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**COMMISSION DECISION**

**of 30 May 2002**

**concerning the technical specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC**

*(notified under document number C(2002) 1952)*

**(Text with EEA relevance)**

**(2002/735/EC)**

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# COMMISSION DECISION

of 30 May 2002

**concerning the technical specification for interoperability relating to the rolling stock subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC**

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**(Text with EEA relevance)**

(2002/735/EC)

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Council Directive 96/48/EC of 23 July 1996 on the interoperability of the trans-European high-speed rail network <sup>(1)</sup>, and in particular Article 6(1) thereof,

Whereas:

- (1) In accordance with Article 2(c) of Directive 96/48/EC, the trans-European high-speed rail system is subdivided into structural or functional subsystems. These subsystems are described in Annex II to the Directive.
- (2) In accordance with Article 5(1) of the Directive, each of the subsystems shall be covered by a technical specification for interoperability (TSI).
- (3) In accordance with Article 6(1) of the Directive, draft TSIs shall be drawn up by the joint representative body.
- (4) The Committee set up under Article 21 of Directive 96/48/EC has appointed the European Association for Railway Interoperability (AEIF) as the joint representative body in accordance with Article 2(h) of the Directive.
- (5) The AEIF has been given a mandate to draw up a draft TSI for the rolling stock subsystem in accordance with Article 6(1) of the Directive. This mandate has been established in accordance with the procedure laid down in Article 21(2) of the Directive.
- (6) The AEIF has drawn up the draft TSI, together with an introductory report containing a cost-benefit analysis as provided for in Article 6(3) of the Directive.
- (7) The draft TSI has been examined by the representatives of the Member States, in the framework of the Committee set up by the Directive, in the light of the introductory report.
- (8) As specified in Article 1 of Directive 96/48/EC, the conditions for achieving interoperability of the trans-European high-speed rail system concern the design, construction, upgrading and operation of the infrastructures and rolling stock contributing to

<sup>(1)</sup> OJ L 235, 17.9.1996, p. 6.

**▼B**

the functioning of the system to be put into service after the date of entry into force of the Directive. With regard to the infrastructures and rolling stock already in service at the time of entry into force of this TSI, the TSI should be applied from the time when work is envisaged on these infrastructures. However, the degree to which the TSI is applied will vary according to the scope and extent of the works foreseen and the costs and the benefits generated by the intended applications. In order for such partial works to concur in achieving full interoperability, they need to be underpinned by a coherent implementation strategy. In this context, a distinction should be made between upgrading, renewal and maintenance-related replacement.

- (9) It is recognised that Directive 96/48/EC and the TSIs do not apply to renewals or maintenance-related replacement. It is desirable however that the TSIs should apply to renewals — as will be the case for the TSIs for the conventional rail system under Directive 2001/16/EC. In the absence of a mandatory requirement and taking into account the extent of the renewal work, Member States are encouraged, where they are able to do so, to apply the TSIs to renewals and maintenance-related replacement.
  
- (10) In its current version, the TSI, which is the subject of this Decision, covers features specific to the high-speed system. As a general rule, it does not address the common aspects of the high-speed and conventional rail system. The interoperability of the latter is the subject of another Directive <sup>(1)</sup>. Given that verification of interoperability has to be established by reference to the TSIs, in accordance with Article 16(2) of Directive 96/48/EC, it is necessary, during the transition period between the publication of this Decision and the publication of the Decisions adopting the ‘conventional rail’ TSIs, to lay down the conditions to be complied with in addition to the TSI attached. For these reasons it is necessary that each Member State informs the other Member States and the Commission of the relevant national technical rules in use for achieving interoperability and meeting the essential requirements of Directive 96/48/EC. In addition, those rules being national, it is necessary that each Member State informs the other Member States and the Commission of the bodies it appoints for carrying out the procedure for the assessment of conformity or suitability for use as well as the checking procedure in use for verifying the interoperability of subsystems within the meaning of Article 16(2) of Directive 96/48/EC. Member States shall apply, as far as possible, the principles and criteria provided for in Directive 96/48/EC for the implementation of Article 16(2) in the case of those national rules. As to the bodies in charge of those procedures, Member States will make use, as far as possible, of bodies notified under Article 20 of Directive 96/48/EC. The Commission will carry out an analysis of this information (national rules, procedures, bodies in charge of implementing procedures, duration of these procedures) and, where appropriate, will discuss with the Committee the necessity of any measure to be taken.

<sup>(1)</sup> Directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the trans-European conventional rail system (OJ L 110, 20.4.2001, p. 1).

**▼B**

- (11) The TSI, which is the subject of this Decision, does not impose the use of specific technologies or technical solutions except where this is strictly necessary for the interoperability of the trans-European high-speed rail network.
  
- (12) The TSI, which is the subject of this Decision, is based on best available expert knowledge at the time of preparation of the corresponding draft. Developments in technology or social requirements may make it necessary to amend or supplement this TSI. Where appropriate, a review or updating procedure will be initiated in accordance with Article 6(2) of Directive 96/48/EC.
  
- (13) In some cases, the TSI, which is the subject of this Decision, allows a choice between different solutions, making it possible to apply definitive or transitional interoperable solutions that are compatible with the existing situation. In addition, Directive 96/48/EC provides for special implementing provisions in certain specific cases. Furthermore, in the cases provided for in Article 7 of the Directive Member States must be allowed not to apply certain technical specifications. It is therefore necessary that the Member States ensure that a rolling stock register is published and updated each year. This register will set out the main characteristics of the national rolling stock (e.g. the basic parameters) and their concordance with the characteristics prescribed by the applicable TSIs. To this end, the TSI, which is the subject of this Decision, indicates precisely which information must appear in the register.
  
- (14) The application of the TSI which is the subject of this Decision must take into account specific criteria relating to technical and operational compatibility between the infrastructures and the rolling stock to be placed in service and the network into which they are to be integrated. These compatibility requirements entail a complex technical and economical analysis that is to be done on a case by case basis. The analysis should take into account:
  - the interfaces between the different subsystems referred to in Directive 96/48/EC,
  
  - the different categories of lines and rolling stock referred to in that Directive and
  
  - the technical and operational environments of the existing network.

That is why it is essential to establish a strategy for the implementation of the TSI which is the subject of this Decision, which should indicate technical stages to move from the present network conditions to a situation where the network is interoperable.

- (15) The provisions of this Decision are in conformity with the opinion of the Committee set up by Directive 96/48/EC,

HAS ADOPTED THIS DECISION:

**▼B***Article 1*

The TSI relating to the ‘rolling stock’ subsystem of the trans-European high-speed rail system referred to in Article 6(1) of Directive 96/48/EC is hereby adopted by the Commission. The TSI is set out in the Annex to this Decision. The TSI is fully applicable to the rolling stock of the trans-European high-speed rail system as defined in Annex I to Directive 96/48/EC, taking into account Article 2 and Article 3 hereunder.

*Article 2*

1. With regard to the aspects that are common to the high-speed and the conventional rail systems, but not covered in the attached TSI, the conditions to be complied with for the verification of the interoperability within the meaning of Article 16(2) of Directive 96/48/EC are the applicable technical rules in use in the Member State which authorises the placing in service of the subsystem concerned by this Decision.

2. Each Member State shall notify to the other Member States and to the Commission within six months of the notification of this Decision:

- the list of the applicable technical rules mentioned under Article 2(1),
- the conformity assessment and checking procedures to be applied with regard to the application of these rules,
- the bodies it appoints for carrying out those conformity assessment and checking procedures.

*Article 3*

1. For the purposes of this Article:

- ‘upgrading’ means major work to modify a subsystem or part of a subsystem which changes the performance of the subsystem,
- ‘renewal’ means major work to replace a subsystem or part of a subsystem which does not change the performance of the subsystem,
- ‘maintenance-related replacement’ means replacement of components by parts of identical function and performances in the context of predictive or corrective maintenance.

2. In the case of upgrading, the contracting entity will submit a dossier describing the project to the Member State concerned. The Member State will examine the dossier and, taking into account the implementation strategy in Chapter 7 of the attached TSI, will (where appropriate) decide whether the scale of the work requires the need for a new authorisation for placing in service under Article 14 of Directive 96/48/EC. Such authorisation for placing in service is necessary whenever the level of safety may objectively be affected by the work envisaged.

**▼B**

Where a new authorisation for placing in service under Article 14 of Directive 96/48/EC is necessary, the Member State decides whether:

- (a) the project includes full application of the TSI, in which case the subsystem will be subject to the EC verification procedure in Directive 96/48/EC; or
- (b) full application of the TSI is not yet possible. In this case the subsystem will not be in full conformity with the TSI and the EC verification procedure in Directive 96/48/EC shall be applied only in respect of the parts of the TSI applied.

In these two cases the Member State will inform the Committee set up pursuant to Directive 96/48/EC of the relevant dossier including the parts of TSI being applied and the degree of interoperability being achieved.

3. In the case of renewal and maintenance-related replacement, application of the attached TSI is voluntary.

*Article 4*

The relevant parts of Commission recommendation 2001/290/EC <sup>(1)</sup> on the basic parameters of the trans-European high-speed rail system have no longer effect from the date of entry into force of the attached TSI.

*Article 5*

The attached TSI shall enter into force six months after notification of this Decision.

*Article 6*

This Decision is addressed to the Member States.

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<sup>(1)</sup> OJ L 100, 11.4.2001, p. 17.

**▼B***ANNEX***Technical specification for interoperability relating to the rolling stock subsystem****▼C1***CONTENTS*

1.	<b>INTRODUCTION</b>
1.1.	TECHNICAL SCOPE
1.2.	GEOGRAPHICAL SCOPE
1.3.	CONTENT OF THIS TSI
2.	<b>SUBSYSTEM DEFINITION/SCOPE</b>
2.1.	SUBSYSTEM DESCRIPTION
2.2.	ROLLING STOCK FUNCTIONS WITHIN THE SCOPE OF THIS TSI
2.2.1.	Carry and protect passengers and train staff
2.2.2.	Accelerate, maintain speed, brake and stop
2.2.3.	Keep train driver informed, provide a view ahead, and allow control of the train
2.2.4.	Support and guide the train on the track
2.2.5.	Signal its presence to others
2.2.6.	Function safely even in the event of incidents
2.2.7.	Respect of the environment
2.3.	FUNCTIONS OUTSIDE THE SCOPE OF THIS TSI
2.3.1.	Ability to operate on available traction supply systems
2.3.2.	Onboard control command equipment
2.3.3.	Maintainability during service on the network
3.	<b>ESSENTIAL REQUIREMENTS</b>
3.1.	
3.2.	
3.3.	
3.3.1.	Safety
3.3.2.	Reliability and availability
3.3.3.	Health requirements
3.3.4.	Protection of the environment
3.3.5.	Technical compatibility
3.4.	<b>VERIFICATION</b>
4.	<b>CHARACTERISTICS OF THE SUBSYSTEM</b>
4.1.	<b>BASIC PARAMETERS OF THE ROLLING STOCK SUBSYSTEM</b>
4.1.1.	Maximum track forces (BP4)
4.1.2.	Axle load (BP10)
4.1.3.	Maximum train length (BP11)
4.1.4.	Vehicle loading gauge (BP12)
4.1.5.	Minimum braking characteristics (BP13)
4.1.6.	Electrical boundary characteristics for rolling stock (BP14)
4.1.7.	Mechanical boundary characteristics for rolling stock (BP15)
4.1.8.	Boundary characteristics linked to exterior noise (BP17)
4.1.9.	Boundary characteristics linked to exterior electromagnetic interference (BP19)
4.1.10.	Boundary characteristics linked to interior noise (BP20)

**▼C1**

- 4.1.11. Boundary characteristics linked to air conditioning (BP21)
- 4.1.12. Characteristics linked to the carriage of persons of reduced mobility (BP22)
- 4.1.13. Maximum pressure variations in tunnels (BP23)
- 4.1.14. Maximum gradients (BP24)
- 4.2. ROLLING STOCK SUBSYSTEM INTERFACES
- 4.2.1. Design of the fixed formation trainset
- 4.2.2. Driver's vigilance device
- 4.2.3. Electrification system
- 4.2.4. Control-command system on board the trains
- 4.2.5. Passenger step
- 4.2.6. Passenger access door
- 4.2.7. Passengers' emergency exits
- 4.2.8. Driver's cab emergency exits
- 4.2.9. Coupling arrangements to rescue trainsets
- 4.2.10. Wheel/rail contact
- 4.2.11. Hot-box detection
- 4.2.12. Emergency alarm
- 4.2.13. Slipstream effects
- 4.2.14. Effect of crosswinds
- 4.2.15. Eddy current brakes
- 4.2.16. Flange lubrication
- 4.2.17. Suspension coefficient
- 4.2.18. Minimum curve radius
- 4.2.19. Maintenance
- 4.2.20. External lights and horn
- 4.2.21. Lifting/rescue procedures
- 4.3. SPECIFIED PERFORMANCE
- 4.3.1. Minimum performance requirements
- 4.3.2. Maximum service speed of trainsets
- 4.3.3. Traction performance requirements
- 4.3.4. Traction adhesion requirements
- 4.3.5. Brake adhesion demand limits
- 4.3.6. Brake system requirements
- 4.3.7. Service braking performance
- 4.3.8. Protection of an immobilised train
- 4.3.9. Brake performance on steep gradients
- 4.3.10. Detection of derailments
- 4.3.11. Protection against fire and toxic fumes
- 4.3.12. Environmental conditions for rolling stock
- 4.3.13. Monitoring and diagnostic concepts
- 4.3.14. Particular specification for long tunnels
- 4.3.15. Emergency lighting system
- 4.3.16. Public address system
- 4.3.17. Protection against electric shock
- 4.3.18. Driver's cab
- 4.3.19. Windscreen and front of the train
- 4.3.20. Passenger information signs
- 4.3.21. Toilets available to passengers and train crew



**▼C1**

5.	<b>INTEROPERABILITY CONSTITUENTS</b>
6.	<b>ASSESSMENT OF CONFORMITY AND/OR SUITABILITY FOR USE</b>
6.1.	INTEROPERABILITY CONSTITUENTS OF ROLLING STOCK
6.1.1.	Conformity and suitability for use assessment procedures (modules)
6.1.2.	Application of modules
6.2.	ROLLING STOCK SUBSYSTEM
6.2.1.	Assessment procedures (modules)
6.2.2.	Application of modules
6.3.	SPECIFIC TEST METHODS
6.3.1.	Limit characteristics related to internal noises — Measuring methods
6.3.2.	Method to test the front window of the cab for sufficient resistance to projectiles
7.	<b>IMPLEMENTATION OF THE ROLLING STOCK TSI</b>
7.1.	APPLICATION OF THIS TSI — PRINCIPLES
7.1.1.	New rolling stock
7.1.2.	Rolling stock being upgraded
7.2.	COMPATIBILITY OF ROLLING STOCK WITH OTHER SUBSYSTEMS
7.3.	SPECIFIC CASES
7.3.1.	Vehicle loading gauge (Section 4.1.4)
7.3.2.	Boundary characteristics linked to exterior noise (Section 4.1.8)
7.3.3.	Maximum pressure variations in tunnels (Section 4.1.13)
7.3.4.	Passenger step (Section 4.2.5)
7.3.5.	Wheel-rail contact (wheel profiles) (Section 4.2.10)
7.3.6.	Protection against fire and toxic fumes
7.4.	RECOMMENDATIONS
7.4.1.	Boundary characteristics linked to interior noise (BP20)
7.4.2.	Boundary characteristics linked to exterior noise (BP17)
7.4.3.	Characteristics linked to the carriage of persons of reduced mobility (BP22)
<i>ANNEX A</i>	<b>PASSIVE SAFETY — CRASHWORTHINESS</b>
<i>ANNEX B</i>	<b>MAXIMUM PRESSURE VARIATIONS IN TUNNELS</b>
<i>ANNEX C</i>	<b>MAXIMUM PROFILE FOR UK1 GAUGE</b>
<i>ANNEX D</i>	<b>ASSESSMENT OF INTEROPERABILITY CONSTITUENTS</b>
<i>ANNEX E</i>	<b>ASSESSMENT OF THE ROLLING STOCK SUBSYSTEM</b>
<i>ANNEX F</i>	<b>PROCEDURES FOR ASSESSMENT OF CONFORMITY AND SUITABILITY FOR USE</b>
<i>ANNEX G</i>	<b>GAUGE</b>
<i>ANNEX H</i>	<b>FRONT AND REAR LAMPS</b>
<i>ANNEX I</i>	
<i>ANNEX J</i>	<b>PROJECTILE TO TEST THE FRONT WINDOW OF THE CAB</b>
<i>ANNEX K</i>	<b>COUPLER</b>
<i>ANNEX L</i>	<b>ASPECTS NOT SPECIFIC TO HIGH SPEED AND FOR WHICH NOTIFICATION OF NATIONAL RULES IS REQUIRED</b>
<i>ANNEX M</i>	<b>(p.m.)</b>

**▼ C1**

<i>ANNEX N</i>	<b>EMERGENCY LIGHTING REQUIREMENTS</b>
<i>ANNEX O</i>	<b>EARTH PROTECTION OF THE VEHICLES' METAL PARTS</b>
<i>ANNEX P</i>	<b>LINE VOLTAGE</b>
<i>ANNEX Q</i>	<b>SIGNS INDICATING THE CASKET WHICH CONTAINS THE EQUIPMENT OF ALARM DEVICE REMINDER</b>

**▼B****1. INTRODUCTION****1.1. TECHNICAL SCOPE**

This TSI concerns the rolling stock subsystem, which is one of the subsystems listed in Annex II(1) to Directive 96/48/EC.

This TSI is part of a set of six TSIs, which cover all the eight subsystems defined in the Directive. The specifications concerning the ‘users’ and ‘environment’ subsystems, which are necessary to ensure interoperability of the trans-European high-speed rail system in compliance with the essential requirements, are set out in the TSIs concerned.

This TSI is applicable to trains running at a speed of at least 250 km/h on the lines specially built for high speed and at a speed of the order of 200 km/h on existing lines which have been or are to be specially upgraded. As far as trains running on upgraded lines at a speed of the order of 200 km/h and on other conventional lines are concerned, Article 2 of the present TSI Decision is applicable as long as this case is not covered in the TSI revision process.

More information about the rolling stock subsystem is given in Chapter 2.

**1.2. GEOGRAPHICAL SCOPE**

The geographical scope of this TSI is the trans-European high-speed rail system as described in Annex I to Directive 96/48/EC.

Reference shall be made in particular to the lines of the trans-European rail network described in European Parliament and Council Decision No 1692/96/EC of 23 July 1996 on Community guidelines for the development of the trans-European transport network or in any update to the same Decision as a result of the revision provided for in Article 21 of that Decision.

**1.3. CONTENT OF THIS TSI**

In accordance with Article 5(3) and with Annex I(1)b of Directive 96/48/EC, this TSI:

- (a) specifies the essential requirements for the subsystems and their interfaces (Chapter 2);
- (b) establishes the basic parameters described in Annex II(3) to that Directive, which are necessary to meet the essential requirements (Chapter 4);
- (c) establishes the conditions to be complied with to achieve the specified performances for each of the following categories of line (Chapter 4):
  - category I: specially built high-speed lines equipped for speeds generally equal to or greater than 250 km/h,
  - category II: specially upgraded high-speed lines equipped for speeds of the order of 200 km/h,

**▼B**

- category III: specially upgraded high-speed lines which have special features as a result of topographical, relief or town-planning constraints, on which the speed must be adapted to each case;
- (d) establishes implementing provisions in certain specific cases (Chapter 7);
- (e) determines the interoperability constituents and interfaces which must be covered by European Specifications, including European standards, which are needed in order to achieve interoperability within the trans-European high-speed rail system while meeting the essential requirements (Chapter 5);
- (f) states, in each case under consideration, which of the modules defined in Decision 93/465/EEC or, where appropriate, which specific procedures are to be used in order to assess either the conformity or the suitability for use of the interoperability constituents, as well as 'EC' verification of the subsystems (Chapter 6).

