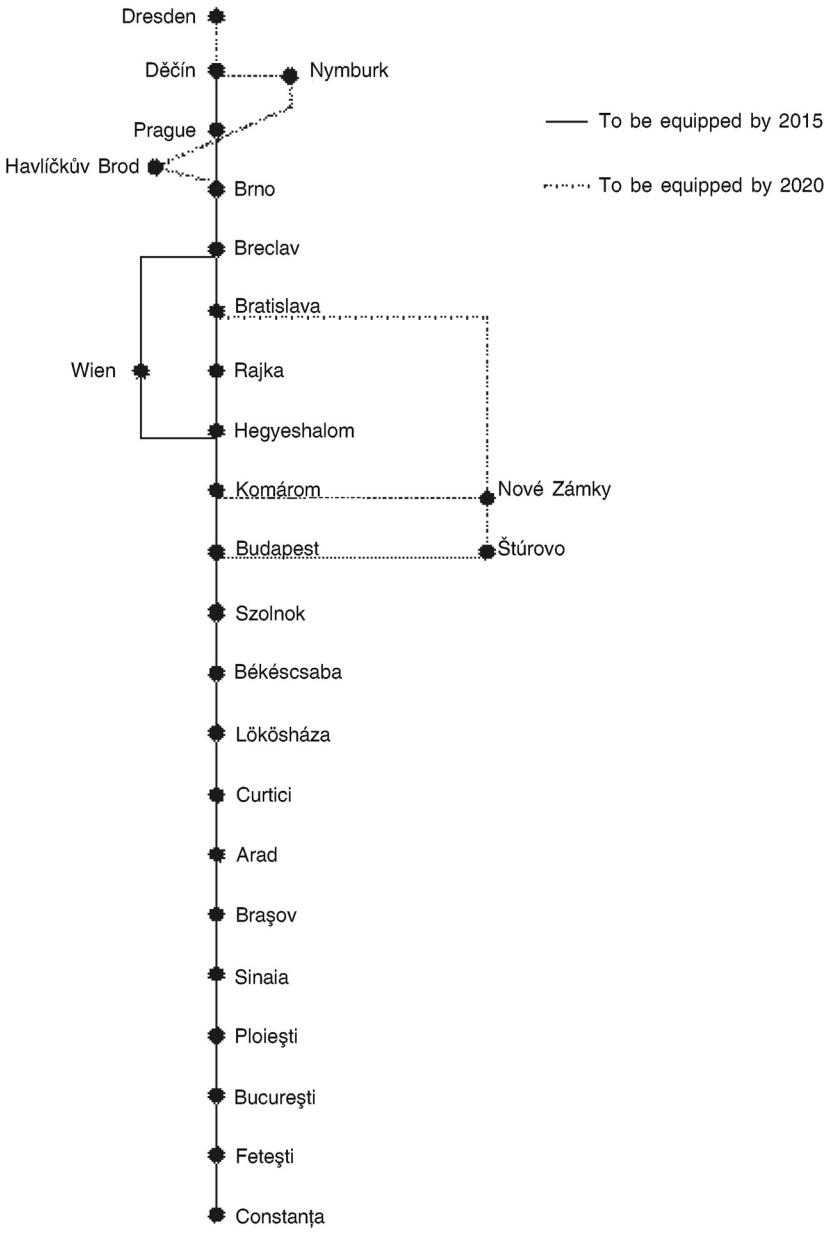
[1] A link between Nancy and Réding will be provided by 2020.

Corridor D ([1])