## 2. SUBSYSTEM DEFINITION/SCOPE

### 2.1. SUBSYSTEM DESCRIPTION

'The characteristics of the rolling stock must be such as to allow it to travel on any line on which it is expected to operate. (Council Directive 96/48/EC, Annex III, essential requirement 2.4.3)'.

Trains that meet the technical requirements stated in this TSI are able to serve the lines mentioned in Annex I(1)b to Directive 96/48/EC.

The rolling stock subsystem does not include the control-command, operation or power supply subsystems since these subsystems are specified in their own TSIs.

In addition, rolling stock does not include the train staff (driver and other on-board train crew).

The rolling stock shall fulfil the following functions:

- carry and protect the passengers and train crew
- accelerate, maintain speed, brake and stop
- keep the train driver informed, provide a view ahead, and allow proper control
- support and guide the train on the track
- signal the presence of the train to others
- function safely even in the event of incidents
- respect the environment.

**▼B****2.2. ROLLING STOCK FUNCTIONS WITHIN THE SCOPE OF THIS TSI****2.2.1. Carry and protect passengers and train staff**

Trains shall ensure the required level of safety for passengers and train crew during access to and egress from the trains, and during their journey. Trains shall also be sensitive to the special needs of persons of reduced mobility.

**2.2.2. Accelerate, maintain speed, brake and stop**

The performance defined in the TSI will allow vehicles to fit into the timetable slots on the sections or stretches of the trans-European high-speed network for which the rolling stock is designed.

**2.2.3. Keep train driver informed, provide a view ahead, and allow control of the train**

The driver shall be provided with a clear view of the line ahead. All instruments and controls relating to train operation and the control-command subsystem shall be clearly marked, work in real-time, and be unambiguous for the driver.

**2.2.4. Support and guide the train on the track**

The different needs of this subsystem are defined by standards for the wheels that comprise the interface with the rail in the infrastructure subsystem.

The contact geometry is such that the stability of the train with all its equipment in good working order is ensured at the highest operating speed specified for the trainset. This aspect allows the interface with the many parameters within the infrastructure subsystem such as the track gauge, cant deficiency and equivalent conicity, to be defined.

**2.2.5. Signal its presence to others**

Trains are provided with equipment which enables them to indicate their presence in an audible, visual and/or electronic form acceptable to all parts of the interoperable network and its traffic management systems.

**2.2.6. Function safely even in the event of incidents**

Trains are provided with safety devices to fulfil their functions in the event of possible incidents, reducing the effects of such incidents, and allowing their elimination whenever possible.

**2.2.7. Respect of the environment**

The materials selected for use on rolling stock shall minimise the emission of harmful and dangerous fumes or gases during use of the trains. The limits set for exterior noise and electromagnetic interference shall result in minimal environmental impact.

**▼B****2.3. FUNCTIONS OUTSIDE THE SCOPE OF THIS TSI****2.3.1. Ability to operate on available traction supply systems**

As national railways are equipped with various electrification systems, electric trains shall be able to use the available voltage and frequency, and have the correct pantograph to handle the catenary geometry.

These requirements for traction supply are defined in the energy subsystem TSI.

Pantograph: despite being installed on rolling stock, the pantographs are considered to be a part of the Energy subsystem as an important device the proper current-collection function of which is directly linked to the characteristics of the overhead line. The interface characteristics of the pantographs are specified and described in the energy TSI.

**2.3.2. Onboard control command equipment**

The interfaces and characteristics of the on-board ERTMS signalling equipment and the radio system are entirely specified and described in the control-command TSI.

**2.3.3. Maintainability during service on the network**

Major maintenance work that allows the required reliability and availability targets to be met are the responsibility of the railway undertaking that operates the vehicles. The specific technical needs for undertaking tasks appropriate to interoperability in facilities on the interoperable network that do not belong to the rolling stock operator are specified in the maintenance TSI.

**3. ESSENTIAL REQUIREMENTS**

3.1. Under Article 4(1) of Directive 96/48/EC, the trans-European high-speed rail system, subsystems and their interoperability constituents shall meet the essential requirements set out in general terms in Annex III to the Directive.

3.2. The essential requirements relate to:

- safety,
- reliability and availability,
- health,
- environmental protection,
- technical compatibility.

According to Directive 96/48/EC, the essential requirements can be generally applied to the whole trans-European high-speed rail system or be specific to particular aspects of each subsystem and its constituents.

3.3. In the case of the rolling stock subsystem, the specific aspects, in addition to the considerations contained in Annex III to the Directive, are as follows:

**▼B****3.3.1. Safety***Essential requirement 1.1.1:*

‘The design, construction or assembly, maintenance and monitoring of safety-critical components, and more particularly of the components involved in train movements must be such as to guarantee safety at the level corresponding to the aims laid down for the network, including those for specific degraded situations’

.

This safety requirement is of universal application; as specified in Chapter 1, Section 1.3, this document is limited to the definition of those conditions relating to interoperability. In this regard, this essential requirement is satisfied when all the basic criteria that define the rolling stock in Chapter 4 of this TSI are met.

*Essential requirement 1.1.2:*

‘The parameters involved in the wheel-rail contact must meet the stability requirements needed in order to guarantee safe movement at the maximum authorised speed’

.

In order to satisfy this requirement, the wheel profiles, the allowable profile wear and the components affecting running stability shall be specified in Section 4.2.10 in such a way as to be completely compatible with the track criteria defined in the infrastructure subsystem.

Bearing in mind the importance of maintaining these parameters to guarantee safe operation, it is necessary to make arrangements to monitor these parameters on a continuous or periodic basis to prevent their deterioration over time.

*Essential requirement 1.1.3:*

‘The components used must withstand any normal or exceptional stresses that have been specified during their period in service. The safety repercussions of any accidental failures must be limited by appropriate means’.

The components concerned in respect of each requirement correspond to the constituents and elements for which the characteristics are given in this TSI, together with their monitoring devices. The main characteristics for this requirement are:

- the static resistance of the vehicle structures,
- wheel-wear criteria as defined by the choice of material,
- the hot-box detection,
- the environmental conditions for which the rolling stock equipment is specified,
- the windscreen characteristics.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.1.7, 4.2.10, 4.3.12 and 4.3.19.

In addition, some characteristics are given in order to meet this requirement in the context of their interface with the infrastructure subsystem:

- maximum track forces,
- heat transmitted to the rail,
- effects of crosswinds.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.1.1, 4.2.15 and 4.2.14.

**▼B***Essential requirement 1.1.4:*

‘The design of fixed installation and rolling stock and the choice of the materials used must be aimed at limiting the generation, propagation and effects of fire and smoke fumes in the event of a fire.’

This requirement is met by Section 4.3.11 which covers fire protection.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.3.11.

*Essential requirement 1.1.5:*

‘Any devices intended to be handled by users must be so designed as not to impair their safety if used foreseeably in a manner not in accordance with the posted instructions.’

The present design of trains already takes these risks into account. There is no need to define any specific characteristics purely for interoperability.

*Essential requirement 2.4.1 Section 1:*

‘The rolling stock structures and those of the links between vehicles must be designed in such a way as to protect the passenger and driving compartments in the event of collision or derailment.’

In order to meet this requirement, the vehicle structures are designed with passive safety provisions. The basic principle envisages the possibility of a collision with an obstacle such as a heavy lorry on a level crossing or a rock fall, where the compartments that contain the passengers and driver are subject to minimal deformation. Collision energy shall be absorbed in unoccupied crumple zones designed for such eventualities, which limit deceleration forces and prevent overriding of the vehicle bodies.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.1.7.

*Essential requirement 2.4.1 Section 2:*

‘The electrical equipment must not impair the safety and functioning of the control and command and signalling installations.’

This requirement is met by the criteria defined in the control command TSI, in the paragraph dealing with the electromagnetic compatibility of the rolling stock and the signalling system.

The constraints to operation over existing infrastructure are dealt with on a case-by-case basis. It is imperative to respect the limits defined for existing installations. To find out the different infrastructure characteristics, refer to the ‘Register of infrastructure’ in which the information is given on a line by line basis.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.1.9.



**▼B***Essential requirement 2.4.1 Section 3:*

‘The braking techniques and the stresses exerted must be compatible with the design of the tracks, engineering structures and signalling systems’.

For the present TSI, this requirement is dealt with by two basic parameters.

- the braking performances defined in Section 4.1.5,
- the maximum longitudinal force, defined in Section 4.1.1c, to be applied to the track without exceeding the maximum acceptable longitudinal force on the infrastructure.

Furthermore, the particular case of brake systems independent of wheel rail adhesion that use electromagnetic effects in the rail (eddy current brakes) rather than wheel/rail adhesion is tackled separately in Section 4.2.15 in order to evaluate the consequences of thermal effects in the rails.

*Essential requirement 2.4.1 Section 4:*

‘Steps must be taken to prevent access to electrically-live constituents in order not to endanger the safety of persons’.

To satisfy this requirement, the rolling stock may also be manufactured using European standards relating to protection against electric shock.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.3.17.

*Essential requirement 2.4.1 Section 5:*

‘In the event of danger, devices must enable passengers to inform the driver and accompanying staff to contact him.’

This requirement concerns the indications given to passengers relating to the passenger alarm signal. The various functions of the public address system and of the intercom between the driver and the train crew are intended to respond to this requirement.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.2.12.

*Essential requirement 2.4.1 Section 6:*

‘The access door must incorporate an opening and closing system which guarantees passenger safety.’

This requirement is dealt with in the functional specification of the door control, and by constraints concerning the possibility of door unlocking.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.2.6.

*Essential requirement 2.4.1 Section 7:*

‘Emergency exits must be provided and indicated.’

The number of emergency exits, their distribution, their operation and their sign posting are defined in the present TSI in order to meet the evacuation requirement.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.2.7 and 4.2.8.

**▼B***Essential requirement 2.4.1 Section 8:*

‘Appropriate provisions must be laid down to take account of the particular safety conditions in very long tunnels.’

The provisions relating to fire and fume protection, the trainset design with a driver's cab at each end, emergency alarms which allow the driver to choose his stopping point, emergency lighting, the public address system and the other items defined in this TSI work together to improve safety in tunnels.

The additional stipulations of this requirement are gathered together in a specific paragraph. They are only envisaged for rolling stock that is regularly used through very long tunnels having specific demands listed in the ‘infrastructure register’.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.3.14 and 4.2.12.

*Essential requirement 2.4.1 Section 9:*

‘An emergency lighting system having a sufficient intensity and duration is an absolute requirement on board trains.’

This requirement is covered by the definition of the main functions of the emergency lighting system.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.3.15.

*Essential requirement 2.4.1 Section 10:*

‘Trains must be equipped with a public address system which provides a means of communication to the public from on-board staff and ground control.’

This requirement is covered by the definition of the main functions of the public address system.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.3.16.

**3.3.2. Reliability and availability***Essential requirement 1.2:*

‘The monitoring and maintenance of fixed or movable components that are involved in train movements must be organised, carried out and quantified in such a manner as to maintain their operation under the intended conditions.’

*Essential requirement 2.4.2:*

‘The design of the vital equipment and the running, traction and braking equipment and also the control and command system must, in a specific degraded situation, be such as to enable the train to continue without adverse consequences for the equipment remaining in service.’

Meeting the performances specified in Sections 4.1.5, 4.2.1, 4.2.9, 4.3.1 and 4.3.3 allows these two requirements to be met.

**3.3.3. Health requirements***Essential requirement 1.3.1:*

‘Materials likely, by virtue of the way they are used, to constitute a health hazard to those having access to them must not be used in trains and railway infrastructures.’

This requirement, which is not specific to the railway field, is covered by compliance with the appropriate European or national legislation.

**▼B***Essential requirement 1.3.2:*

‘Those materials must be selected, deployed and used in such a way as to restrict the emission of harmful and dangerous fumes or gases, particularly in the event of fire.’

As already defined in Section 3.3.1, dealing with essential requirement 1.1.4, this requirement is dealt with in Section 4.3.11, which deals with fire protection.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.3.11.

**3.3.4. Protection of the environment***Essential requirement 1.4.1:*

‘The repercussions on the environment of the establishment and operation of the trans-European high-speed rail system must be assessed and taken into account at the design stage of the system in accordance with the Community provisions in force.’

As concerns rolling stock, this requirement is covered by boundary characteristics relating to outside noise, electromagnetic interference as well as light pollution.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.1.8; 4.1.9; 4.2.20.

*Essential requirement 1.4.2:*

‘The materials used in the trains must prevent the emission of fumes or gases which are harmful and dangerous to the environment, particularly in the event of fire.’

This requirement, which is not specific to the railway field, is covered by compliance with the appropriate European or national legislation.

*Essential requirement 1.4.3:*

‘The rolling stock and energy-supply systems must be designed and manufactured in such a way as to be electromagnetically compatible with the installations, equipment and public or private networks with which they might interfere.’

This essential requirement is covered by the basic parameter ‘Boundary characteristics linked to outside electromagnetic interference’.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.1.9.

**3.3.5. Technical compatibility***Essential requirement 1.5:*

‘The technical characteristics of the infrastructures and fixed installations must be compatible with each other and with those of the trains to be used on the trans-European high-speed rail system.’

If adherence to these characteristics proves difficult on certain sections of the network, temporary solutions, which ensure compatibility in the future, may be implemented.’

This general requirement concerns the rolling stock fundamental criteria that correspond to the characteristics defined in Chapter 4 of this TSI.

Some temporary solutions are envisaged. They will be evoked in particular cases to allow proper operation on existing lines or will ultimately appear in the form of special characteristics within the ‘infrastructure register’.

**▼B***Essential requirement 2.4.3 Section 1:*

‘The electrical equipment must be compatible with the operation of the control and command and signalling installations.’

Defining the electrical boundary characteristics, the limits of electromagnetic interference and the interface with the control command subsystem ensures this compatibility.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.1.6, 4.1.9 and 4.2.4.

*Essential requirement 2.4.3 Section 2:*

‘The characteristics of the current-collection devices must be such as to enable trains to travel under the energy supply systems for the trans-European high-speed rail system.’

This compatibility is ensured by the definition of the interface interfaces with the electrification system as specified in the TSI energy subsystem.

The relevant characteristics to validate in respect of this TSI are defined in Section 4.2.3.

*Essential requirement 2.4.3 Section 3:*

‘The characteristics of the rolling stock must be such as to allow it to travel on any line on which it is expected to operate.’

This essential requirement is covered by values of the basic parameters, characteristics of the subsystem interfaces and additionally by the specified rolling stock performance.

The relevant characteristics to validate in respect of this TSI are defined in Sections 4.1, 4.2 and 4.3.

## 3.4. Verification

Conformity of the rolling stock subsystem and its constituents to the essential requirements is checked in accordance with the provisions envisaged in Directive 96/48/EC as well as in this TSI.

## 4. CHARACTERISTICS OF THE SUBSYSTEM

The Trans-European high-speed rail system (to which Directive 96/48/EC applies and of which the subsystem is a part) is an integrated system. It requires the basic parameters, interfaces and performance to be verified in particular so as to ensure that the system is interoperable and that the essential requirements are met.

With regard to technical interoperability, the rolling stock subsystem has the following characteristics:

- basic parameters
- interfaces with other subsystems
- specified performance

**▼M1**

The common characteristics of rolling stock are defined in Section 4 of the present TSI.

**▼B**

## 4.1. BASIC PARAMETERS OF THE ROLLING STOCK SUBSYSTEM

The basic parameters for the Rolling Stock subsystem are those listed in Annex II of Directive 96/48/EC:

- maximum track forces (BP4)

**▼B**

- axle load (BP10)
- maximum train length (BP11)
- vehicle loading gauge (BP12)
- minimum braking characteristics (BP13)
- electrical boundary characteristics for rolling stock (BP14)
- mechanical boundary characteristics for rolling stock (BP15)
- exterior noise limits (BP17)
- electromagnetic interference limits (BP19)
- interior noise limits (BP20)
- air conditioning limits (BP21)
- requirements for the transport of mobility impaired people (BP22).

Additional basic parameters:

- maximum pressure variations in tunnels (BP23)
- maximum gradients (BP25).

#### 4.1.1. **Maximum track forces (BP4)**

In addition to basic parameter BP10 that deals with the static axle load, the characteristics that allow the maximum track forces to be defined are:

- the dynamic load applied to the rail by the wheel,
- the transverse forces exerted on the track by the train.

##### (a) Dynamic load

The maximum vertical load to be exerted by the wheels on the rail (dynamic load of wheel  $Q$ ) is defined as follows:

- for rolling stock designed to operate on specially constructed high-speed lines at speeds equal to or greater than 250 km/h, the following values apply:

V (km/h)	Q (kN)
V = 250	180
$250 < V \leq 300$	170
V > 300	160

- for rolling stock designed to operate on specially upgraded high-speed lines at speeds of the order of 200 km/h:

**▼M1**

the technical rules in use on these lines are applicable.

**▼B**

##### (b) Transverse track forces

Interoperable rolling stock shall comply with the Prud'homme criteria for the maximum transverse force  $\Sigma Y$  defined as follows:

**▼B**

- total dynamic maximal transverse effort exercised by an axle on the track:

$$\left(\sum Y\right)_{\max} = 10 + \frac{P}{3} \text{ kN},$$

P being the static load on the axle in kN. This result of this formula defines the limit of adhesion between the track tie and the ballast under the influence of transverse dynamic efforts,

- quotient of the transverse and vertical efforts of a wheel:

$$(Y/Q)_{\lim} = 0,8,$$

Y and Q expressing respectively transverse dynamic effort and vertical effort exercised by a wheel on the rail. This limit characterizes the risk of a wheel climb on the rail.

(c) Longitudinal track forces

Longitudinal forces exerted on the track by the rolling stock shall always be less than those corresponding to an acceleration or a deceleration of 2,5 m/s<sup>2</sup>.

4.1.2. **Axle load (BP10)**

The mass on the rail shall be minimised in order to reduce the forces exerted on the track by the train.

This paragraph specifies the static axle load for interoperable rolling stock; note that the dynamic load from train movement is specified in basic parameter 4 (Section 4.1.1).

The limiting values for the static axle loads specified for interoperable trains are set out in the infrastructure TSI.

The track forces are based on the limits set by the increased track stresses resulting from excessive axle loads.

These different aspects are closely linked with the infrastructure subsystem in which the quality of the track is specified.

Note that a limit to the mass will also have the effect of reducing the installed power required and the energy consumption.

The maximum static load  $P_0$  for a motored axle shall not exceed:

- for rolling stock designed to operate on specially constructed high-speed lines at speeds equal to or greater than 250 km/h:

$$P_0 < \text{or} = 17 \text{ t/axle where } V > 250 \text{ km/h,}$$

$$P_0 < \text{or} = 18 \text{ t/axle where } V = 250 \text{ km/h,}$$

**▼ B**

where  $V$  = maximum service speed

The static load  $P_0$  for a non-powered axle shall not exceed 17 t,

— for rolling stock designed to operate on specially upgraded high-speed lines at speeds of the order of 200 km/h:

**▼ M1**

the technical rules in use on these lines are applicable.

**▼ B**

These maximum values are to be considered with a 2 % tolerance for the average axle load of the whole trainset. Furthermore, for each individual axle load, a 4 % tolerance is acceptable.

In addition, the difference in static load between each side of the same vehicle shall not exceed 6 %.

#### 4.1.3. **Maximum train length (BP11)**

High-speed trains suitable for running on the interoperable network shall be made up of fixed-consist trainsets (indivisible in service), able to run either singly (single unit) or coupled together (units in multiple).

The maximum length of the trains thus formed shall not exceed 400 m. A tolerance of 1 % is permissible in order to improve aerodynamic penetration of the front and rear of the train.

To allow them to operate in the terminal stations on the network, the maximum length of the trains shall be compatible with the length of platforms on high-speed and conventional lines that they are intended to serve on the trans-European network.

#### 4.1.4. **Vehicle loading gauge (BP12)**

Interoperable rolling stock shall comply with the dynamic reference contour of one of the following vehicle gauges UIC 505-1, GA, GB or GC as defined in Annex G to this TSI.

**▼ M1**

The choice of rolling stock gauge shall be made based on the routes over which the rolling stock is required to operate.

**▼ B**

#### 4.1.5. **Minimum braking characteristics (BP13)**

(a) High-speed trains incorporate a speed control system with different deceleration levels. The prescribed performance levels defining the minimum braking power for trains suitable for working on all high-speed lines are given in the two following tables. Meeting these performance levels and the safe operation of the braking system, for new systems, shall be fully demonstrated.

**▼B**

- (b) It is important to note that the values in Tables 4.1.5c and 4.1.5d are those appropriate for rolling stock and they shall not be interpreted as being the parameter values for defining the braking curves required by the control-command sub-system. These require the essential safety margins for rail operations in all conditions to be taken into account. These margins shall be specified, for the lines concerned, in liaison with the control-command subsystem.
- (c) Performances: the interoperable trainsets shall be able to achieve, over the range of speeds shown, the average decelerations listed hereafter.

Table 4.1.5c

Braking mode	$t_e$ (s)	Minimum deceleration under set braking conditions (m/s <sup>2</sup> )			
		330 to 300 (km/h)	300 to 230 (km/h)	230 to 170 (km/h)	170 to 0 (km/h)
Case A — emergency braking with certain equipment isolated	3	0,85	0,9	1,05	1,2
Case B — emergency braking with certain equipment isolated and unfavourable climatic conditions	3	0,65	0,7	0,8	0,9

$t_e$ (s) = Equivalent time of application.

*Note:* Emergency braking applications in Case A and Case B shall be performed under the following conditions:

## Case A

- level track and normal train load (number of seats × 80 kg)
- dynamic brake of a motor traction module isolated.

## Case B

In addition to the conditions in Case A, the following shall be added:

- one pneumatic brake distributor is isolated;
- reduced wheel-rail adhesion;
- friction coefficient between pad and disc reduced by humidity.

*Note 1:* On existing infrastructures, infrastructure managers may define further requirements because of the different signalling and control systems on their part of interoperable networks, (infrastructure register), e.g. additional braking systems or reduced service speeds for given braking distances.

*Note2:* Normal service braking conditions are defined in Section 4.3.7.



**▼B**

- (d) *Stopping distances:* the stopping distance 'S' calculated as a function of the minimum decelerations defined above can be defined by using the formula:

$$S = V_0 \times t_e + \frac{V_0^2 - V_1^2}{2ab_1} + \frac{V_1^2 - V_2^2}{2ab_2} + \dots + \frac{V_n^2}{2ab_n}$$

where:  $V_0$  = initial speed (measured in m/s)

$V_1 \dots V_n$  = speed given in Table 4.1.5c (measured in m/s)

$ab_1 \dots ab_n$  = specified deceleration over the speed band under consideration (measured in m/s<sup>2</sup>)

$t_e$  = equivalent time of application (measured in s)

For example, the stopping distances to be met from specific initial speeds are given in Table 4.1.5d:

Table 4.1.5d

Braking mode	$t_e$ (s)	Stopping distances must not exceed			
		330—0 (km/h)	300—0 (km/h)	250—0 (km/h)	200—0 (km/h)
Case A — emergency braking with certain equipment isolated	3	4 530	3 650	2 430	1 500
Case B — emergency braking with certain equipment isolated and unfavourable climatic conditions	3	5 840	4 690	3 130	1 940

- (e) Supplementary conditions:

For cases A and B, when emergency braking is considered:

- the contribution of electric dynamic brakes can only be included in the calculation of the performances defined above if their operation is independent of the presence of voltage in the catenary,
- the contribution of brakes independent of adhesion and based on retardation caused by the generation of eddy current in the rails can be included in the emergency braking performances, under the conditions defined in Section 4.2.15,
- in this case, the condition that an independent eddy current brake module shall be isolated shall be added to the conditions stated in Cases A and B of Tables 4.1.5c and 4.1.5d,
- electromagnetic track brakes independent of wheel/rail adhesion shall be available for emergency applications on all lines.

**▼B****4.1.6. Electrical boundary characteristics for rolling stock (BP14)**

The electrical characteristics of the rolling stock which interface with the fixed infrastructure can be considered under the following headings:

- the voltage and frequency variations in the electrical supply,
- the maximum power that can be drawn from the catenary,
- the power factor of the alternating current supply,
- the short over voltages generated by the operation of rolling stock,
- the electromagnetic interference, see Section 4.1.9,
- the other functional interfaces quoted in Section 4.2.3.

**4.1.6.1. Voltage and frequency of the electricity supply****4.1.6.1.1. Energy supply**

These boundary characteristics are defined in the energy TSI, Section 4.1.1 within which is defined, amongst other things, the voltage range to be supplied by the fixed installations.

**4.1.6.1.2. Energy recuperation**

The general conditions for the return of energy to the catenary from regenerative braking are specified in Section 4.3.6 and in Annex K to the energy TSI.

Rolling stock equipped with a regenerative braking system able to return energy to the catenary shall not, under any circumstances, cause the voltage to exceed the limits given in the Annex previously mentioned.

**4.1.6.2. Maximum power that can be drawn from the catenary**

The rolling stock shall be specified so that the maximum power demand on the catenary shall always be less than the value defined in Section 4.2.2.5 of the energy TSI.

The maximum current that can be drawn from the catenary during a stop of long duration is defined in Section 4.2.2.6 of the energy TSI.

**4.1.6.3. Power factor**

The power factor  $\lambda$  (defined by  $\lambda = \alpha \cos\phi$ ) of the rolling stock shall in all normal operating conditions remain above the values specified in Section 4.3.1.3 of the energy TSI,

**4.1.6.4. Harmonic characteristics and related over-voltages on the OHL**

The characteristics that prevent the generation of unacceptable over-voltages in the catenary are defined in Section 4.2.2.7 of the energy TSI.

**4.1.7. Mechanical boundary characteristics for rolling stock (BP15)**

The static and dynamic strength of vehicle bodies shall ensure the safety required for passengers and train crew. In particular, it should cope in the event of a collision with objects from outside of the rail system, such as heavy lorries or rock falls.

**▼B**

The construction standards used for this purpose shall ensure what is called passive safety. They do not compensate for a possible lack of active safety in the railway network but shall complement personal safety in unforeseen events that are beyond the control of the railway system.

The mechanical boundary limits defined for rolling stock to ensure that this requirement is met are defined below:

(a) static resistance of vehicle structures, and

(b) passive safety (crashworthiness).

(a) Static resistance of vehicle bodyshells

(a1) Vertical static resistance:

The bodyshell of each vehicle shall be able to withstand, without permanent deformation, the vertical static proof loads  $F_z$  in the following configurations:

— jacking of the complete body of the vehicle in running order (VRO), without the running gear, by its four jacking points,

— lifting of one end of the body, VRO,

— exceptional vertical load:

the greater of the two values of  $F_z = 1,3 (m_1 + (m_{21} \text{ or } m_{22})) \times g$  (N) where

$m_1$  = weight of the car body, VRO, with tanks assumed to be half full,

$m_{21}$  = number of seats (excluding tip-ups)  $\times 2 \times 80$  kg,

$m_{22}$  = number of seats (excluding tip-ups)  $\times 80$  kg + area of corridors and vestibules ( $m^2$ )  $\times 4 \times 80$  kg.

(a2) Longitudinal static resistance:

The bodyshell of each vehicle shall be able to withstand a static longitudinal, compressive loading, at the level of the coupler attachments, of at least 1 500 kN without residual deformation.

*Note:* If this value is lower than the longitudinal resistance specified by the passive safety criteria, then the passive safety criteria value shall be applied.

(b) Passive safety (crashworthiness)

See Annex A for a detailed explanation of these characteristics.

In the event of a frontal impact, the mechanical structure of vehicles shall:

— resist over-riding,

— limit deceleration,

— protect the areas occupied by passengers and the driver as far as possible,

— absorb the energy collision.

**▼B**

Three collision scenarios are proposed; corresponding respectively to:

- a front end impact between two trainsets,
- a front end impact with a vehicle fitted with side buffers,
- an impact with a lorry on a level crossing.

Main specifications to be met:

- limited deformation to the driver and passenger areas from a static resistance with the ability to withstand a mean crush load of 1 500 kN,
- dissipation of 6 MJ of crash energy of which at least 4,5 MJ shall be in the front part of the first vehicle,
- all the vehicles in the trainset shall have a consistent level of crashworthiness
- a maximum average deceleration in passenger and drivers cab areas to 5 g,
- the vehicle ends shall be fitted with devices preventing over-riding.

The problems, principles, scenarios as well as the specifications to be met for crashworthiness are described in more detail in Annex A.

Assessment shall be made during the design phase and the integration of components and subassemblies; it shall include the assessment of material properties by crash tests on mock-ups or prototypes. Crush tests can be used as an alternative to assess conformity if the results can be accurately correlated with those of crash tests. Validation of technical solutions related to the present paragraph shall be made according to EN 12663 standard.

Trains must withstand the mechanical loads due to pressure variations in tunnels.

#### 4.1.8. **Boundary characteristics linked to exterior noise (BP17)**

##### (a) Stationary noise levels:

Noise levels in stations or on stabling tracks shall not exceed 65 dB(A) measured continuously or 70 dB(A) intermittently.

The following conditions apply to these values: measured over 30 seconds, in open country at 7,5 m from the axis of the track at a height between 1,2 and 3,5 m.

##### (b) Noise levels in high-speed service:

**▼ B**

Measurements are carried out in accordance with the constant speed test in prEN ISO 3095 — January 2001, with the following additional conditions:

The noise level generated by a trainset in service shall not exceed a value of 87 dB(A) at a speed of 250 km/h, 91 dB(A) at a speed of 300 km/h and 92 dB(A) at a speed of 320 km/h (linear interpolation for other maximum speeds) <sup>(1)</sup>.

Measurements are carried out in accordance with the constant speed test in prEN ISO 3095 — January 2001, with the following additional conditions:

- the passage of a train is measured in open country at 25 m from the axis of the track at a height of 3,5 m,
- at constant speed with traction power operating,
- minimal possible operational configuration for normal service,
- a track type is used with design parameters ensuring minimum sound radiation from the track. These include: monoblock concrete sleepers in ballast and railpads with a static pad stiffness of at least 500 kN/mm at 60 kN preload. It is also permitted to use an acoustically equivalent track design, if available and proven. In that case, the track radiation must be shown to be equivalent to that of the track type mentioned, in accordance with prEN ISO 3095 — January 2001, Annex B: railhead roughness level  $L_{\text{rough}}$  (one-third-octave-band) averaged over a width of 20 mm should be

$$L_{\text{rough}} \leq \left[ 4 - 6 \log \left( \frac{\lambda_0}{\lambda} \right) \right] \text{ dB}$$

with  $\lambda_0 = 1$  m and the wavelength  $\lambda$  between 0,2 and 0,005 m (rail roughness measurements according to ISO 3095, Annex C).

In areas particularly sensitive to noise, the level of noise perceived on the passing of a train can be reduced by the installation of sound attenuating measures placed along the track.

All noise measurements shall be made according to prEN ISO 3095 — January 2001.

#### 4.1.9. **Boundary Characteristics linked to exterior electromagnetic interference (BP19)**

For electric trains, the supply of electricity from the distribution substation to the trains generates interference of high or low intensity by conduction (through the catenary and rail) and by electromagnetic radiation. In addition, any on-board electrical equipment is capable of causing interference.

<sup>(1)</sup> Taking into account that the measurement conditions and the description of the reference track were still under discussion at the time of the adoption of the present TSI, a margin of 1 dB(A) on the limit values is tolerated. This section will be revised when adopting the next generation TSI.

**▼B****4.1.9.1. *Interference generated on the signalling system and the telecommunications network***

The rolling stock shall meet specifications not to interfere with track circuits, axle counters, and the telecommunications network. The items to be taken into account are listed in the infrastructure register for reference purposes.

Compatibility between the rolling stock and the characteristics of the detection system shall be demonstrated using the acceptance procedures in EN 50238 standard.

**4.1.9.2. *not used*****4.1.9.3. *Radio frequency interference***

The rolling stock shall meet the requirements of the EN 50121-3-1 standard by not generating interference affecting lineside and adjacent installations on a line declared to be interoperable.

**4.1.9.4. *Electromagnetic immunity***

In order to avoid interference to the proper operation of rolling stock due to electromagnetic interference, the requirements of the following standards shall be met:

— EN 50121-3-1 for the total rolling stock subsystem,

— EN 50121-3-2 for the different kinds of on-board equipment susceptible to interference.

**4.1.10. *Boundary characteristics linked to interior noise (BP20)***

The interior noise level of passenger vehicles is not considered to be an interoperability constituent. However, the noise level within the driver's cab is an important issue and in this case a permissible equivalent continuous sound pressure level of 84 dB(A) shall not be exceeded over 30 minutes. The measuring methods are defined in Chapter 6 of this TSI. The values recommended for new vehicle designs are indicated in Chapter 7.

**4.1.11. *Boundary characteristics linked to air conditioning (BP21)***

— Driving cab:

The ventilation of the driving cab shall be such as to ensure that carbon monoxide and dioxide levels remain under the level set by European health and safety legislation.

**4.1.12. *Characteristics linked to the carriage of persons of reduced mobility (BP22)***

The railway company has to take the necessary measures to guarantee the access of persons of reduced mobility to the operated vehicles. The horizontal and vertical surfaces required for the fixed installations are specified in the infrastructure TSI.

**▼B**

With two possible platform heights (550 mm and 760 mm) specified in the infrastructure TSI, it is unlikely that level access from platform to train will be achieved in all parts of the network. It will therefore be necessary to use technical and operational solutions to overcome this problem for disabled passengers. There are several solutions available that could be adopted on the trans-European high speed network which include:

- rolling stock solutions:
  - bridging ramp integrated into rolling stock
  - lift integrated into rolling stock,
- infrastructure solutions:
  - platform lift
  - partially raised platform (i.e. section of all platforms at 750 mm),
- operational solutions:
  - portable ramp deployed by operating staff
  - mobile lift deployed by operating staff.

Access to trains for those with reduced mobility shall be possible. Since 'disabled passengers' includes wheelchair users (WCU), provisions for wheelchair users shall be designed to accommodate a 'wheelchair' conforming to the dimensions specified in ISO 7193. High-speed trains should be specifically equipped to meet their needs with an adapted toilet, space for at least one wheelchair, and gangways and doors of sufficient width.

These measures shall be put in place during upgrading or new building as disabled access measures are incorporated into harmonised national legislation.

#### 4.1.13. **Maximum pressure variations in tunnels (BP23)**

The design of the interoperable trainsets shall be such that the maximum pressure variation defined in the infrastructure TSI (10 kPa) is never exceeded, even in the event that the pressure sealing of vehicles (when so equipped) fails.

Thus one can define the pressure characteristics of the trainset by a unique envelope curve in order to provide the three pressure variations P0, P1 and P2, which are specified in Annex B.

For reference purposes, the following values are used:

- $\Delta P_0 < \text{or} = 1\,800 \text{ Pa}$ ,
- $\Delta P_1 < \text{or} = 3\,200 \text{ Pa}$ ,
- $\Delta P_1 - 0,8\Delta P_0 < \text{or} = \Delta P_2$ .

These values are given by:

- a ratio between the train and tunnel cross-sections of 0,18,
- a service speed of 250 km/h

**▼B****4.1.14. Maximum gradients (BP24)**

The rolling stock will be able to start, operate and stop on the maximum gradients on all the lines for which it is designed and over which it is likely to operate.

This is of particular relevance to the performance requirements specified in Chapter 4.3.

The maximum gradients of each line are defined in the infrastructure register.

**4.2. ROLLING STOCK SUBSYSTEM INTERFACES**

As far as technical compatibility is concerned, these are the interfaces of the rolling stock subsystem with the other subsystems:

- the design of the fixed formation trainset
- driver vigilance device
- the electrification system
- on-board train control equipment
- platform height
- the door controls
- emergency exits
- emergency couplers
- wheel/rail contact
- hot-box detection
- alarm signal
- pressure wave effects
- effect of crosswinds
- brakes independent of adhesion
- flange lubrication
- coefficient of flexibility.

The interfaces are defined in the following list in order to ensure the development of a consistent trans-European network.

**4.2.1. Design of the fixed formation trainset**

The trainsets shall be able to run on the European network and provide seamless travel for passengers. In this respect, they shall comply with the technical requirements stated in this TSI.

The trains concerned shall be self-propelled fixed formation trainsets, capable of bi-directional operation and achievement of the performance stated elsewhere. They shall provide a driver's cab at each end to aid reversals at terminal stations and in the event of a tunnel evacuation.

The following are permissible:

- conventional or articulated fixed consist trainsets,
- trainsets with or without tilt systems,
- single or double deck trainsets.



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To allow train passenger capacity to meet changing traffic needs it is permissible to couple trainsets of the same type to run in multiple. Such a train formed from two or more trainsets shall meet the specification in this document. It is not a requirement that trains of different manufacturers' designs or from other networks shall operate coupled together.

**4.2.2. Driver's vigilance device**

Any lack of driver vigilance shall be detected within a given time and shall lead, in the absence of driver reaction, to an automatic emergency brake application on the train.

**4.2.3. Electrification system**

For electrically powered interoperable trainsets, the principal interface elements between the rolling stock and the energy subsystem are defined in the energy TSI.

They are as follows:

- the maximum power that can be drawn from the catenary (Section 4.1.6.2 of this document) defined in Section 4.2.2.5 of the energy TSI,
- the maximum current that can be drawn at standstill is defined in Section 4.2.2.6 of the energy TSI,
- the voltage and the frequency of the traction supply (see Section 4.1.6.1.1) defined in Section 4.2.2.7 of the energy TSI,
- over-voltages generated on the overhead line by harmonics (see Section 4.1.6.4) defined in Section 4.3.1.7 of the energy TSI,
- electrical protection measures defined in Section 4.2.2.8 of the energy TSI,
- the distribution of the pantographs defined in Section 4.2.2.9 of the energy TSI,
- running through phase separation sections defined in Section 4.2.2.10 of the energy TSI,
- running through system separation sections defined in Section 4.2.2.11 of the energy TSI,
- adjustment of the pantograph contact defined in Section 4.2.2.12 of the energy TSI,
- power factor (see Section 4.1.6.3) defined in Section 4.3.1.3 of the energy TSI,
- regenerative braking (see Section 4.1.6.1.2) defined in Section 4.3.1.4 of the energy TSI.

The interaction between the pantographs and the catenary is of particular importance since their joint operation will ensure an uninterrupted power supply for traction and, if required, regenerative braking. These requirements shall also be observed by all combinations of trains, single trainsets as well as trainsets that are coupled in multiple. The constraints imposed by the distribution of pantographs and the quality of current collection are defined in Section 4.3.2.3 of the energy TSI.

**▼ B****4.2.4. Control-command system onboard the trains**

To conform Directive 96/48/EC, and finally move towards a unified system, interoperable trainsets shall be compatible with the ERTMS system (Commission Decision 2001/260/EC). Compatibility with existing systems will be achieved using adaptive modules installed on the trainsets. In practical terms it would be impossible to install all the modules required on board a train set. The choice of modules shall be based on the routes for which the trainset is intended.

The interface characteristics between the rolling stock and the control command subsystem are included in Section 4.2.1.2 of the TSI for that subsystem, and are notably:

- the minimum braking characteristics for the train covered in Section 4.1.5 of the present document,
- compatibility between the ground-based train detection systems and the rolling stock, dealt with Section 4.1.9.1 of the present document,
- compatibility between the detectors fixed under vehicles and the dynamic clearances of those vehicles,
- the environmental conditions for the on-board equipment are dealt with in Section 4.3.12 of the present document,
- electromagnetic compatibility with on-board control command equipment are dealt with in Section 4.1.9.4 of the present document,
- train data concerning braking, train integrity and train length,
- electromagnetic compatibility with the ground-based systems covered in Section 4.1.9.3 of the present document.