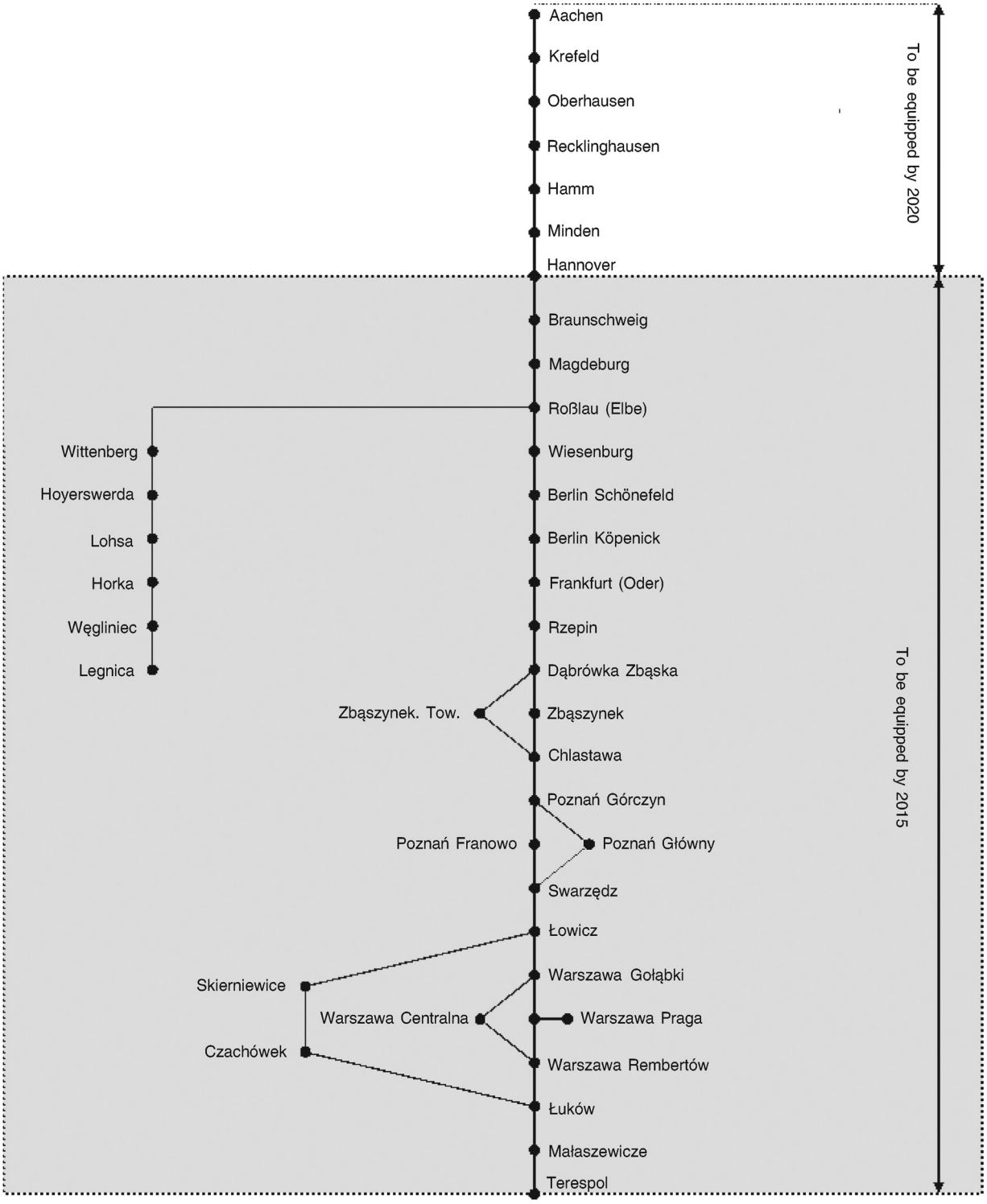


([1]) Two additional branches will be equipped by 2020: Montmélian – Grenoble – Valence and Lyon – Valence – Arles – Miramas (left bank of the Rhône).

Corridor E


Dresden
Děčín
Nymburk
Prague
Havlíčkův Brod
Brno
Breclav
Bratislava
Wien
Rajka
Hegyeshalom
Komárom
Nové Zámky
Budapest
Štúrovo
Szolnok
Békéscsaba
Lökösháza
Curtici
Arad
Braşov
Sinaia
Ploieşti
Bucureşti
Feteşti
Constanţa
To be equipped by 2015
To be equipped by 2020