In addition, the following functions are directly linked with parameters defined by the control-command subsystem.

- operation in degraded mode conditions
- monitoring to ensure that the train speed is at all times less than or at most equal to the maximum permitted speed in the operating environment.

Information about the characteristics of these interfaces is given in Tables 5.1 A, 5.1 B and 6.1 in the control-command TSI. In addition, reference to European standards and specifications to be used as part of the assessment procedure for conformity are indicated, for each characteristic, in Annex A to the control-command TSI.

**4.2.5. Passenger step**

The passenger step for access to vehicles shall be optimised for the two platform heights of 550 mm and 760 mm that exist on the network, unless the trainset can only operate over a part of the network with a single platform height.

**▼B****4.2.6. Passenger access door****(a) Terminology used:**

- a ‘closed door’ is a door held closed by the door closing mechanism only,
- a ‘locked door’ is a door held closed by a mechanical door locking device,
- a ‘door locked out of service’ is immobilised in a closed position by a mechanical device activated by a member of the train crew.

- (b) Door operation: The passenger access doors shall be designed to operate in such a way that their opening and closing does not require any significant effort on the part of the passengers.
- (c) Door closing: The control and command system shall allow the train crew (driver or conductor) to close and lock the doors before the train departs.

When the locking control is under staff control, and activated from a door, this door can remain open when the other doors close, but it must then be possible for staff to close and lock it subsequently. In addition, a closing and locking order of this door shall occur automatically before the train reaches 5 km/h.

The doors shall be kept closed and locked until the train crew releases them.

In the event of loss of power to the door controls, the doors shall be kept locked by the locking mechanism.

**(d) Information available to the train crew:**

An appropriate device shall indicate that all the doors apart from a door under local control are closed and locked.

Appropriate indication will be provided to the train crew of any fault in the door closing operation. A ‘door locked out of service’ shall not be taken into account.

- (e) Locking a door out of service: A manual device shall be provided to enable the train crew to lock a door out of service. This action shall be possible from both inside and outside the train.

After the door is locked out of service it shall no longer be taken into account by the door controls or the onboard monitoring systems.

- (f) Door opening release: The train crew shall be provided with controls that allow the doors to be released separately on each side, to allow them to be opened by passengers when the train is stopped.

**▼B**

This opening control shall be accessible from both the outside and the inside of the vehicle.

Each door shall be provided with an individual opening device, accessible to passengers, to allow that door to be opened for emergency reasons, at speeds below 10 km/h. This device shall have no effect on 'a door locked out of service'.

- (g) Door dimensions shall allow the complete evacuation of passengers in normal operation within three minutes.

#### 4.2.7. **Passengers' emergency exits**

- (A) Arrangement: the vehicles shall have a minimum number of emergency exits on each side of the vehicle, and shall conform to the following rules:

- the distance between each passenger seat and an emergency exit shall always be less than 16 m,
- there shall be at least two emergency exits in each vehicle accommodating 40 passengers or less and more than two in each vehicle accommodating more than 40 passengers,
- the dimensions through the emergency exits shall be at least 700 mm × 550 mm.

- (B) Operation: if doors cannot be opened, it is permissible to use the following as emergency exits:

- the windows, by ejection of the window or glazing or by breaking the glass,
- compartment doors, by rapid removal of the door or breaking the glass,
- access doors, by ejecting them or breaking the glass.

Trains must allow evacuation in a limited time. The dimension of doors and corridors must allow a free flow of passengers to the access doors and promote an even distribution of passengers over the doors.

- (C) Signage: emergency exits shall be clearly identified to passengers and rescue teams by means of suitable signs.
- (D) Evacuation via the doors: the interoperable high-speed trains shall be equipped with emergency devices allowing the evacuation of passengers via the access doors away from stations (emergency steps or ladders).

#### 4.2.8. **Driver's cab emergency exits**

In an emergency, evacuation from the driver's cab (or access to the interior of the train by the emergency services) shall normally be by means of the access doors specified in Section 4.3.18a.

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Where the doors do not give direct external access, each driver's cab shall be provided with an appropriate means of evacuation or at least one of the side windows shall have sufficient dimensions to allow for the release of trapped persons after the glass is removed or broken.

#### 4.2.9. **Coupling arrangements to rescue trainsets**

High-speed trainsets shall:

- (a) be equipped at each end of the trainset with a type of coupler meeting the requirements of Annex K. This provision enables the rescue of a trainset in the event of a breakdown by another interoperable trainset, without the need to use an intermediate coupler adapter;
- (b) be able to be rescued by motive power units with standard UIC buff and draw components. To this extent, a special coupling equipment (emergency coupler) can be used. The emergency coupler shall be able to be installed by two people in 15 minutes.

#### 4.2.10. **Wheel/rail contact**

- (a) Description of the interface with the infrastructure:

wheel/rail contact has an influence on:

- vehicle running stability,
- the vehicle ride behaviour,
- noise emitted into the environment.

Concerning the first point, the contact geometry shall be such that the stability of running gear is ensured at the highest running speeds.

In relation to the other points, account shall also be taken both of conventional formations (ballast and sleepers), and of ballast-less track which has different characteristics.

The required criteria shall also be complied with for vehicles and equipment with the wear that can be expected to occur on a high-speed network.

This aspect interfaces closely with many parameters within the infrastructure subsystem such as the track gauge, cant deficiency and equivalent conicity.

The different needs of this aspect are translated for this subsystem by the definition of standards for the wheels and axles that comprise the interface points.

The definition of this interface with the infrastructure subsystem allows the ride stability of the rolling stock to be guaranteed in all circumstances and limits of wear of the running gear.

- (b) Specification of ride stability criteria:

vehicle ride stability, which is essential for vehicle running safety, depends on the design characteristics of vehicles and more specifically on the wheel-rail contact parameters.

The following characteristics relate to the equivalent conicity defined by the infrastructure subsystem.

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Three infrastructure-related parameters determine this:

- the profile of the rail head (e.g. UIC 60, etc.)
- rail inclination (e.g. 1/40, 1/20, etc.)
- track gauge (e.g. 1 435 mm, etc.).

The geometric characteristics of the wheelset (tread profile, gauge of active surfaces, etc.) combined with the three previous parameters generally determines the ride stability to be maintained in the new or worn condition within the range of extreme tolerances permitted for each of these parameters.

(c) Characteristics of the interface elements:

to be accepted for working on the interoperable network, rolling stock shall comply with the criteria on equivalent conicity defined in the infrastructure subsystem, and therefore shall:

(c1) be fitted with axles fitted with: wheels having a profile in conformity with one of the following:

- S 1002,
- GV 1/40,

distance between internal wheel faces measured at 60 mm below the top of the flange:

- 1 357 to 1 363 mm for wheel diameter = or > 840 mm,
- 1 359 to 1 363 mm for wheel diameter < 840 mm,

distance between active faces of the wheel:

- 1 410 to 1 426 mm for wheel diameter = or > 840 mm,
- 1 415 to 1 426 mm for wheel diameter < 840 mm;

(c2) be subject to acceptance tests in accordance with the provisions in Chapter 6 of the present TSI;

(c3) to guarantee ride stability under all conditions and protect against failures, have mandatory procedures for periodic checking of the integrity of that equipment by ensuring ride stability (axles, suspension linkages, dampers, etc.);

(c4) be fitted with an approved device for continuous detection of running gear instability, which shall only be active at speeds in excess of 220 km/h (i.e. in high-speed operation). This device shall advise the driver to reduce speed in the event of instability.

(d) Wear criteria characteristics:

to achieve a proper match between the choice of materials for the rail (as defined in the Infrastructure TSI) and the wheels, the wheels shall use materials defined as follows:

- for the entire zone of wheel rims wear, the values of Brinell hardness (HB) of the material have to be equal or superior (for every measure) to 245,

**▼B**

- if the thickness of the zone of wear is superior to 35 mm, the value of 245 HB has to be obtained until a depth of 35 mm under the bearing surface,
- the value of hardness in the connection between the wheel centre and the wheel rim should be lower at least by 10 points than the measured one on the verge of the range of wear.

## (e) Electrical resistance of wheelsets:

to ensure the operation of track circuits, the electrical resistance of each wheelset measured:

- from tyre to tyre,
- in tare condition,
- with a voltage of between 1,8 and 2 volts,

shall be less than:

- 0,01 ohm when new,
- 0,1 ohm after overhaul of the wheelset.

In the case of independent wheels (left and right parallel wheels that rotate independently), it is necessary to electrically connect the pair of wheels to comply with the abovementioned values.

**4.2.11. Hot-box detection <sup>(1)</sup>**

Axle box temperature rise shall be detected on high-speed trains.

This monitoring equipment shall be able to detect a temperature rise over time to allow abnormal temperature rises in an axle box to be detected. It shall be able to reliably transmit warning and alarm messages that, if necessary, are graduated in order to initiate a speed reduction or a train-stop depending on the extent of the temperature rise.

To prevent confusion when a hot box warning is given, the hotbox detection system has to be located entirely on board.

In addition, it has to be taken into account that axle box temperature-monitoring equipment is nevertheless installed on the ground to monitor trains not yet equipped with such train-borne systems or other types of trains running on the line.

Train-borne equipment shall not interfere with trackside axle box temperature-monitoring equipment installed on the routes concerned.

Infrastructure managers shall ensure the compatibility between the operation of interoperable trainsets and trackside axle box temperature monitoring equipment, according to the conditions set out in Section 7.2.6.2 of infrastructure TSI.

<sup>(1)</sup> This item will be included in the list of interoperability constituents in a future version of this TSI.

**▼B****4.2.12. Emergency alarm**

Passenger areas on high-speed trains shall be fitted with emergency signal devices conforming to the following provisions:

- emergency handle to activate the continuous brake must be installed in coaches where they can be easily seen and reached by passengers without having to pass through an interior door. The emergency handle must be clearly indicated by easily understood logos and instructions enabling passengers to use it without difficulty.

The emergency handle must have a clearly visible seal prior to passenger use.

The alarm once activated shall not be capable of being disengaged by passengers. If a device is provided to indicate that the alarm has been activated it should be marked as indicated in Annex Q to this TSI.

Operation of the emergency signal shall be indicated next to the device used.

Activating the alarm shall:

- initiate braking,
- cause a visual (flashing light) and acoustic (buzzer/klaxon) alarm to be triggered in the driver's cab,
- transmit a message (acoustic or visual signal) to the train crew working among the passengers,
- transmit an acknowledgement, recognisable by the person who triggered the signal (acoustic signal in the vehicle, braking application, etc.).

In all cases, the arrangements installed in the rolling stock (automatic brake application, in particular) shall allow the driver to intervene in the braking process so as to be able to choose the stopping point of the train, or start again immediately if the train has stopped. For this purpose, activation of one or more other alarms shall have no further effect, whilst the train-crew has not re-armed the first.

Lastly a connection between cab and train shall enable the driver, at his or her initiative, to investigate the reasons why the emergency signal was triggered.

**4.2.13. Slipstream effects**

The behaviour of a train with respect to slipstream effects on persons outside the train is characterised by the trackside forces created on passage of the trainset.

The sensor used is a dummy with the following characteristics:

A cylinder constituting a test body subjected to the slipstream effect with the following geometrical characteristics:

- cylinder frontal area:  $0,36 \text{ m}^2 \pm 0,05 \text{ m}^2$ ,
- cylinder height:  $0,92 \text{ m} \pm 0,10 \text{ m}$ ,
- height of the pressure centre (cylinder centre) in relation to the base of the bearing device:  $1,10 \text{ m} \pm 0,15 \text{ m}$ ,



**▼ B**

— a device maintaining the cylinder in its measuring position at garage distance  $d_G$ ,

— a measurement system.

Definitions:

$V_e$ : test speed in km/h.

$V_{\max}$ : the anticipated operating maximum speed in km/h.

$TT_{\max}$ : maximal effort module for the whole trainset.

IT: trail index in N.

$d_G$ : garage distance, or distance separating the outside model face (the closest to the rail) of the outside rail face.

It can be defined:

$$NM = \frac{TT_{\max}}{Ve^2}$$

Then comes:

$$\left\{ \begin{array}{l} IT = (\overline{NM} + 2 \cdot \sigma_{NM}) \cdot V_{\max}^2 \\ \overline{NM} : \text{Sample mean of NM} \\ \sigma_{NM} : \text{Standard deviation of NM} \end{array} \right.$$

The reference values of the drag effect IT are defined as follows:

The interoperable trainsets have to respect:

- at the speed of 300 km/h,
- or in the maximal speed of the trainset if it is lower than 300 km/h,

IT value:

$$IT < \text{or} = 185 \text{ Nat a distance } d_g \text{ of 2 m}$$

#### 4.2.14. Effect of cross-winds

This item is still an open question (further studies underway). The transitional situation is described in the infrastructure TSI, Section 4.3.3.23.

#### 4.2.15. Eddy current brakes

This paragraph deals with the Infrastructure subsystem interfaces relating to the use of eddy current track brakes.

As specified in the infrastructure TSI, the use of this type of brake, independent of adhesion, on the lines (to be built, upgraded or connecting) of the interoperable network is permissible as follows:

- for emergency braking on all lines except some specific connecting lines listed in the infrastructure register,

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- for Full or normal service braking over the major part of the network. Use of this type of brake is permissible, line-by-line, as given in the infrastructure register.

The interoperable trainsets equipped with this type of brake shall meet the following specifications:

- brakes independent of wheel rail adhesion can be used from the maximum operating speed down to 50 km/h: ( $V_{\max} \geq V \geq 50$  km/h),
- the maximum average deceleration shall be less than  $2,5 \text{ m/s}^2$  (this value, which is an interface with the longitudinal resistance of the track, shall be met with all brakes in use).
- in the worst case, that is to say with the trainsets working in multiple to their maximum permitted train length, the maximum longitudinal braking force applied to the track by a train shall not exceed:
  - 360 kN in emergency braking
  - 180 kN (provisional value) for full service braking to meet the speed limits set by the signalling system
  - 100 kN (provisional value) for braking on steep gradients or where speed limits are automatically applied.

This is with the understanding that the safe operation of this type of brake can be proven and in particular the absence of risk relating to common mode failures. It is permissible to include the contribution of brakes independent of adhesion in the braking performances defined in Section 4.1.5 of the present TSI, for operation on lines where their use is permitted for full and normal service braking.

#### 4.2.16. **Flange lubrication**

To protect the rails and wheels against excessive wear, particularly in curves, the interoperable trainset shall be equipped with flange lubrication. This shall be installed and monitored according to the following provisions:

lubrication must be assured in the curves with radius lower or equal to 1 200 m;

after such a lubrication:

- a continuous film of lubricant is present on the active zone of the rail shoulder,
- the bearing surface wheel/rail is not polluted, so as to not degrade braking performance.

Flange lubrication shall ensure the protection of all axles of the trainset.

#### 4.2.17. **Suspension coefficient**

This parameter influences the dynamic loading gauge of a vehicle. The suspension coefficient of vehicles equipped with pantographs shall be less than 0,25.

#### 4.2.18. **Minimum curve radius**

This parameter is an interface with the infrastructure subsystem in that the minimum curvatures to be taken into account are defined partly by the high-speed tracks (based on the cant deficiency) and partly by the existing network.

**▼B****4.2.19. Maintenance****(a) Maintenance plan**

In order to guarantee that the performance of each of the characteristics in this TSI is maintained, the existence and application of a rolling stock maintenance plan shall be required.

The maintenance plan shall be set up by the owner of the rolling stock or his agent in order to guarantee maintenance of the characteristics specified in the rolling stock subsystem.

As a minimum the maintenance plan shall contain the following elements:

- a set of inspections to be carried out with, if necessary, statements of the allowable limits (values outside which the train can no longer safely operate),
- a set of equipment replacement schedules to be carried out on the basis of wear or period of use,
- statements of the periodicity of these checks and how they are controlled,
- provisions for the training and qualification of maintenance personnel,
- standards relating to the provisions, checks and values called for above,
- arrangements of the means of implementing these checks,
- methods to ensure traceability of maintenance work on the rolling stock.

The existence of the maintenance plan including the above elements will be verified by the notified body, but the operator is responsible for values and periodicities indicated in the maintenance plan.

**(b) Maintenance work**

The majority of the maintenance work shall be the responsibility of the railway undertaking that operates the vehicle. In-service maintenance and minor repairs necessary to ensure a safe return journey shall be able to be carried out on parts of the network distant from the vehicles' home base, including whilst stabled on a foreign network. The main tasks concerned are required between the legs of a return journey:

- filling and emptying (water, WC, sand, etc.),
- cleaning of the vehicle.

Also minor repairs and unplanned maintenance.

To facilitate these operations, interoperable trainsets shall be capable of being stabled, with no crew onboard, with auxiliary power supply maintained for lighting, air conditioning, refrigerated cabinets, etc.

The various requirements applicable to interoperability for undertaking these tasks are specified in the maintenance TSI.

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The functional interfaces between the maintenance subsystem and the rolling stock subsystem are as follows:

- external cleaning of trainsets (Section 4.2.2.2.1 of the maintenance TSI)
- the system for emptying retention toilets (Section 4.2.2.2.2 of the maintenance TSI)
- interior cleaning of trainsets (Section 4.2.2.2.3 of the maintenance TSI)
- arrangements for replenishing water and sand (Sections 4.2.2.2.4 and 5 of the maintenance TSI)
- stabling arrangements (Section 4.2.2.2.6 of the maintenance TSI).

The constituents that interface between the maintenance and rolling stock subsystems are:

- the connectors for toilet emptying (Section 5.3.1 of the maintenance TSI)
- the power sockets for interior cleaning of the trainsets (Section 5.3.3 of the maintenance TSI)
- the connectors for water replenishment (Section 5.3.5 of the maintenance TSI)

#### 4.2.20. **External lights and horn**

##### (a) Front and rear lights

As specified in Section 4.2.1, it is permissible for trains to be made up of one or more trainsets. The lights described below shall only appear at the front and rear ends of the complete train formation.

The external lights of driving cabs located at intermediate points within the train shall be kept switched off.

The trainsets shall be fitted with:

- three fixed white indicator lamps at the front of the train in the direction of travel, two in a horizontal line on the lower part and a third placed centrally above,
- two red indicator lamps at the rear of the train in a horizontal line.

In addition to their traditional role as the front and rear indicator lamps, it shall be possible in emergency to use the lamps in specific ways and arrangements.

The dimensions, fitting, positioning, visibility, intensity, operation, etc., of the lamps shall be as specified in Annex H to this TSI.

##### (b) Horns

The trainsets shall be fitted with horns with two distinct tones.

**▼B****4.2.21. Lifting/rescue procedures**

A procedure shall be established for managers of the infrastructures regularly operated over by the trainsets which describes the method as well as the means of recovering a trainset in difficulties.

**4.3. SPECIFIED PERFORMANCE**

To verify the rolling stock subsystem, performance criteria for the trans-European high-speed network shall be met for the specific requirements of each of the following line categories:

- lines specifically built for high speed,
- lines specifically upgraded for high speed,
- lines specially upgraded for high speed but with special characteristics.

For the rolling stock subsystem these requirements are:

**4.3.1. Minimum performance requirements**

In order to run on the interoperable network and under conditions allowing trains to slot smoothly into the overall traffic pattern, all high-speed rolling stock shall be required to guarantee minimum traction and braking performance levels. The trains shall have sufficient standby and backup capacity to ensure that these performance levels are maintained or only slightly downgraded in case of breakdown in systems or modules contributing to these processes (traction chain from pantograph to axles, mechanical/electrical braking equipment). These margins and redundancies are defined in detail in the characteristics contained in Sections 4.3.2 to 4.3.6, 4.3.9, 4.3.11, 4.3.15 and 4.3.16.

In the event of the failure of rolling stock equipment or functions, or passenger overload, the rolling stock operator shall, in full knowledge of the consequences, have defined the acceptable limits and operating conditions associated with each degraded mode. For this purpose, the various degraded modes that can be experienced in service shall be described and indexed in a special document.

Performance levels demanded on the other lines and feeder lines that do not form part of the interoperable network as such, but allow access to terminal installations (stations, train stabling tracks,), shall be defined in bi-or multilateral agreements between operators and infrastructure managers depending on the service levels planned.

**4.3.2. Maximum service speed of trainsets**

Interoperable trains shall have, in conformity with Article 5(3) of and Annex I to Directive 96/48/EC, a maximum service speed of:

- at least 250 km/h in the case of rolling stock designed for lines specially built for high speed,
- the order of 200 km/h in the case of rolling stock designed for existing lines which have been or are to be specially upgraded.

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The maximum service speed is the nominal speed trains are expected to run in daily operation on appropriate sections.

In both cases, it shall be possible for interoperable rolling stock to be worked at their maximum speed (if allowed by the infrastructure) with sufficient acceleration margins (as specified in the following paragraphs).

#### 4.3.3. **Traction performance requirements**

In order to guarantee proper compatibility with other train operations, the mean minimum accelerations calculated over time on a level track shall be:

- 0 to 40 km/h: 48 cm/s<sup>2</sup>
- 0 to 120 km/h: 32 cm/s<sup>2</sup>
- 0 to 160 km/h: 17 cm/s<sup>2</sup>

At the maximum service speed and on level track, the residual acceleration shall be at least 5 cm/s<sup>2</sup>.

For reasons of availability, traffic flow, and safe clearance of tunnels, three conditions shall be met by the trainsets:

- performance shall be achieved with the mean supply voltage available at the pantograph as specified in energy TSI Section 4.3.1.1, Annex L,
- a failed traction module shall not deprive the trainset of more than 25 % of its rated output,
- failure of a traction supply element shall allow at least 50 % of the traction modules to continue in operation.

Under these conditions it shall be possible for a trainset under normal load (number of seats × 80 kg) with a traction module out-of-service to start on the maximum gradient it is likely to meet with a residual acceleration in the vicinity of 5 cm/s<sup>2</sup>. It shall be possible for this starting regime to be maintained for 10 minutes, and for the speed to reach 60 km/h.

#### 4.3.4. **Traction adhesion requirements**

To ensure a high availability of traction, the utilisation of adhesion shall not exceed the values given below:

- at start-up and at very low speed: 25 %
- at 100 km/h: 25 %
- at 200 km/h: 17,5 %
- at 300 km/h: 10 %.

In order to make the best of the adhesion available, interoperable rolling stock shall be equipped with an anti-slip system.

**▼B****4.3.5. Brake adhesion demand limits**

For speeds between 50 and 200 km/h, the maximum adhesion coefficient demand during braking shall be no more than 0,15. For speeds above 200 km/h, the adhesion coefficient demand declines linearly to 0,10 at 350 km/h.

A train in full service condition and a normal passenger load shall be used to verify these values.

**4.3.6. Brake system requirements**

In addition to the needs listed in Sections 4.1.5 and 4.3.5, the braking system of interoperable trainsets shall be designed in such a way that attainment of the safety objectives set by Directive 96/48/EC can be demonstrated. In particular that they do not introduce any degradation in this area, either for the rolling stock subsystem or the total rail system.

This demand is implicitly satisfied by interoperable trainsets using UIC braking systems. For other braking systems, a demonstration must establish that it is possible to achieve a level of operation at least as safe as that achieved in the prescribed standard.

Furthermore, and whatever is envisaged for construction, the brake system must meet the following requirements:

for the complete train:

- use of the emergency brake, for whatever reason, shall automatically cut all traction power, without the facility to reapply traction power while the emergency brake is applied,
- the emergency brake shall be capable of being applied at all times with the driver in his normal driving position,
- vehicles shall be fitted with wheel-slide devices to control the sliding of wheels in the event of reduced adhesion between wheel and rail,
- vehicles shall be equipped with a wheel-monitoring system to advise the driver that an axle has seized. The wheel-monitoring system shall be independent of the wheel-slide system in all its functions.

Electric braking:

- it shall only be permissible to take account of the electric brake in the brake performance if its operation is independent of the presence of voltage in the catenary,
- where the electrical installations (the sub-stations) permit, the return of electrical energy generated in braking is permissible, but this shall not cause the voltage to exceed the limits defined in Annex P to this TSI,
- in addition, in the event that the supply to the catenary is lost, it shall not prohibit the line voltage dropping to 0 V.

In addition, interoperable trainsets shall be provided with:

- indicators of brake failure,
- a means of brake isolation,
- a system of (brake) fault diagnostics.

**▼B****4.3.7. Service braking performance**

In addition to the specifications required in Section 4.1.5 ‘minimum braking characteristics’, the trainsets shall comply with the average decelerations in service defined below:

Table 4.3.7

Braking mode	$t_e$ (s)	Minimum deceleration under set braking conditions (m/s <sup>2</sup> )			
		330 to 300 (km/h)	300 to 230 (km/h)	230 to 170 (km/h)	170 to 0 (km/h)
Normal service braking	2	0,35	0,35	0,6	0,6

$t_e(s)$  = equivalent time of application.

These decelerations shall be achieved by a train on level track, in the configurations defined in Section 4.1.5, case A and B.

**4.3.8. Protection of an immobilised train**

It shall be possible for the train to be kept stationary for an indefinite period on the maximum gradient on the line concerned. When the parking brake alone is not sufficient, it shall be supplemented by extra on-board facilities.

**4.3.9. Brake performance on steep gradients**

(reserved)

**4.3.10. Detection of derailments**

Derailment detection systems shall be installed on new builds of trainsets, when they are available and homologated.

**4.3.11. Protection against fire and toxic fumes**

(a) The trainsets shall be able to continue to operate for 15 minutes at a speed of at least 80 km/h with a fire declared to be on board. A fire in an area that is open to natural ventilation must not allow transmission to other areas of the train within 15 minutes.

(b) Passengers and train crew shall be protected against fire hazards. A fire resistance of at least 15 minutes shall be provided between:

— high power electrical equipment and passengers and staff areas,

— two vehicles of the trainset



**▼ B**

- (c) For thermal engines, the fire barriers between the driver's cab, passenger and staff areas, thermal engines and fuel tanks, shall have a fire resistance of at least 30 minutes.
- (d) The high voltage electrical equipment compartments and those parts of the train not directly visible to the train crew or passengers which are likely to be the source of a fire shall be equipped with a system of fire detection, parts of the train to be so equipped shall be defined as the result of a global assessment of fire risks.
- (e) In order to prevent fire, materials with low flammability must be used and electrical installations must meet appropriate European specifications.
- (f) In case of fire in closed areas in the train, material on board shall not produce fumes that could jeopardise passenger and crew who are evacuating.
- (g) In order to enable train crew and passengers to fight a fire, adequate and sufficient fire extinguishers must be provided on board.
- (h) External signs shall indicate the location of emergency exits and the position of the devices to unlock the doors

**4.3.12. Environmental conditions for rolling stock**

The rolling stock, as well as the on-board equipment, shall be able to be put into service and operate normally in the conditions specified in the EN 50125-1 standard and function in climatic zones for which the equipment is designed and in which it is likely to run.

The different environmental conditions likely to be experienced on the lines worked are specified in the infrastructure register.

**4.3.13. Monitoring and diagnostic concepts**

The functions and equipment specified in this TSI and repeated below, shall be monitored because they present an important risk to safety in the event of a failure or operating fault:

- failure of the driver vigilance device (Section 4.2.2)
- control-command sub-system information (Section 4.2.4)
- door operation (Section 4.2.6)
- running gear instability detection (Section 4.2.10)
- on-board hot-box detection system (Section 4.2.11)
- activation of the passenger alarm (Section 4.2.12)
- fault in the brake system (Section 4.3.6)
- derailment detection (Section 4.3.10)
- fire detection (Section 4.3.11).

**▼B**

This monitoring shall be continuous, or at a suitable frequency to ensure reliable detection of failure in good time. The system shall also be linked to the on-board data recorder to allow the necessary traceability.

Indication to the driver shall be made of such detection, and shall require acknowledgement by the driver. Automatic action shall be required where a fault can have grave consequences for safety.

**4.3.14. Particular specification for long tunnels**

The characteristics described in this paragraph shall only be applicable to interoperable trainsets called on to traverse long tunnels in normal service. The information to identify the lines where such tunnels are located is to be found in the infrastructure register.

- (a) Passenger and train crew areas as well as drivers' cabs equipped with air conditioning:

The train crew shall be able to close external air vents to prevent the inhalation of fumes in the event of a fire in close proximity to the train. At the same time, the ducting for the air recirculation shall be designed so as not to distribute fumes to the whole train in the event of an internal fire located in a passenger saloon.

- (b) Public address system:

In order to remain available in the event of an incident, the public address system shall be designed in such a manner that it will continue to operate the majority of its loud speakers in the event of a failure in one of its transmission elements.

**4.3.15. Emergency lighting system**

To provide protection and safety on board in the event of all types of emergency, including fire, the interoperable trainsets shall be equipped with an emergency lighting system. This system shall provide a suitable lighting level in the passenger and in the service areas, for a minimum operating time:

- operating time of three hours after catenary supply has failed,
- lighting level of at least 5 lux at floor level.

These applicable values are defined in Annex N to this TSI. The testing methods are indicated in Chapter 6.

**4.3.16. Public address system**

Trains shall be equipped with a means of communication:

- for the train crew and ground control to address the passengers in a train,
- for the train crew and ground control to communicate between one another, using the track to train link,
- for internal communication between the train crew, especially between the driver and staff in the passenger saloons.

**▼B**

The equipment shall be able remain on standby and function independent of the catenary supply for at least three hours.

The public address system shall be designed so as to operate 50 % of its loudspeakers in the event of a failure of one of the transmission elements.

Apart from the emergency alarm (see Section 4.2.12) no specific provisions are prescribed for passengers to contact train crew or ground control.

#### 4.3.17. **Protection against electric shock**

Electrically live components shall be designed such that conscious and unconscious contact with train staff and passengers is prevented, in normal operation and in case of equipment failure.

Earth bonding of the coach body shall be provided in case of failures in the high-voltage train equipment or of breakage of the contact wire.

Rolling stock shall comply with EN 50153, and for earthing, with the provisions of Annex O to the present TSI.

#### 4.3.18. **Driver's cab**

##### (a) Access and egress:

The cab shall be accessible from both sides of the train from the platform and ground level.

It is permissible for this access to be either directly from the exterior or through an adjoining compartment (either an equipment room or an area occupied by passengers) at the rear of the cab.

The train crew shall be able to prevent the cab being accessed by non-authorised persons.

##### (b) External visibility

Vision ahead: The driver shall be able to see fixed signals set to the left or right of the track when the trainset is on a level and straight track in the following conditions:

- a high level signal set at a distance of 2,5 m from the track centre, with a height up to 6,3 m at a distance at least 10 m ahead of the coupler,
- a ground signal set at a distance of 1,75 m from the track centre at a distance of at least 15 m ahead of the coupler.

Side vision: The driver shall be provided with a window or opening panel at each side of the cab allowing him to view his train while it is standing at the platform or speak with platform staff if necessary.

##### (c) Seats:

The main seat available to the driver shall be designed in such a way that it allows him to undertake all normal driving functions in a seated position.

In addition, a second seat shall be provided giving a forward view for possible accompanying crew.

**▼B**

## (d) Interior layout:

Freedom of movement of personnel in the cab interior shall not be inhibited by projections. The floor of the cab shall not be uneven.

**4.3.19. Wind screen and front of the train**

The drivers cab windscreens shall:

(A) be of an optical quality in accordance with the following characteristics: The types of safety glass used for the front windows, and any heated windows (windows heated to prevent frost) of drivers' cabs must not alter the colour of signals and their quality must be such (generally laminated glass) that the glass, when pierced or starred, remains in position and affords staff protection and sufficient visibility to enable the train to continue its journey;

(B) be equipped with cleaning, de-icing and de-misting facilities;

(C) Be able to resist impacts from projectiles: the front windows must be sufficiently strong to obviate any risk of their being pierced by solid projectiles such as large ice blocks, birds, large pieces of ore falling from freight trains, or bottles, cans, etc. thrown from passing trains.

Conformity will be validated by the test indicated in Section 6.3.

The front end of the train shall be capable of resisting the same impact as the window in order to protect persons travelling in the front vehicle.

**4.3.20. Passenger information signs**

All passenger signs closely connected with safety shall be capable of being instantly understood by the majority of passengers. For this purpose, they shall use the unified sign formats given in standard ISO 7001.

**4.3.21. Toilets available to passengers and train crew**

Sealed retention toilets shall be installed onboard. Flushing is permissible with either clean water or by re-circulation techniques. They shall have tanks able to operate in normal service for three days without emptying.

**5. INTEROPERABILITY CONSTITUENTS**

5.1. According to Article 2(d) of Directive 96/48/EC the interoperability constituents are 'any elementary component, group of components, sub-assembly or complete assembly of equipment incorporated or intended to be incorporated into a subsystem, on which the interoperability of the trans-European high-speed rail system depends either directly or indirectly'.

5.2. The interoperability constituents are subject to the relevant provisions of the Directive 96/48/EC and are listed in Annex to the present TSI.

**▼B**

- 5.3. These interoperability constituents are subject to performance specifications Assessment of conformity and/or the range of their application is principally carried out by means of the interfaces of the interoperability constituent — recourse to conceptual or descriptive characteristics being exceptional.
- 5.4. For the purposes of this TSI the following are declared to be ‘interoperability constituents’:
- the couplers at the ends of the trainsets (Section 4.2.9)
  - the wheels (Section 4.2.10)
  - the constituents that interface with the maintenance subsystem (Section 4.2.19)
  - lights and warning devices at the ends of the trainset (Section 4.2.20)
  - driver’s cab windscreens (Section 4.3.19).

The characteristics to be respected by interoperable high-speed rolling stock are given in the relevant paragraphs of Chapters 4.2 and 4.3 indicated above.

## 6. **ASSESSMENT OF CONFORMITY AND/OR SUITABILITY FOR USE**

### 6.1. INTEROPERABILITY CONSTITUENTS OF ROLLING STOCK

#### 6.1.1. **Conformity and suitability for use assessment procedures (modules)**

The assessment procedure for conformity and suitability for use of interoperability constituents as defined in Chapter 5 of this TSI shall be carried out by application of modules as specified in Annex F to this TSI.

The phases for the application of the conformity and suitability for use assessment procedures for the interoperability constituents: end couplers, wheels, constituents that interface with the maintenance subsystem, lighting and warning devices at the vehicle ends, driver’s cab windscreen as defined in Chapter 5 of this TSI are indicated in Annex D, Table 1 to this TSI.

As far as required by the modules specified in Annex F of this TSI, the assessment of conformity and of suitability for use of an interoperability constituent shall be appraised by a notified body, when indicated in the procedure, with which the manufacturer or his authorised representative established within the Community has lodged the application.

The manufacturer of an interoperability constituent or his authorised representative established within the Community shall draw up an EC declaration of conformity or an EC declaration of suitability for use in accordance with Article 13(1) of and Annex IV, Chapter 3, to Directive 96/48/EC before placing the interoperability constituent on the market.

#### 6.1.2. **Application of modules**

##### 6.1.2.1. *Assessment of conformity*

For the assessment procedure of interoperability constituents that interface with the maintenance subsystem within the rolling stock subsystem, the manufacturer or his authorised representative established within the Community shall apply the internal control of production procedure (module A) indicated in Annex F of this TSI for all phases.

**▼B**

For the assessment procedure of interoperability constituents such as end couplers, wheels, lighting and warning devices at the vehicle ends, driver's cab windcreens within the rolling stock subsystem, the manufacturer or his authorised representative established within the Community may choose:

- the type-examination procedure (module B) indicated in Annex F to this TSI for the design and development phase in combination with:

either the production quality assurance procedure (module D) indicated in Annex F of this TSI for the production phase,

or the product verification procedure (module F) indicated in Annex F to this TSI,

or alternatively

- the full quality assurance with design examination procedure (module H2) indicated in Annex F to this TSI for all phases.

#### 6.1.2.2. *Assessment of suitability for use*

For the assessment procedure of interoperability constituent such as end couplers, wheels, constituents that interface with the maintenance subsystem, lighting and warning devices at the vehicle ends, driver's cab windscreen within the rolling stock subsystem, the manufacturer or his authorised representative established within the Community shall apply the type validation of in service experience procedure (module V) indicated in Annex F to this TSI.

#### 6.1.2.3. *Definition of assessment procedures*

The assessment procedures are defined in Annex F to this TSI.

Module D may only be chosen where the manufacturer operates a quality system for production, final product inspection and testing, approved and surveyed by a notified body.

Module H2 may only be chosen where the manufacturer operates a quality system for design, production, final product inspection and testing, approved and surveyed by a notified body.

The conformity and suitability for use assessment shall cover the phases and characteristics as indicated by X in the Table 1 of Annex D to this TSI.

### 6.2. ROLLING STOCK SUBSYSTEM

#### 6.2.1. **Assessment procedures (modules)**

At the request of the adjudicating entity, or its authorised representative established within the Community, the notified body carries out the EC verification in accordance with Article 18(1) of and Annex VI to Directive 96/48/EC and in accordance with the provisions of the relevant modules as specified in Annex F to this TSI.

If the adjudicating entity can demonstrate that tests or verifications for previous applications remain valid in the new application, then the notified bodies shall take them into account in the conformity assessment.

**▼B**

Assessment procedures for the EC verification of the rolling stock subsystem, list of specifications and descriptions of the testing procedures are indicated in Annex E, Table 2 to this TSI.

As far as specified in this TSI the EC verification of the rolling stock subsystem shall take account of its interfaces with other subsystems of the trans-European high-speed rail system.

The adjudicating entity shall draw up the EC declaration of verification for the rolling stock subsystem in accordance with Article 18(1) of and Annex V to Directive 96/48/EC.

#### 6.2.2. **Application of modules**

For the verification procedure of the rolling stock subsystem the adjudicating entity or its authorised representative established within the Community may choose either:

- the type-examination procedure (module SB) indicated in Annex F to this TSI for the design and development phase in combination with:

either the production quality assurance procedure (module SD) indicated in Annex F to this TSI,

or the product verification procedure (module SF) indicated in Annex F to this TSI for the production phase,

or alternatively

- the full quality assurance with design examination procedure (module SH2) indicated in Annex F to this TSI for all phases.

The SH2 module may be chosen only where all activities contributing to the rolling stock subsystem project to be verified (design, manufacturing, assembling, installation) are subject to a quality system for design, production, final product inspection and testing, approved and surveyed by a notified body.

The SD module may be chosen only where all activities contributing to the rolling stock subsystem project to be verified (manufacturing, assembling, installation) are subject to a quality system for production, final product inspection and testing, approved and surveyed by a notified body.

If these two above conditions are not fulfilled, the SB module in combination with the SF module is to be applied.

The assessment shall cover the phases and characteristics as indicated in Table 2, of Annex E to this TSI.

### 6.3. **SPECIFIC TEST METHODS**

#### 6.3.1. **Limit characteristics related to internal noises — measuring methods**

Measurements shall be effected under the following conditions:

- the doors and windows must be closed,
- the track must be in good running order, and track characteristics must be specified by the owner-railway,
- the hauled loads must be equal to at least twothirds of the maximum permissible value.

**▼B**

The maximum speed must be maintained for at least 90 % of the measurement time.

The measurement time may be subdivided into several short periods in order to comply with the abovementioned conditions.

The measurement shall be made level with the driver's ear (in the seated position), in the centre of the horizontal surface stretching from the front windowpanes to the rear wall of cabs.