Corridor F


Aachen
Krefeld
Oberhausen
Recklinghausen
Hamm
Minden
Hannover
To be equipped by 2020
Braunschweig
Magdeburg
Roßlau (Elbe)
Wittenberg
Wiesenburg
Hoyerswerda
Berlin Schönefeld
Lohsa
Berlin Köpenick
Horka
Frankfurt (Oder)
Węgliniec
Rzepin
Legnica
Dąbrówka Zbąska
Zbąszynek. Tow.
Zbąszynek
Chlastawa
Poznań Górczyn
Poznań Franowo
Poznań Główny
Swarzędz
Łowicz
Skierniewice
Warszawa Gołąbki
Warszawa Centralna
Warszawa Praga
Czachówek
Warszawa Rembertów
Łuków
Małaszewicze
Terespol
To be equipped by 2015

7.3.5. *Main European ports, marshalling yards, freight terminals and freight transport areas*

Country	Freight transport area	Date	Remark
Belgium	Antwerpen	31.12.2015	A link to Rotterdam shall also be provided by 2020.
	Gent	31.12.2020	
	Zeebrugge	31.12.2020	
Bulgaria	Burgas	31.12.2020	The connection to corridor E implies equipping the Burgas-Sofia section and the Sofia-Vidin-Calafat and Calafat-Curtici sections in Romania (PP22).
Czech Republic	Praha	31.12.2015	
	Lovosice	31.12.2020	
Denmark	Taulov	31.12.2020	Connecting this terminal implies that the Flensburg-Padborg line is chosen to be an ERTMS equipped link – see corridor B footnote.
Germany	Dresden ([1])	31.12.2020	By 2020, a direct link between corridor E and corridor F (from Dresden to Hannover) shall also be ensured.
	Lübeck	31.12.2020	
	Duisburg	31.12.2015	
	Hamburg ([2])	31.12.2020	
	Köln	31.12.2015	
	München	31.12.2015	
	Hannover	31.12.2015	
	Rostock	31.12.2015	
	Ludwigshafen/ Mannheim	31.12.2015	
	Nürnberg	31.12.2020	
Greece	Pireás	31.12.2020	The connection to Corridor E implies equipping the Kulata-Sofia section in Bulgaria.
Spain	Algeciras	31.12.2020	
	Madrid	31.12.2020	

Country	Freight transport area	Date	Remark
	Pamplona	31.12.2020	Three connections are requested. A connection to Paris via Hendaye, a connection from Pamplona to Madrid and a connection from Pamplona to corridor D via Zaragoza.
	Zaragoza	31.12.2020	
	Tarragona	31.12.2020	
	Barcelona	31.12.2015	
	Valencia	31.12.2020	
France	Marseille	31.12.2020	
	Perpignan	31.12.2015	
	Avignon	31.12.2015	
	Lyon	31.12.2015	
	Le Havre	31.12.2020	
	Lille	31.12.2020	
	Dunkerque	31.12.2020	
	Paris	31.12.2020	By 2020 the following connections will be provided: (i) Hendaye; (ii) Channel Tunnel; (iii) Dijon; and (iv) Metz via Epernay and Châlons-en-Champagne.
Italy	La Spezia	31.12.2020	
	Genova	31.12.2015	
	Gioia Tauro	31.12.2020	
	Verona	31.12.2015	
	Milano	31.12.2015	
	Taranto	31.12.2020	
	Bari	31.12.2020	
	Padova	31.12.2015	
	Trieste	31.12.2015	
	Novara	31.12.2015	

Country	Freight transport area	Date	Remark
	Venezia	31.12.2020	
	Bologna	31.12.2020	
	Roma	31.12.2020	
Luxembourg	Bettembourg	31.12.2015	
Hungary	Budapest	31.12.2015	
Netherlands	Amsterdam	31.12.2020	
	Rotterdam	31.12.2015	A link to Antwerpen shall also be provided by 2020.
Austria	Graz	31.12.2020	
	Wien	31.12.2020	
Poland	Gdynia	31.12.2015	
	Katowice	31.12.2020	
	Wrocław	31.12.2015	By 2020 the Wrocław-Legnica line, shall be equipped in order to ensure a direct link to the German border (Görlitz).
	Gliwice	31.12.2015	
	Poznań	31.12.2015	
	Warszawa	31.12.2015	
Portugal	Sines	31.12.2020	
	Lisboa	31.12.2020	
Romania	Constanța	31.12.2015	
Slovenia	Koper	31.12.2015	
	Ljubljana	31.12.2015	
Slovakia	Bratislava	31.12.2015	
United Kingdom	Bristol		This terminal will be connected as corridor C is extended to the Channel Tunnel.