### 6.3.2. **Method to test the front window of the cab for sufficient resistance to projectiles**

A cylindrical projectile shall be fired at the front window, the projectile shall have a hemispheric tip and have a total mass of 1 kg and be constructed as shown in Annex J. If the projectile sustains permanent damage after impact, it must be replaced.

For the test, the front window shall be fixed in a frame of the same construction as that mounted on the vehicle.

The temperature of the window during the tests must be between -15 °C and 35 °C. The projectile is assumed to impact at right angles to the window or alternatively the test window can be mounted at the same angle to the track as it is mounted in the vehicle.

The projectile's impact velocity shall be determined by:

$$V_p = V_{max} + 160 \text{ km/h}$$

$V_p$  = velocity of the projectile in km/h on impact

$V_{max}$  = maximum velocity of the trainset in km/h

The test result shall be deemed satisfactory if:

- the projectile does not break through the front window,
- the window remains in its frame.

## 7. **IMPLEMENTATION OF THE ROLLING STOCK TSI**

### 7.1. **APPLICATION OF THIS TSI — PRINCIPLES**

#### 7.1.1. **New rolling stock**

As to the new rolling stock which will be put into service after the entry into force of this TSI, Chapters 2 to 6 are entirely applicable, except possible specific provisions of Section 7.3 hereafter.

In addition, information included in the infrastructure register shall be taken into account, as explained in Section 7.2 hereafter.

#### 7.1.2. **Rolling stock being upgraded**

In respect of rolling stock already in operation, this TSI applies to existing high-speed trains or conventional rolling stock to be upgraded under the conditions specified in Article 3 of this Decision. In this particular context, it relates fundamentally to the application of a migration strategy that enables an economically justifiable adaptation of existing installations to be made taking into account the principle of grandfather rights.



**▼B**

In the majority of cases, the application of this TSI on existing rolling stock will demand important modifications, which will mainly be undertaken at the time that the trainsets undergo major refurbishment or overhauls.

## 7.2. COMPATIBILITY OF ROLLING STOCK WITH OTHER SUBSYSTEMS

The implementation of the rolling stock TSI has to comply with the requirement of full compatibility between the rolling stock and the fixed installations, including energy and control-command. This principle applies to the interoperable network covered by the TSIs, whereby it has to be taken into account that the rolling stock may have to be prepared to circulate also on existing national networks.

Following this, the implementation methods and phases concerning rolling stock depend on the following conditions:

- the progress of implementation of the infrastructure, energy and control-command TSIs,
- the rolling stock operational schemes (rosters) which may cover existing national networks.

The tools to ensure the compatibility requirement as well as to take into account the abovementioned conditions are: infrastructure register (trans-European network high-speed (TEN HS)), respectively set up for a specific line or route, represent a compilation of the following characteristics (basic parameters, interfaces, performances):

- characteristics on which TSIs allow alternative values,
- characteristics on which TSIs contain specific cases,
- characteristics on which the specifications given in the TSIs are provisionally not met, e.g. before full implementation of the TSIs, or due to temporary maintenance works,
- characteristics which are based on regional conditions.

**▼M1****▼B**

## 7.3. SPECIFIC CASES

The following special provisions are authorised in the following specific cases. These specific cases are classified according to two categories: the provisions apply either permanently ('P' cases), or temporarily ('T' cases). As to temporarily cases, it is recommended that the target system is reached either by 2010 ('T1' cases), an objective set in European Parliament and Council Decision No 1692/96/EC of 23 July 1996 on Community guidelines for the development of the trans-European transport network, or by 2020 ('T2' cases).

### 7.3.1. Vehicle loading gauge (Section 4.1.4)

- Specific case for lines in Britain:

Trains designed for interoperable running on upgraded lines in Britain shall comply with 'UK1' gauge as defined in Annex C to this TSI.

**▼B**

- Specific case for trains running on Irish and Northern Irish networks:

The loading gauge of trains designed for interoperable running on lines of the Irish and Northern Irish networks shall be compatible with the Irish standard structure gauge.

### 7.3.2. **Boundary characteristics linked to exterior noise (Section 4.1.8)**

It is allowable to apply Section 4.1.8 of this TSI (excluding the footnote) with the limit values referred to in the table below, for a transitional period of 24 months starting from the date of entry into force of this TSI, in the case of:

- options to purchase additional vehicles in contracts already signed at the date of entry into force of this TSI, or
- rolling stock being contracted during the transitional period based on one existing design platforms.

V km/h	Noise level dB(A)
250	90
300	93
320	94

Rolling stock already in operation and requiring a new authorisation for placing into service or already contracted at the date of entry into force of this TSI shall be allowed to run with the maximum above-mentioned limit values.

### 7.3.3. **Maximum pressure variations in tunnels (Section 4.1.13)**

To take account of the numerous tunnels with a cross-section of 54 m<sup>2</sup> which are traversed at 250 km/h, and those with a cross-section of 82,5 m<sup>2</sup> and traversed at 300 km/h, Interoperable trainsets operating on the Italian network shall conform to the following envelope curve:

- $\Delta P_0 < \text{or} = 1\,600 \text{ Pa}$ ,
- $\Delta P_1 < \text{or} = 3\,000 \text{ Pa}$ ,
- $\Delta P_1 - 0,8\Delta P_0 < \text{or} = \Delta P_2$ .

These values are given by:

- a ratio between the train and tunnel cross-sections of 0,18,
- a service speed of 250 km/h,

If a trainset does not fulfil the values specified above, the operation rules for this train shall be determined by applying the published rules of the infrastructure manager.

**▼B****7.3.4. Passenger step (Section 4.2.5)**

- Specific case for British lines:

The passenger step for those trainsets intended to serve the British network shall be optimised for the 915 mm platform height on that system in accordance with Section 4.2.5.

- Specific case for the lines of the Netherlands network:

The passenger step for those trainsets intended to serve the Netherlands network shall be optimised for the 840 mm platform height on that system in accordance with Section 4.2.5.

- Specific case for trains running on Irish and Northern Irish networks:

The passenger step of trains designed for interoperable running on lines of the Irish and Northern Irish networks shall be optimised for the design platform height set down for these lines in the TSI for the infrastructure system.

**7.3.5. Wheel-rail contact (wheel profiles) (Section 4.2.10)**

- Specific case for trainsets operating frequently on British lines:

It is permissible for trainsets that frequently operate on the British network to be fitted with wheels with the EP8 profile when the following conditions are met:

- the maximum service speed of the trainsets so equipped shall be less than or equal to 250 km/h,
- a report is made available which contains:
  - a demonstration of the stable running of this profile on interoperable tracks,
  - a calculation of the different critical speeds on interoperable tracks taking into account the range of wear experienced in service,
  - a report of service trials on interoperable tracks to confirm these results.
- Specific case for trains running on Irish and Northern Irish networks:

Wheel sets of trains designed for interoperable running on lines of the Irish and Northern Irish networks shall be compatible with the track gauge of 1 602 mm.

**7.3.6. Protection against fire and toxic fumes**

Prior to the publication of the relevant European specifications, the conformity with the requirements of Section 4.3.11 shall be deemed to be satisfied by the verification of conformity to the applicable national regulation of a Member State.

**▼B****7.4. RECOMMENDATIONS****7.4.1. Boundary Characteristics linked to interior noise (BP20)**

Noise levels in the driver's compartments must be kept as low as possible, by limiting noise at source through appropriate measures (acoustic insulation, sound absorption).

The  $L_{eq}$  equivalent continuous noise level measured over 30 minutes must not exceed 78 dB(A) in the drivers' cabs of motive power units running at speeds of 160 km/h.

When higher speeds are involved, every effort should be made to achieve the same value specified above.

Values for speed = 300 km/h

open track	$\leq 78$ dB (A) recommended level
	$\leq 75$ dB (A) target level
in tunnel regardless of the super-structure	$\leq 83$ dB (A) recommended level
	$\leq 80$ dB (A) target level
while stationary, with auxiliary equipment	
running and the windows closed	$\leq 68$ dB (A).

**7.4.2. Boundary characteristics linked to exterior noise (BP17)**

It is recommended that in the case of rolling stock to be ordered after 1 January 2005 or to be put into service after 1 January 2008, Section 4.1.8 of this TSI is applied with a reduction of 2 dB(A) at a speed of 250 km/h and 3 dB at speeds of 300 km/h and 320 km/h. In the case of 350 km/h, a reduction of 3 dB(A) should be striven towards.

This recommendation will serve as a basis for revising Section 4.1.8. in the context of the TSI revision process.

**7.4.3. Characteristics linked to the carriage of persons of reduced mobility (BP22)**

In addition to the provisions of Section 4.1.12, rolling stock have to take into account, as appropriate, the results of the COST 335 Action.

**▼B***ANNEX A***PASSIVE SAFETY — CRASHWORTHINESS**

Detailed description of the passive safety provisions covered in Section 4.1.7b of this document.

**(b1) Reminder of the problem at issue**

Collision is a risk of train operation that may be analysed depending on the nature of the different obstacles encountered. In the case of a railway obstacle (another train or rail vehicle), such an eventuality should normally be under the control of the railway system, signalling system, the operational rules, the automatic control mechanisms and the brakes which should be designed to reduce the probability of such an event to as close to zero as possible.

However, obstructions from outside the rail system such as road vehicles or lumps of rock may accidentally occur in the path of a train.

In the event of such a collision, an energy absorbing system allows the controlled deformation of parts specially designed for this purpose.

Improvements to rolling stock passive safety (to limit damage in the event of a collision) are not designed to compensate for any shortcomings in the active safety (collision avoidance) of the railway system but to supplement it in order to take account of events outside the railway system's control.

**(b2) Basic principles**

The guiding principles of this improvement are:

- to avoid overriding in the event of a collision between the two vehicles involved or between two vehicles behind one another in the same trainset,
- to limit the degree of deceleration in areas of the train reserved for passengers and the crew,
- to ensure minimal penetration of areas of the train reserved for passengers and the crew,
- to ensure the controlled deformation of the leading vehicle and the rest of the train by introducing elements that can absorb the energy generated by a collision elements and/or crumple zones.

**(b3) Reference accident**

Three reference accidents are considered:

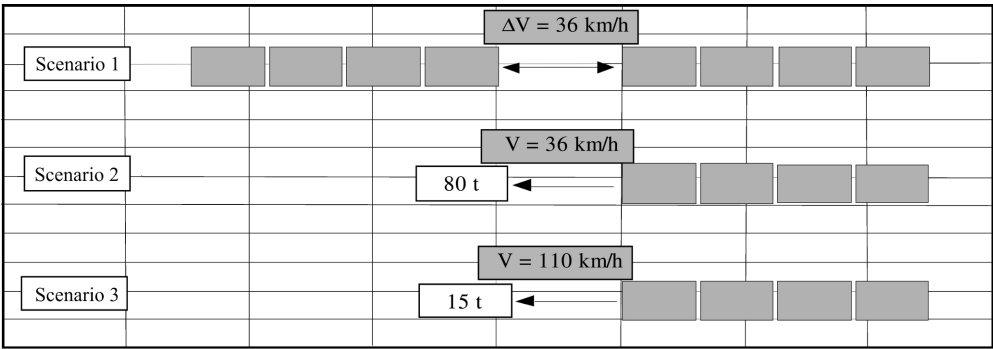
- *Scenario 1*

Collision between two identical high speed trainsets at a relative speed of 36 km/h

**▼B**

— *Scenario 2*

Collision between a high-speed trainset and a railway vehicle equipped with side buffers at a speed of 36 km/h. The railway vehicle is a four-axle freight wagon UIC 571-2 with an 80 tonne mass.



— *Scenario 3*

Collision at a speed of 110 km/h at a level crossing with a 15 tonne lorry represented by a rigid mass presenting a vertical surface for impact.

**(b4) Specifications**

- For Scenario 1 the driver's cab and the passenger saloons should not present plastic deformations which could affect the occupants' safety.

For Scenarios 2 and 3 the driver's cab may deform but the passengers saloons should not present plastic deformations which could affect the occupants' safety. The rear of the cab shall be fitted with a rigid survival cell for the driver with a length of at least 0,75 m. Access to the staff or passenger compartment located behind the cab shall be kept free at all times. Drivers' cabs at the ends of vehicles must have at least a door or a gangway allowing easy access for staff in an emergency to a longitudinal corridor leading to the opposite end. If a door is provided, it must open outwards from the driver's cab and must be as airtight as possible.

However, it must be possible to open the door just by pushing or in some other simple and quick manner. If there is any risk of obstruction (baggage, passengers), the door must be of the swing-type (opening outwards and inwards) or of the sliding type.

The exit must be easily accessible, not only to the driver, but also to the second man.

Accordingly the seat(s) must not be a major obstacle to reaching the exit.

It must be possible to exit from the driver's cab safely and without difficulty over a distance of at least 2 m. The exit should measure at least 1 800 mm in height, at least 500 mm in width, and the free door space should measure a minimum of 1 700 mm × 430 mm.

**▼B**

- 6 MJ of crash energy shall be dissipated, of which at least 75 % shall be in the front part of the first vehicle of the trainset and the remainder distributed over all the intercar links down the train,
- crashworthiness shall be increased in passenger saloons located in the leading vehicle and in the driver's survival cell. These sections shall be designed with a static load limit of at least 1 500 kN above the mean crush force of the crumple zones for the three collision scenarios considered,
- the crashworthiness of the leading vehicles should be consistent with that of the other vehicles in the trainset. The forces experienced in the crumple zones should not result in mean accelerations exceeding 5g in the passenger areas in the leading vehicle or in the driver's survival cell,
- anti-climbing devices shall be fitted between the vehicles comprising the train set.

**▼ B***ANNEX B***MAXIMUM PRESSURE VARIATIONS IN TUNNELS**

A significant number of tunnels (both twin and single track) exist on the certain stretches of the high-speed network that can be passed through at maximum line speed.

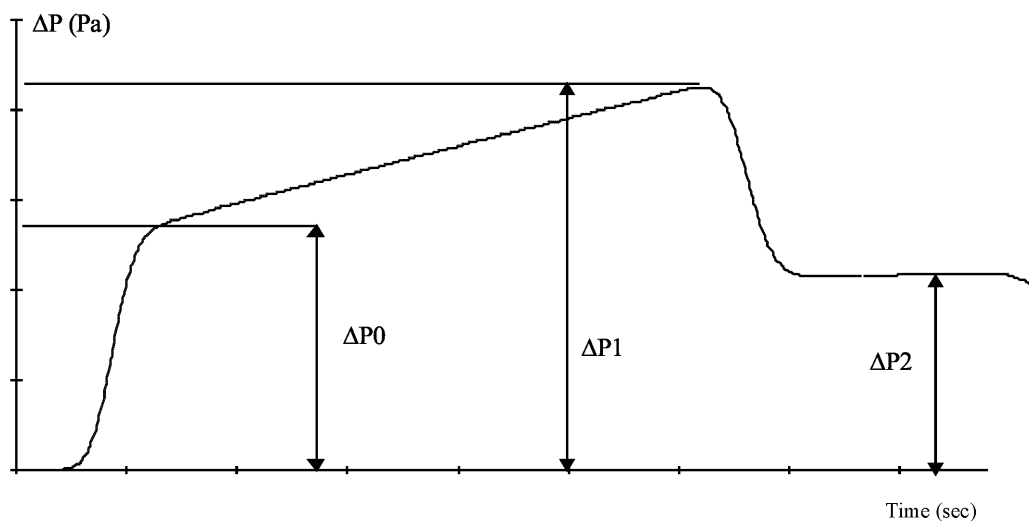
When a train enters a tunnel, pressure waves are created in the tunnel that rebound from the tunnel ends. For health reasons, the effects of pressure waves experienced by passengers and train staff shall be limited.

The extent of the phenomenon depends on a number of parameters, of which the following are specific to the rolling stock:

- the ratio between the train and tunnel cross-sections,
- the shape of the nose of the train,
- the coefficient of friction between the train and the air flow in the tunnel,
- the length of the trainset,
- the shape of the train end.

The aerodynamic characteristics of a trainset vis-à-vis the generation of pressure waves in a tunnel can be created from the pressure variation in the tunnel at the time of the train's total entry into the tunnel.

The train can be defined by an envelope curve signature unique to that provided by the three pressure variations P0, P1 and P2. An example of these values can be found on the curve below.



Pressure variation at a point within the tunnel.

Envelope curve unique to the trainset.

Take these values at 250 km/h

- $\Delta P_0 < \text{or} = 1\,800 \text{ Pa}$ ,
- $\Delta P_1 < \text{or} = 3\,200 \text{ Pa}$ ,
- $\Delta P_1 - 0,8\Delta P_0 < \text{or} = \Delta P_2$ .

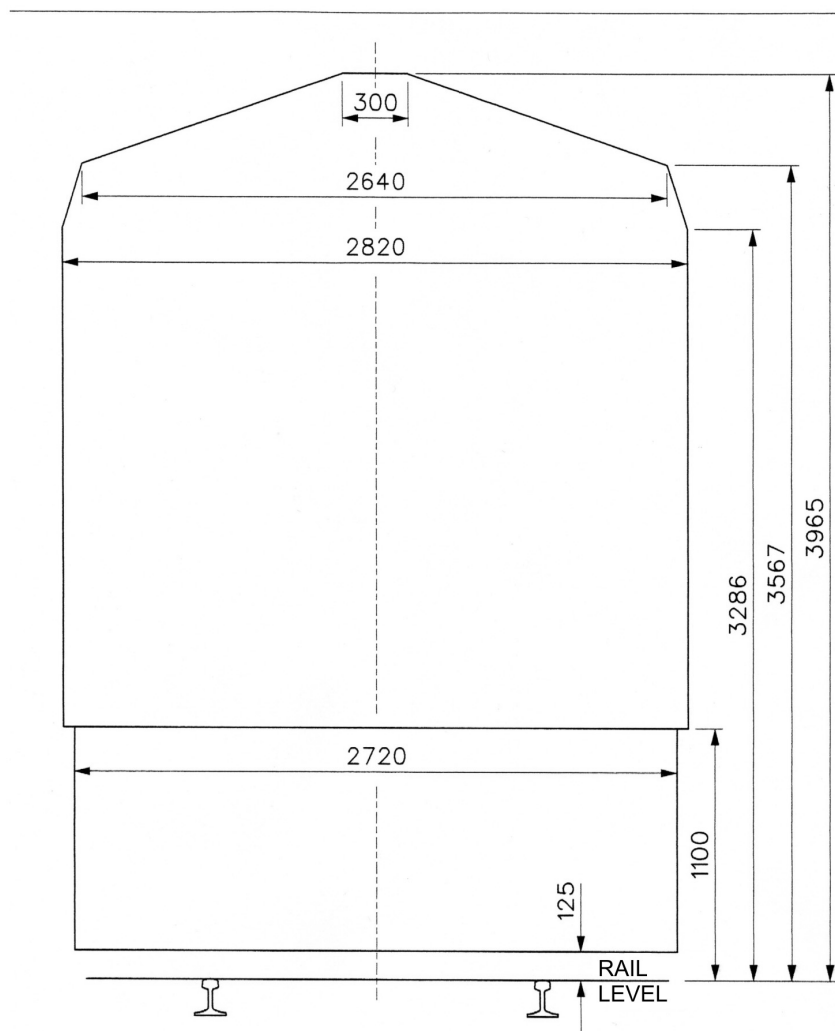
These values are given by a blocking ratio between the train and tunnel cross-sections of 0,18.



▼ B

## ANNEX C

## MAXIMUM PROFILE FOR UK1 GAUGE



## Notes:

1. All dimensions in millimetres.
2. This is a static gauge.

**RAILTRACK**

UK1 Gauge

Drawn: 20/09/01

**Definition of UK1 gauge**

The approach in the UK is to maximise the vehicle gauge while ensuring that the swept envelope of the vehicle is within the structure gauge at each point along the routes.

As a result the UK 1 gauge has initially been defined as a vehicle gauge:

1. The diagram gives the basic dimensions for the UK1 gauge. (Static on a straight level track).
2. The horizontal and vertical profile below 1 100 mm ARL must not be infringed under any combination of vehicle load, wear, suspension travel and geometric conditions.
3. The effects of cant and kinematic movements combined with bogie spacing and bogie overhang, which require enlarged clearances on curves, have to be considered on a case-by-case basis.



## ANNEX D

## ASSESSMENT OF INTEROPERABILITY CONSTITUENTS

## 1. Scope

This Annex indicates the assessment of conformity and suitability for use for interoperability constituents within the rolling stock subsystem.

## 2. Characteristics

The characteristics of the interoperability constituents to be assessed in the different phases of design and production are marked by an 'X' in Table 1.

Table 1

Assessment of interoperability constituents of the rolling stock subsystem.

1	2	3	4	5	6
Characteristics to be assessed	Assessment in the following phase				
	Design and development phase				Production phase
	Design review	Review of manufacturing process	Type test	In service experience	(Series)
4.2.9.a. End coupler	X	n.a.	X	X	X
4.2.9.b. Emergency coupler	X	n.a.	X	X	X
4.2.10.c. Wheel profile	X	n.a.	n.a.	n.a.	X
4.2.10.d. Wheel material	X	X	X	X	X
4.2.19. In service maintenance:					
Coupling for emptying retention toilets (TSI maintenance Section 5.3.1 and Annex IV)	X	n.a.	n.a.	n.a.	X
Internal power sockets (TSI maintenance Section 5.3.3)	X	n.a.	n.a.	n.a.	X
Connections for water replenishment (TSI maintenance Section 5.3.5 and Annex V)	X	n.a.	n.a.	n.a.	X
4.2.20. External lights and horn	X	n.a.	n.a.	n.a.	X
4.3.19. Windscreen					
optical quality	X	n.a.	X	n.a.	X
ability to resist impacts	X	n.a.	X	n.a.	X



## ANNEX E

## ASSESSMENT OF THE ROLLING STOCK SUBSYSTEM

## 1. Scope

This Annex indicates the assessment of conformity of the rolling stock subsystem

## 2. Characteristics and modules

The subsystem characteristics to be assessed in the different phases of design, installation and operation are marked by an 'X' in Table 2. This table also lists the European specifications (standards) and the references of other documents giving details of assessment procedures.

Table 2

Assessment of the rolling stock subsystem

1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
4.1.1. Maximum track forces			
4.1.1.a. Dynamic vertical load	n.a.	X	n.a.
4.1.1.b. Transversal track forces	n.a.	X	n.a.
4.1.1.c. Longitudinal track forces <sup>(1)</sup>	X	X	n.a.
4.1.2. Static axle load	n.a.	X	X
4.1.3. Maximum train length	X	n.a.	n.a.
4.1.4. Vehicle kinematic gauge	X	X	n.a.
4.1.5. Minimum braking characteristics			
Safe operation <sup>(2)</sup>	X	X	n.a.
Minimum deceleration	X	X	X
Maximum braking distance	X	X	X
4.1.6. Electrical boundary characteristics			
4.1.6.1. Voltage and frequency variations in the electrical supply <sup>(**)</sup>	X	X	n.a.
4.1.6.2. Maximum power demand <sup>(**)</sup>	X	X	n.a.
4.1.6.3. Power factor <sup>(**)</sup>	X	X	n.a.
4.1.6.4. Short over-voltages generated	X	n.a.	n.a.
4.1.7.a. Static resistance (vertical/longitudinal)	n.a.	X	n.a.

▼ **B**

1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
4.1.7.b. Crash worthiness	X	n.a.	n.a.
4.1.8. Boundary characteristics outside noise	n.a.	X	n.a.
4.1.9.1. Interference to signalling system (**)	X	X	n.a.
4.1.9.2. Not used	X	X	n.a.
4.1.9.3. Radio frequency interference (**)	X	X	n.a.
4.1.9.4. Electromagnetic immunity (**)	X	X	n.a.
4.1.10. Boundary characteristics linked to inside noise in drivers cab	n.a.	X	n.a.
4.1.11. Boundary characteristics linked to air conditioning	n.a.	X	n.a.
4.1.12. Characteristics linked to carriage of persons of reduced mobility	X	n.a.	n.a.
4.1.13. Maximum pressure variations in tunnels	X	n.a.	n.a.
4.1.14. Starting, operating, stopping in maximum gradients	n.a.	X	n.a.
4.2. Rolling stock subsystem interfaces			
4.2.1. Design of train configuration	X	n.a.	n.a.
4.2.2. Driver vigilance device	n.a.	n.a.	X
4.2.3. Electrification system:			
Maximum power drawn from catenary (energy TSI Section 4.2.2.5)	X	X	n.a.
Maximum power drawn at standstill (energy TSI Section 4.2.2.6) (**)	X	X	n.a.
Voltage and frequency of supply (energy TSI Section 4.2.2.7)	X	X	n.a.
Over-voltages caused by harmonics (energy TSI Section 4.2.2.8)	X	X	n.a.
Electrical protection measures (energy TSI Section 4.2.2.8)	X	n.a.	n.a.
Distribution of pantographs (energy TSI Section 4.2.2.9, Annex H)	X	n.a.	n.a.

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1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
Running through phase separations (energy TSI Section 4.2.2.10, Annex H)	n.a.	X	n.a.
Running through system separations (energy TSI Section 4.2.2.11)	n.a.	X	n.a.
Pantograph contact forces (energy TSI Section 5.3.2.7)	n.a.	X	X
Power factor (**)	X	X	n.a.
Regenerative braking (energy TSI Section 4.3.1.4, Annex K)	X	X	n.a.
4.2.4. On board train control equipment			
Braking performances (verification in Section 4.1.5)			
Electromagnetic compatibility (verification in Section 4.1.9)			
Dynamic clearances of vehicles	X	X	n.a.
Train data transmission (braking, integrity, length)	n.a.	X	n.a.
4.2.5. Passenger step	X	n.a.	n.a.
4.2.6. Doors and door controls	X	n.a.	X
4.2.7. Passenger emergency exits	n.a.	X	n.a.
4.2.8. Drivers' cab emergency	n.a.	X	n.a.
4.2.9.a. End couplers			
4.2.9.b. Emergency couplers			
4.2.10. Wheel/rail contact/ride stability			
4.2.10.c1. Wheel profile			
4.2.10.c2. Acceptance tests	n.a.	X	n.a.
4.2.10.c3. Periodic checking procedures <sup>(3)</sup>	X	n.a.	n.a.
4.2.10.c4. Detection device for running gear instability	X	X	n.a.
4.2.10.d. Wheel materials			

**▼ B**

1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
4.2.10.e. Electrical resistance (**)	X	X	n.a.
4.2.11. Hotbox detection:			
validation of the system	X	X	X
interface with existing trackside systems	X	n.a.	n.a.
4.2.12. Emergency alarm	n.a.	X	X
4.2.13. Slipstream	n.a.	X	n.a.
4.2.14. Effects of crosswinds ( <sup>4</sup> )	X	n.a.	n.a.
4.2.15. Eddy current brakes			
Maximum deceleration ( <sup>5</sup> )	n.a.	X	n.a.
Maximum longitudinal track forces (Section 4.2.15)	X	n.a.	n.a.
Safety of failures modes (Section 4.2.15)	X	n.a.	n.a.
4.2.16. Flange lubrication	n.a.	X	n.a.
4.2.17. Suspension coefficient	n.a.	X	n.a.
4.2.18. Clearance in minimum curve radius	n.a.	X	n.a.
4.2.19. In service maintenance:			
4.2.19.a. Maintenance plan	The existence of the maintenance plan including the elements defined in Section 4.2.19.a will be verified by the notified body.		
4.2.19.b. Maintenance work:			
External cleaning (Maintenance TSI Section 4.2.2.2.1)	X	n.a.	n.a.
Toilet emptying: technology of trainset toilets to allow them to be emptied at three-day intervals (Maintenance TSI Section 4.2.2.2.2)	X	n.a.	n.a.
Power supply for internal cleaning: power, voltage; availability of electrical sockets; spacing of sockets (Maintenance TSI Section 4.2.2.2.3)	X	n.a.	n.a.
Replenishment of water and sand (Maintenance TSI Section 4.2.2.2.4 and 5)	X	n.a.	n.a.

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1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
Trainsets standby: Stationary noise level (Maintenance TSI Section 4.2.2.2.6) see Section 4.1.8 of this TSI Capability of being stabled with no crew aboard and with auxiliary power supply sustained (Maintenance TSI Section 4.2.2.2.6)	X	n.a.	n.a.
Parking brake (Section 4.3.8)			
4.2.20. External lights and horn		X	
4.2.21. Lifting/rescue procedures	Verification carried out independently of the rolling stock assessment Existence of a procedure for recovering a trainset in difficulties		
4.3. Specified performance			
4.3.1. Minimum performances in degraded modes	n.a.	X	n.a.
4.3.1. Description of degraded modes in special document	X	n.a.	n.a.
4.3.2. Service speed (**)	X	X	n.a.
4.3.3. Traction performance requirements (normal and degraded modes)	n.a.	X	X
4.3.4. Traction adhesion requirements	X	n.a.	n.a.
4.3.4. Validation of the anti-slip system	n.a.	X	n.a.
4.3.5. Brake adhesion limits	X	n.a.	n.a.
4.3.6. Brake system requirements			
conformity assessment of control system	X	X	X
safety assessment of new control systems <sup>(6)</sup>	X	n.a.	n.a.
wheel-slide device	n.a.	X	n.a.
detection of seized up axle	n.a.	X	n.a.
taking the electric brake into account in the performances	X	n.a.	n.a.
regenerative braking characteristics	n.a.	X	n.a.

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1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
indicators of brake and means of brake isolation	X	n.a.	n.a.
brake fault diagnostics	X	n.a.	n.a.
4.3.7. Service braking performance	n.a.	X	n.a.
4.3.8. Devices for immobilisation of train	n.a.	X	n.a.
4.3.9. Brake performance on gradients	X	n.a.	n.a.
4.3.10. Detection of derailment <sup>(7)</sup>	n.a.	X	n.a.
4.3.11.a, b, c, d, e, f, g. Fire and fumes protection	X	X	n.a.
4.3.11.a. Ability to operate for 15 minutes with a declared fire on board	X	n.a.	n.a.
4.3.12. Environmental conditions	X	n.a.	n.a.
4.3.13. Monitoring and diagnostic concepts	X	X	n.a.
4.3.14. Special provisions for tunnels	X	n.a.	n.a.
4.3.15. Emergency lighting	n.a.	X	n.a.
4.3.16. Public address system	n.a.	X	n.a.
4.3.17. Protection against electrical shocks	X	X	n.a.
4.3.18. Driver's cab			
(a) access and egress	X	n.a.	n.a.
(b) external visibility	X	n.a.	n.a.
(c) and (d) seats and interior layout	X	n.a.	n.a.
4.3.19. Windscreen characteristics			
optical quality			
ability to resist impacts			
4.3.20. Passenger information signs	n.a.	n.a.	X
4.3.21. Toilets available to passengers and train crew	X	n.a.	n.a.
7.3. Specific cases			
7.3.1. Vehicle loading gauge (Great Britain)			
7.3.2. Boundary characteristics linked to outside noise (existing designs)			



**▼ B**

1	2	3	4
Characteristics to be assessed	Assessment in the following phase		
	Design and development phase		Production phase
	Design review	Type test	Serial production quality
7.3.3. Maximum pressure variations in tunnels (Italian network)			
7.3.4. Passenger step (British and Netherlands lines)			
7.3.5. Wheel rail contact (British lines)			

**► M1 ◀**

(\*\*) Type test only if necessary.

(1) Verification during assessment of the braking characteristics.

(2) Only for new systems.

(3) Creation of maintenance documents.

(4) Under evaluation (simulations and calculations).

(5) Less than 2,5 m/s<sup>2</sup>, all brakes in use.

(6) Only for new technology.

(7) Functional verification.



## *ANNEX F*

### **PROCEDURES FOR ASSESSMENT OF CONFORMITY AND SUITABILITY FOR USE**

#### MODULE A (INTERNAL PRODUCTION CONTROL)

##### **Conformity assessment of interoperability constituents**

1. This module describes the procedure whereby the manufacturer or his authorised representative established within the Community, who discharges the obligations laid down in point 2, ensures and declares that the interoperability constituent concerned satisfies the requirements of the TSI that apply to it.
2. The manufacturer must prepare the technical documentation described in point 3.
3. The technical documentation must enable the conformity of the interoperability constituent with the requirements of this TSI to be assessed. It must, as far as relevant for such assessment, cover the design, manufacture and operation of the interoperability constituent. So far as relevant for the assessment, the documentation must contain:
  - a general description of the interoperability constituent,
  - conceptual design and manufacturing drawings and schemes of components, subassemblies, circuits, etc.,
  - descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the interoperability constituent,
  - a list of the technical specifications (relevant TSI and/or European specifications with relevant clauses, referred to in the TSI), applied in full or in part,
  - descriptions of the solutions adopted to meet the requirements of this TSI, where the European specifications referred to in the TSI have not been applied in full,
  - results of design calculations made, examinations carried out, etc.,
  - test reports.
4. The manufacturer must take all the measures necessary in order that the manufacturing process ensures compliance of the manufactured interoperability constituent with the technical documentation referred to in point 2 and with the requirements of the TSI that apply to it.
5. The manufacturer or his authorised representative established within the Community must draw up a written declaration of conformity. The content of this declaration has to include at least the information, indicated in Directive 96/48/EC, Annex IV(3) and in Article 13(3). The EC declaration of conformity and the accompanying documents must be dated and signed.

The declaration shall be written in the same language as the technical file and include the following:

- the Directive reference (Directive 96/48/EC and other Directives to which the interoperability constituent may be subject),
- the name and address of the manufacturer or his authorised representative established within the Community (give trade name and full address and in the case of authorised representative also give the trade name of the manufacturer or constructor),
- description of interoperability constituent (make, type, etc.)

**▼B**

- description of the procedure (module) followed in order to declare conformity,
  - all the relevant descriptions met by the interoperability constituent and in particular its conditions of use,
  - reference to this TSI and to any other applicable TSI, and where appropriate reference to European specifications,
  - identification of the signatory having received authority to engage the manufacturer or his authorised representative established within the Community.
6. The manufacturer or his authorised representative must keep a copy of the EC declaration of conformity with the technical documentation for a period of 10 years after the last interoperability constituent has been manufactured.
- Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the interoperability constituent in the Community market.
7. If in addition to the EC declaration of conformity, an EC declaration for suitability for use for the interoperability constituent is required by the TSI, this declaration has to be added after being issued by the manufacturer under the conditions of module V.

**MODULE B (TYPE-EXAMINATION)****Conformity assessment of interoperability constituents**

1. This module describes that part of the procedure by which a notified body ascertains and attests that a type, representative of the production envisaged, meets the provisions of the TSI that apply to it.

The manufacturer, or his authorised representative established within the Community, must lodge the application for the type-examination with a notified body of his choice.

2. The application must include:
- the name and address of the manufacturer and, if the application is lodged by the authorised representative, his name and address in addition,
  - a written declaration that the same application has not been lodged with any other notified body,
  - the technical documentation, as described in point 3.

The applicant must place at the disposal of the notified body a specimen, representative of the production envisaged and hereinafter called 'type'.

A type may cover several versions of the interoperability constituent provided that the differences between the versions do not affect the provisions of the TSI.

The notified body may request further specimens if needed for carrying out the test programme.

If no type tests are requested within the type-examination procedure (see point 4.4), and the type is sufficiently defined by the technical documentation, as described in point 3, the notified body may agree, that no specimens are placed at their disposal.

3. The technical documentation must enable the conformity of the interoperability constituent with the provisions of the TSI to be assessed. It must, as far as relevant for such assessment, cover the design, manufacture and operation of the product.

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The technical documentation must contain:

- a general type-description,
- conceptual design and manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.,
- descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the product,
- conditions of integration of the interoperability constituent in its system environment (subassembly, assembly, subsystem) and the necessary interface conditions,
- conditions for use and maintenance of the interoperability constituent (restrictions of running time or distance, wear limits, etc.),
- a list of the technical specifications, against which the conformity of the interoperability constituent is to be assessed (relevant TSI and/or European specifications with relevant clauses),
- descriptions of the solutions adopted to meet the requirements of the TSI in cases where the European specifications referred to in the TSI have not been applied in full,
- results of design calculations made, examinations carried out, etc.,
- test reports.

4. The notified body must:

- 4.1. examine the technical documentation,
- 4.2. if a design review is requested in the TSI, perform an examination of the design methods, the design tools and the design results to evaluate their capability to fulfil the requirements for conformity for the interoperability constituent at the completion of the design process,
- 4.3. if a review of the manufacturing process is requested in the TSI, perform an examination of the manufacturing process devised for manufacturing the interoperability constituent, to evaluate its contribution to product conformity, and/or examine the review carried out by the manufacturer at the completion of the design process,
- 4.4. if type tests are requested in the TSI, verify that the specimen(s) has (have) been manufactured in conformity with the technical documentation, and carry out or have carried out the type tests in accordance with the provisions of the TSI and the European Specifications referred to in the TSI,
- 4.5. identify the elements which have been designed in accordance with the relevant provisions of the TSI and the European Specifications referred to in the TSI, as well as the elements which have been designed without applying the relevant provisions of those European Specifications,
- 4.6. perform or have performed the appropriate examinations and necessary tests in accordance with points 4.2, 4.3 and 4.4 to establish whether, where the appropriate European specifications referred to in the TSI have not been applied, the solutions adopted by the manufacturer meet the requirements of the TSI,
- 4.7. perform or have performed the appropriate examinations and necessary tests in accordance with points 4.2, 4.3 and 4.4 to establish whether, where the manufacturer has chosen to apply the relevant European specifications, these have actually been applied,
- 4.8. agree with the applicant the location where the examinations and necessary tests will be carried out.

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5. Where the type meets the provisions of the TSI, the notified body must issue a typeexamination certificate to the applicant. The certificate must contain the name and address of the manufacturer, conclusions of the examination, conditions for its validity and the necessary data for identification of the approved type.

The time period of validity shall be no longer than three years.

A list of the relevant parts of the technical documentation must be annexed to the certificate and a copy kept by the notified body.

If the manufacturer or his authorised representative established within the Community is denied an EC type-examination certificate, the notified body must provide detailed reasons for such denial.

Provision must be made for an appeals procedure.

6. The applicant must inform the notified body that holds the technical documentation concerning the EC type-examination certificate of all modifications to the approved product which must receive additional approval where such changes may affect the conformity with the requirements of the TSI or the prescribed conditions for use of the product. This additional approval is given in the form of an addition to the original typeexamination certificate, or a new certificate will be issued after withdrawal of the old certificate.
7. If no modifications as under point 6 have been made, the validity of an expiring certificate can be extended for another period of validity. The applicant will apply for such a prolongation by a written confirmation that no such modifications have been made, and the notified body issues a prolongation for another period of validity as in point 5, if no contrary information exists. This procedure can be reiterated.
8. Each notified body must communicate to the other notified bodies the relevant information concerning the type-examination certificates it has withdrawn or refused.
9. The other notified bodies will receive copies of the type-examination certificates issued and/or their additions on request. The annexes to the certificates must be kept at the disposal of the other notified bodies.
10. The manufacturer or his authorised representative established within the Community must keep with the technical documentation copies of the EC type-examination certificates and their additions for a period of 10 years after the last product has been manufactured. Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the product on the Community market.

#### MODULE D (PRODUCTION QUALITY ASSURANCE)

##### **Conformity assessment of interoperability constituents**

1. This module describes the procedure whereby the manufacturer or his authorised representative established within the Community who satisfies the obligations of point 2 ensures and declares that the interoperability constituent concerned is in conformity with the type as described in the EC type-examination certificate and satisfies the requirements of the Directive 96/48/EC and of the TSI that apply to it.

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2. The manufacturer must operate an approved quality system for production, final product inspection and testing as specified in point 3 and is subject to monitoring as specified in point 4.