([1]) Germany will do its best to equip the corridor E section from Dresden to the Czech border at an earlier date.
([2]) Germany will equip a rail link to Hamburg but the harbour area may be only partly equipped by 2020.

ANNEX A

References

For each reference made in the basic parameters (Chapter 4 of this TSI) the following table indicates the corresponding mandatory specifications, via the Index in Table 2.

Table A 1

Reference in Chapter 4	Index number (See Table A 2)
4.1	
4.1a	1
4.1b	32
4.1c	3
4.2.1	
4.2.1 a	27, 78
4.2.1 b	28
4.2.2	
4.2.2.a	14
4.2.2.b	1, 4, 13, 15
4.2.2.c	31, 37
4.2.2.d	18, 20
4.2.2.e	6,
4.2.2.f	7
4.2.3	
4.2.3 a	14
4.2.3 b	1, 4, 13, 15
4.2.3 c	31, 37 b, c, d
4.2.3 d	18, 21
4.2.4	
4.2.4 a	64, 65
4.2.4 b	66
4.2.4 c	67
4.2.4 d	68
4.2.4 e	73, 74
4.2.4 f	32, 33
4.2,4 g	48
4.2,4 h	69, 70
4.2.4 j	71, 72
4.2.4 k	75, 76
4.2.5	
4.2.5 a	64, 65
4.2.5 b	10, 39, 40
4.2.5c	19, 20
4.2.5 d	9, 43
4.2.5 e	16, 50
4.2.6	
4.2.6 a	8, 25, 26, 49
4.2.6 b	45
4.2.6 c	46
4.2.6 d	34
4.2.6 e	20
4.2.6 f	44
4.2.7	
4.2.7 a	12
4.2.7 b	62, 63
4.2.7 c	34
4.2.7 d	9
4.2.7 e	16

Reference in Chapter 4	Index number (See Table A 2)
4.2.8	
4.2.8 a	11
4.2.9	
4.2.9 a	23
4.2.10	
4.2.10 a	77 (Section 3.1)
4.2.11	
4.2.11 a	77 (Section 3.2)

Reference in Chapter 4	Index number (See Table A 2)
4.2.12	
4.2.12 a	51
4.2.13	
4.2.13 a	32, 33, 51
4.2.14	
4.2.14 a	5
4.2.15	
4.2.15 a	38

Specifications

For the purposes of applying this TSI, all specifications listed in Table A 2 below shall be legally binding in the version indicated in Table A 2. Documents referred to within a specification listed in Table A 2 shall be considered as being for information only, unless otherwise stated Table A 2.

In cases where statements within the specifications listed in Table A 2 contradict the abovementioned provisions, the latter shall take precedence.

Note: specifications indicated as 'Reserved' in Table A 2 correspond to the open points listed in Annex G.

Table A 2

List of mandatory specifications

Index N	Reference	Name of Specification	Version	Notes
1	ERA/ERTMS/003204	ERTMS/ETCS Functional requirement specification	5.0	
2	Intentionally deleted			
3	UNISIG SUBSET-023	Glossary of terms and abbreviations	2.0.0	
4	UNISIG SUBSET-026	System requirement specification	2.3.0	
5	UNISIG SUBSET-027	FFFIS Juridical recorder-downloading tool	2.3.0	**Note 1**
6	UNISIG SUBSET-033	FIS for man-machine interface	2.0.0	
7	UNISIG SUBSET-034	FIS for the train interface	2.0.0	
8	UNISIG SUBSET-035	Specific transmission module FFFIS	2.1.1	
9	UNISIG SUBSET-036	FFFIS for Eurobalise	2.4.1	
10	UNISIG SUBSET-037	EuroRadio FIS	2.3.0	
11	UNISIG SUBSET-038	Offline key management FIS	2.3.0	
12	UNISIG SUBSET-039	FIS for the RBC/RBC handover	2.3.0	

Index N	Reference	Name of Specification	Version	Notes
13	UNISIG SUBSET-040	Dimensioning and engineering rules	2.3.0	
14	UNISIG SUBSET-041	Performance requirements for interoperability	2.1.0	
15	ERA SUBSET-108	Interoperability related consolidation on TSI Annex A documents	1.2.0	
16	UNISIG SUBSET-044	FFFIS for Euroloop subsystem	2.3.0	
17	Intentionally deleted			
18	UNISIG SUBSET-046	Radio in-fill FFFS	2.0.0	
19	UNISIG SUBSET-047	Track-side-trainborne FIS for radio in-fill	2.0.0	
20	UNISIG SUBSET-048	Trainborne FFFIS for radio in-fill	2.0.0	
21	UNISIG SUBSET-049	Radio in-fill FIS with LEU/interlocking	2.0.0	
22	Intentionally deleted			
23	UNISIG SUBSET-054	Assignment of values to ETCS variables	2.1.0	
24	Intentionally deleted			
25	UNISIG SUBSET-056	STM FFFIS Safe time layer	2.2.0	
26	UNISIG SUBSET-057	STM FFFIS Safe link layer	2.2.0	
27	UNISIG SUBSET-091	Safety requirements for the technical interoperability of ETCS in levels 1 and 2	2.5.0	
28	Reserved	Reliability — availability requirements		
29	UNISIG SUBSET-102	Test specification for interface 'K'	1.0.0	
30	Intentionally deleted			
31	UNISIG SUBSET-094	Functional requirements for an on-board reference test facility	2.0.2	
32	EIRENE FRS	GSM-R Functional requirements specification	7	
33	EIRENE SRS	GSM-R System requirements specification	15	
34	A11T6001 12	(MORANE) Radio transmission FFFIS for EuroRadio	12	
35	Intentionally deleted			
36 a	Intentionally deleted			
36 b	Intentionally deleted			
36 c	UNISIG SUBSET-074-2	FFFIS STM Test cases document	1.0.0	
37 a	Intentionally deleted			
37 b	UNISIG SUBSET-076-5-2	Test cases related to features	2.3.1	
37 c	UNISIG SUBSET-076-6-3	Test sequences	2.3.1	
37 d	UNISIG SUBSET-076-7	Scope of the test specifications	1.0.2	

Index N	Reference	Name of Specification	Version	Notes
37 e	Intentionally deleted			
38	06E068	ETCS Marker-board definition	2.0	
39	UNISIG SUBSET-092-1	ERTMS EuroRadio conformance requirements	2.3.0	
40	UNISIG SUBSET-092-2	ERTMS EuroRadio test cases safety layer	2.3.0	
41	Intentionally deleted			
42	Intentionally deleted			
43	UNISIG SUBSET 085	Test specification for Eurobalise FFFIS	2.2.2	
44	Reserved	Odometry FIS		
45	UNISIG SUBSET-101	Interface 'K' specification	1.0.0	
46	UNISIG SUBSET-100	Interface 'G' specification	1.0.1	
47	Intentionally deleted			
48	Reserved	Test specification for mobile equipment GSM-R		
49	UNISIG SUBSET-059	Performance requirements for STM	2.1.1	
50	UNISIG SUBSET-103	Test specification for Euroloop	1.0.0	
51	Reserved	Ergonomic aspects of the DMI		
52	UNISIG SUBSET-058	FFFIS STM Application layer	2.1.1	
53	Intentionally deleted			
54	Intentionally deleted			
55	Intentionally deleted			
56	Intentionally deleted			
57	Intentionally deleted			
58	Intentionally deleted			
59	Intentionally deleted			
60	Intentionally deleted			
61	Intentionally deleted			
62	Reserved UNISIG SUBSET-099	RBC-RBC Test specification for safe communication interface		
63	UNISIG SUBSET-098	RBC-RBC Safe communication interface	1.0.0	
64	EN 301 515	Global System for Mobile Communication (GSM); Requirements for GSM operation on railways	2.3.0	**Note 2**
65	TR 102 281	Detailed requirements for GSM operation on railways	1.0.0	**Note 3**
66	(MORANE) A 01 T 0004 1	ASCI Options for Interoperability	1	
67	(MORANE) P 38 T 9001	FFFIS for GSM-R SIM Cards	4.1	

Index N	Reference	Name of Specification	Version	Notes
68	ETSI TS 102 610	Railway Telecommunication; GSM; Usage of the UUIE for GSM operation on railways	1.1.0	
69	(MORANE) F 10 T 6002	FFFS for Confirmation of High-Priority Calls	4	
70	(MORANE) F 12 T 6002	FIS for Confirmation of High-Priority Calls	4	
71	(MORANE) E 10 T 6001	FFFS for Functional Addressing	4	
72	(MORANE) E 12 T 6001	FIS for Functional Addressing	5.1	
73	(MORANE) F 10 T6001	FFFS for Location Dependent Addressing	4	
74	(MORANE) F 12 T6001	FIS for Location Dependent Addressing	3	
75	(MORANE) F 10 T 6003	FFFS for Presentation of Functional Numbers to Called and Calling Parties	4	
76	(MORANE) F 12 T 6003	FIS for Presentation of Functional Numbers to Called and Calling Parties	4	
77	ERA/ERTMS/033281	Interfaces between CCS track-side and other subsystems	1.0	
78	Reserved	Safety requirements for ETCS DMI functions		

Note 1: only the functional description of information to be recorded is mandatory, not the technical characteristics of the interface.

Note 2: the specifications listed in Section 2.1 of EN 301 515 are mandatory.

Note 3: the change requests (CRs) listed in Tables 1 and 2 of TR 102 281 are mandatory.

Table A 3

List of mandatory standards

The standards listed in the table below shall be applied in the certification process, without prejudice for the provisions of Chapters 4 and 6 of this TSI.

No	Reference	Document name and comments	Version
A1	EN 50126	Railway applications — The specification and demonstration of reliability, availability, maintainability and safety (RAMS)	1999
A2	EN 50128	Railway applications — Communication, signalling and processing systems — Software for railway control and protection systems	2001
A3	EN 50129	Railway applications — Communication, signalling and processing systems — Safety related electronic systems for signalling	2003
A4	EN 50159-1	Railway applications — Communication, signalling and processing systems — Part 1	2001
A5	EN 50159-2	Railway applications — Communication, signalling and processing systems — Part 2: Safety related communication in open transmission systems	2001

ANNEX B

Intentionally deleted

ANNEX C

Intentionally deleted

ANNEX D

Intentionally deleted

ANNEX E

Intentionally deleted

ANNEX F

Intentionally deleted

ANNEX G

OPEN POINTS

Open Point	Notes
Braking aspects	This open point will be solved by ERTMS/ETCS baseline 3. The harmonised braking model is already included for information purposes in Annex A, Table A 2, Index 15.
Index 28 availability	Frequent occurrence of degraded situations caused by failures of Control-Command and Signalling equipment will decrease the system safety. To avoid this, minimum reliability/availability requirements that shall be specified.
Index 78 safety requirements for ETCS DMI functions	This open point is related to the interface between ETCS on-board and driver, i.e. errors in displaying information and in entering data and commands
Index 51 Ergonomic aspects of the DMI	This open point will be solved by ERTMS/ETCS baseline 3. A specification for information purposes already exists.
Minimum wheel diameter for speed greater than 350 km/h	See Annex A, Table A 2, Index 77
Minimum axle distance for speed greater than 350 km/h	See Annex A, Table A 2, Index 77
Metal and inductive components free space between wheels	See Annex A, Table A 2, Index 77 This is not an open point for freight wagons
Characteristics of sand applied to tracks	See Annex A, Table A 2, Index 77
Vehicle metal mass	See Annex A, Table A 2, Index 77
Combination of rolling stock characteristics for the purpose of adequate dynamic shunting impedance	See Annex A, Table A 2, Index 77
Electromagnetic interferences (traction current)	See Annex A, Table A 2, Index 77
Electromagnetic interferences (electromagnetic fields)	See Annex A, Table A 2, Index 77 This is not an open point for power systems other than DC
DC and low frequency components of traction current	See Annex A, Table A 2, Index 77
Use of magnetic/eddy current brakes	See Annex A, Table A 2, Index 77

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