3. Quality system

- 3.1. 3.1. The manufacturer must lodge an application for assessment of his quality system with a notified body of his choice, for the interoperability constituents concerned.

The application must include:

- all relevant information for the product category representative for the interoperability constituents envisaged,
- the documentation concerning the quality system,
- the technical documentation of the approved type and a copy of the type-examination certificate.

- 3.2. The quality system must ensure compliance of the interoperability constituents with the type as described in the EC type-examination certificate and with the requirements of the Directive 96/48/EC and of the TSI that apply to them. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. The quality system documentation must permit a consistent interpretation of the quality programmes, plan, manuals and records.

It must contain in particular an adequate description of:

- the quality objectives and the organisational structure,
- responsibilities and powers of the management with regard to product quality,
- the manufacturing, quality control and quality assurance techniques, processes and systematic actions that will be used,
- the examinations and tests that will be carried out before, during and after manufacture, and the frequency with which they will be carried out,
- the quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.,
- the means to monitor the achievement of the required product quality and the effective operation of the quality system.

- 3.3. The notified body must assess the quality system to determine whether it satisfies the requirements referred to in point 3.2. It presumes conformity with these requirements in respect of quality systems that implement the relevant harmonised standard. This harmonised standard shall be EN ISO 9001 — December 2000, completed if necessary to take into consideration the specificity of the interoperability constituent for which it is implemented.

The audit must be specific for the product category, which is representative for the interoperability constituent. The auditing team must have at least one member experienced as an assessor in the product technology concerned. The evaluation procedure must include an inspection visit to the manufacturer's premises.

The decision must be notified to the manufacturer. The notification must contain the conclusions of the examination and the reasoned assessment decision.

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- 3.4. The manufacturer must undertake to fulfil the obligations arising out of the quality system as approved and to uphold it so that it remains adequate and efficient.

The manufacturer, or his authorised representative established within the Community, shall keep the notified body that has approved the quality system informed of any intended updating of the quality system.

The notified body must evaluate the modifications proposed and decide whether the amended quality system will still satisfy the requirements referred to in point 3.2 or whether a reassessment is required.

It must notify its decision to the manufacturer. The notification must contain the conclusions of the examination and the reasoned assessment decision.

- 3.5. Each notified body must communicate to the other notified bodies the relevant information concerning the quality system approvals that it has withdrawn or refused.

- 3.6. The other notified bodies will receive copies of the quality system approvals issued on request.

4. Surveillance of the quality system under the responsibility of the notified body

- 4.1. The purpose of surveillance is to make sure that the manufacturer duly fulfils the obligations arising out of the approved quality system.

- 4.2. The manufacturer must allow the notified body entrance for inspection purposes to the locations of manufacture, inspection and testing, and storage and must provide it with all necessary information, in particular:

— the quality system documentation,

— the quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.

- 4.3. The notified body must periodically carry out audits to make sure that the manufacturer maintains and applies the quality system and must provide an audit report to the manufacturer.

The frequency of the audits shall be at least once a year.

- 4.4. Additionally the notified body may pay unexpected visits to the manufacturer. During such visits the notified body may carry out, or cause to be carried out, tests to verify that the quality system is functioning correctly, if necessary. The notified body must provide the manufacturer with a visit report and, if a test has taken place, with a test report.

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5. The manufacturer must, for a period of 10 years after the last product has been manufactured, keep at the disposal of the national authorities:

- the documentation referred to in the second indent of point 3.1,
- the updating referred to in the second paragraph of point 3.4,
- the decisions and reports from the notified body which are referred to in the final paragraph of point 3.4, points 4.3 and 4.4.

6. The manufacturer or his authorised representative established within the Community must draw up the EC declaration of conformity of the interoperability constituent.

The content of this declaration has to include at least the information, indicated in Directive 96/48/EC, Annex IV(3) and Article 13(3). The EC declaration of conformity and the accompanying documents must be dated and signed.

The declaration must be written in the same language of the technical file and must contain the following:

- the Directive references (Directive 96/48/EC and other Directives, to which the interoperability constituent may be subject),
- the name and address of the manufacturer or his authorised representative established within the Community (give trade name and full address and in the case of authorised representative also give the trade name of the manufacturer or constructor),
- description of interoperability constituent (make, type, etc.),
- description of the procedure (module) followed in order to declare conformity,
- all of the relevant descriptions met by the interoperability constituent and in particular its conditions of use,
- name and address of notified body (bodies) involved in the procedure followed in respect of conformity and date of examination certificates together with the duration and conditions of validity of the certificate,
- reference to this TSI and any other applicable TSI and where appropriate reference to European specifications,
- identification of signatory having received power to engage the manufacturer or his authorised representative established within the Community.

The certificates to be referred to are:

- the quality system approval and surveillance reports indicated in points 3 and 4,
- the type-examination certificate and its additions,

7. The manufacturer or his authorised representative established within the Community must keep a copy of the EC declaration of conformity for a period of 10 years after the last interoperability constituent has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the interoperability constituent on the Community market.



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8. If additional to the EC declaration of conformity an EC declaration of suitability for use for the interoperability constituent is requested in the TSI, this declaration has to be added, after being issued by the manufacturer under the conditions of Module V.

**MODULE F (PRODUCT VERIFICATION)****Conformity assessment of interoperability constituents**

1. This module describes that part of the procedure whereby a manufacturer or his authorised representative established within the Community checks and attests that the interoperability constituent concerned, subject to the provisions of point 3 is in conformity with the type as described in the EC type-examination certificate and satisfies the requirements of Directive 96/48/EC and of the TSI that apply to it.
2. The manufacturer must take all measures necessary in order that the manufacturing process ensures conformity of the interoperability constituents with the type as described in the EC type-examination certificate and with the requirements of Directive 96/48/EC and of the TSI that apply to them.
3. The notified body must carry out the appropriate examinations and tests in order to check the conformity of the interoperability constituent with the type as described in the EC type-examination certificate and with the requirements of Directive 96/48/EC and of the TSI either by examination and testing of every interoperability constituent as specified in point 4 or by examination and testing of interoperability constituents on a statistical basis, as specified in point 5, at the choice of the manufacturer.
4. *Verification by examination and testing of every interoperability constituent*
  - 4.1. All products must be individually examined and appropriate tests as set out in the relevant European specifications referred to in Article 10 or equivalent tests shall be carried out in order to verify their conformity with the type as described in the EC type-examination certificate and the requirements of Directive 96/48/EC and of the TSI that apply to them.
  - 4.2. The notified body must draw up a written certificate of conformity for the approved products relating to the tests carried out.
  - 4.3. The manufacturer or his authorised representative must ensure that he is able to supply the notified body's certificates of conformity on request.
5. *Statistical verification*
  - 5.1. The manufacturer must present his interoperability constituents in the form of homogeneous lots and shall take all measures necessary in order that the manufacturing process ensures the homogeneity of each lot produced.
  - 5.2. All interoperability constituents must be available for verification in the form of homogeneous lots. A random sample shall be drawn from each lot. Interoperability constituents in a sample shall be individually examined and appropriate tests as set out in the relevant European specifications referred to in Article 10, or equivalent tests, shall be carried out to ensure their conformity with the requirements of Directive 96/48/EC and of the TSI which apply to them and to determine whether the lot is accepted or rejected.

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- 5.3. The statistical procedure must use appropriate elements (statistical method, sampling plan, etc.), depending on the characteristics to be assessed, as specified in the TSI which apply to them.
- 5.4. In the case of accepted lots, the notified body shall draw up a written certificate of conformity relating to the tests carried out. All interoperability constituents in the lot may be put on the market except those interoperability constituents from the sample which were found not to be in conformity.

If a lot is rejected, the notified body or the competent authority must take appropriate measures to prevent the putting on the market of that lot. In the event of frequent rejection of lots the notified body may suspend the statistical verification.

- 5.5. The manufacturer or his authorised representative established within the Community must ensure that he is able to supply the notified body's certificates of conformity on request.
6. The manufacturer or his authorised representative established within the Community must draw up the EC declaration of conformity of the interoperability constituent.

The content of this declaration has to include at least the information, indicated in Directive 96/48/EC, Annex IV(3) and Article 13(3). The EC declaration of conformity and the accompanying documents must be dated and signed.

The declaration must be written in the same language of the technical file and must contain the following:

- the Directive references (Directive 96/48/EC and other Directives, to which the interoperability constituent may be subject),
- the name and address of the manufacturer or his authorised representative established within the Community (give trade name and full address and in the case of authorised representative also give the trade name of the manufacturer or constructor),
- description of interoperability constituent (make, type, etc.),
- description of the procedure (module) followed in order to declare conformity,
- all of the relevant descriptions met by the interoperability constituent and in particular its conditions of use,
- name and address of notified body (bodies) involved in the procedure followed in respect of conformity and date of examination certificates together with the duration and conditions of validity of the certificate,
- reference to this TSI and any other applicable TSI and where appropriate reference to European specifications,
- identification of signatory having received power to engage the manufacturer or his authorised representative established within the Community.

The certificates to be referred to are:

- the EC type-examination certificate and its additions,
- the certificate of conformity as mentioned under point 4 or 5.

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7. The manufacturer or his authorised representative established within the Community must keep a copy of the EC declaration of conformity for a period of 10 years after the last interoperability constituent has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the interoperability constituent on the Community market.

8. If additional to the EC declaration of conformity an EC declaration of suitability for use for the interoperability constituent is requested in the TSI, this declaration has to be added, after being issued by the manufacturer under the conditions of Module V.

## MODULE H2 (FULL QUALITY ASSURANCE WITH DESIGN EXAMINATION)

### Conformity assessment of interoperability constituents

1. This module describes the procedure whereby a notified body carries out an examination of the design of an interoperability constituent and the manufacturer or his authorised representative established within the Community who satisfies the obligations of point 2 ensures and declares that the interoperability constituent concerned satisfies the requirements of Directive 96/48/EC and of the TSI that apply to it.
2. The manufacturer must operate an approved quality system for design, manufacture and final product inspection and testing as specified in point 3 and shall be subject to surveillance as specified in point 4.
3. *Quality system*
- 3.1. The manufacturer must lodge an application for assessment of his quality system with a notified body.

The application must include:

- all relevant information for the product category representative for the interoperability constituent envisaged,
- the quality system's documentation.

- 3.2. The quality system must ensure compliance of the interoperability constituent with the requirements of Directive 96/48/EC and of the TSI that apply to it. All the elements, requirements and provisions adopted by the manufacturer must be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. This quality system documentation shall ensure a common understanding of the quality policies and procedures such as quality programmes, plans, manuals and records.

It must contain in particular an adequate description of:

- the quality objectives and the organisational structure,
- responsibilities and powers of the management with regard to design and product quality,
- the technical design specifications, including European specifications, that will be applied, and, where the European specifications referred to in Article 10 will not be applied in full, the means that will be used to ensure that the requirements of Directive 96/48/EC and of the TSI that apply to the interoperability constituent will be met,

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- the design control and design verification techniques, processes and systematic actions that will be used when designing the interoperability constituents pertaining to the product category covered,
- the corresponding manufacturing, quality control and quality assurance techniques, processes and systematic actions that will be used,
- the examinations and tests that will be carried out before, during and after manufacture, and the frequency with which they will be carried out,
- the quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.,
- the means to monitor the achievement of the required design and product quality and the effective operation of the quality system.

The quality policies and procedures shall cover in particular the assessment phases, as design review, review of manufacturing process and type tests, as they are specified in the TSI for different characteristics and performances of the interoperability constituent.

- 3.3. The notified body must assess the quality system to determine whether it satisfies the requirements referred to in point 3.2. It shall presume compliance with these requirements in respect of quality systems that implement the relevant harmonised standard. This harmonised standard shall be EN ISO 9001 — December 2000, completed if necessary to take into consideration the specificity of the interoperability constituent for which it is implemented.

The audit must be specific for the product category, which is representative for the interoperability constituent. The auditing team must have at least one member experienced as an assessor in the product technology concerned. The evaluation procedure shall include an assessment visit to the manufacturer's premises.

The decision must be notified to the manufacturer. The notification must contain the conclusions of the examination and the reasoned assessment decision.

- 3.4. The manufacturer must undertake to fulfil the obligations arising out of the quality system as approved and to uphold it so that it remains adequate and efficient.

The manufacturer or his authorised representative must keep the notified body that has approved the quality system informed of any intended updating of the quality system.

The notified body must evaluate the modifications proposed and decide whether the amended quality system will still satisfy the requirements referred to in point 3.2 or whether a reassessment is required.

It must notify its decision to the manufacturer. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

4. *Surveillance of the quality system under the responsibility of the notified body*
- 4.1. The purpose of surveillance is to make sure that the manufacturer duly fulfils the obligations arising out of the approved quality system.

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- 4.2. The manufacturer must allow the notified body entrance for inspection purposes to the locations of design, manufacture, inspection and testing, and storage, and shall provide it with all necessary information, in particular:

- the quality system documentation,
- the quality records as foreseen by the design part of the quality system, such as results of analyses, calculations, tests, etc.,
- the quality records as foreseen by the manufacturing part of the quality system, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.

- 4.3. The notified body must periodically carry out audits to make sure that the manufacturer maintains and applies the quality system and shall provide an audit report to the manufacturer.

The frequency of the audits shall be at least once a year.

- 4.4. Additionally the notified body may pay unscheduled visits to the manufacturer. At the time of such visits, the notified body may carry out tests or have them carried out in order to check the proper functioning of the quality system. Where necessary, it must provide the manufacturer with a visit report and, if a test has been carried out, with a test report.

5. The manufacturer must, for a period of 10 years after the last product has been manufactured, keep at the disposal of the national authorities:

- the documentation referred to in the second indent of the second subparagraph of point 3.1,
- the updating referred to in the second subparagraph of point 3.4,
- the decisions and reports from the notified body which are referred to in the final subparagraph of point 3.4, points 4.3 and 4.4.

6. *Design examination*

- 6.1. The manufacturer must lodge an application for examination of the design of the interoperability constituent with a notified body.
- 6.2. The application must enable the design, manufacture and operation of the interoperability constituent to be understood, and shall enable conformity with the requirements of Directive 96/48/EC and of the TSI to be assessed.

It must include:

- the technical design specifications, including European specifications, that have been applied,
- the necessary supporting evidence for their adequacy, in particular where the European specifications referred to in Article 10 have not been applied in full. This supporting evidence must include the results of tests carried out by the appropriate laboratory of the manufacturer or on his behalf.

- 6.3. The notified body must examine the application and where the design meets the provisions of the TSI that apply to it must issue a design examination certificate to the applicant. The certificate shall contain the conclusions of the examination, conditions for its validity, the necessary data for identification of the approved design and, if relevant, a description of the product's functioning.

The time period of validity shall be no longer than three years.

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- 6.4. The applicant must keep the notified body that has issued the design examination certificate informed of any modification to the approved design. Modifications to the approved design must receive additional approval from the notified body that issued the design examination certificate where such changes may affect the conformity with the requirements of the TSI or the prescribed conditions for use of the product. This additional approval is given in the form of an addition to the original design examination certificate.
- 6.5. If no modifications as under point 6.4 have been made the validity of an expiring certificate can be extended for another period of validity. The applicant will apply for such a prolongation by a written confirmation that no such modifications have been made, and the notified body issues a prolongation for another period of validity as in point 6.3 if no contrary information exists. This procedure can be reiterated.
7. Each notified body must communicate to the other notified bodies the relevant information concerning the quality system approvals and the design examination certificates which it has withdrawn or refused.

The other notified bodies will receive copies of:

- the quality system approvals and additional approvals issued, and
- the design examination certificates and additions issued

on request.

8. The manufacturer or his authorised representative established within the Community must draw up the EC declaration of conformity of the interoperability constituent.

The content of this declaration has to include at least the information, indicated in Directive 96/48/EC, Annex IV(3) and in Article 13(3). The EC declaration of conformity and its accompanying documents must be dated and signed.

The declaration must be written in the same language of the technical file and must contain the following:

- the Directive references (Directive 96/48/EC and other Directives to which the interoperability constituent may be subject),
- the name and address of the manufacturer or his authorised representative established within the Community (give trade name and full address and in the case of authorised representative also give the trade name of the manufacturer or constructor),
- description of interoperability constituent (make, type, etc.),
- description of the procedure (module) followed in order to declare conformity,
- all of the relevant descriptions met by the interoperability constituent and in particular its conditions of use,
- name and address of notified body(ies) involved in the procedure followed in respect of conformity and date of examination certificates together with the duration and conditions of validity of the certificate,

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- reference to this TSI and other applicable TSI and where appropriate to European specifications,
- identification of the signatory having received power to engage the manufacturer or his authorised representative established within the Community.

The certificates to be referred to are:

- the quality system approval and surveillance reports indicated in points 3 and 4,
  - the design examination certificate and its additions.
9. The manufacturer, or his authorised representative established within the Community, must keep a copy of the EC declaration of conformity for a period of 10 years after the last interoperability constituent has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the interoperability constituent on the Community market.

10. If additional to the EC declaration of conformity an EC declaration of suitability for use for the interoperability constituent is requested in the TSI, this declaration has to be added, after being issued by the manufacturer under the conditions of Module V.

#### MODULE V (EC TYPE-VALIDATION BY IN SERVICE EXPERIENCE)

##### **Suitability for use assessment of interoperability constituents**

1. This module describes that part of the procedure by which a notified body ascertains and attests that a specimen, representative of the production envisaged, meets the provisions of Directive 96/48/EC and of the TSI that apply to it for suitability for use, to be demonstrated by type validation by in service experience.
2. The application for the type-validation by in service experience must be lodged by the manufacturer, or his authorised representative established within the Community, with a notified body of his choice.

The application must include:

- the name and address of the manufacturer and, if the application is lodged by the authorised representative, his name and address in addition,
- a written declaration that the same application has not been lodged with any other notified body,
- the technical documentation, as described in point 3,
- the programme for validation by in service experience, as described in point 4,
- the name and address of the company (infrastructure manager or railway enterprise), with which the applicant has obtained an agreement to contribute to a suitability for use assessment by in service experience
  - by operating the interoperability constituent in service,
  - by monitoring the in service behaviour and

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- by issuing a report about in service experience,
- the name and the address of the company, undertaking the maintenance of the interoperability constituent during the time period or running distance, required for in service experience,
- an EC declaration of conformity for the interoperability constituent and,
  - if Module B is required in the TSI, an EC type-examination certificate,
  - if Module H2 is required in the TSI, an EC design examination certificate.

The applicant must place at the disposal of the company, undertaking the operation of the interoperability constituent in service, a specimen or a sufficient number of specimens, representative of the production envisaged and hereinafter called 'type'. A type may cover several versions of the interoperability constituent provided that the differences between the versions are all covered by EC declarations of conformity and certificates as mentioned above.

The notified body may request further specimens if needed for carrying out the validation by in service experience to be put in service.

3. The technical documentation must enable the assessment of the product with the requirements of Directive 96/48/EC and of the TSI. It must cover the operation of the interoperability constituent, and, as far as relevant for such assessment, cover also the design and manufacture.

The technical documentation must contain:

- a general type-description,
- the technical specification(s), against which the performance and in service behaviour of the interoperability constituent is to be assessed (relevant TSI and/or European specifications with relevant clauses),
- schemes of components, subassemblies, circuits, etc.,
- conditions of integration of the interoperability constituent in its system environment (subassembly, assembly, subsystem) and the necessary interface conditions,
- conditions for use and maintenance of the interoperability constituent (restrictions of running time or distance, wear limits, etc.),
- descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the interoperability constituent,

and, as far as is relevant for assessment,

- conceptual design and manufacturing drawings,
- results of design calculations made and examinations carried out,
- test reports.

If the TSI is requiring further information for the technical documentation, this has to be included.

A list of the European specifications referred to in the technical documentation, applied in full or in part, has to be attached.



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4. The programme for the validation by in service experience must include:
  - the required performance or behaviour in service of the interoperability constituent under trial,
  - the installation arrangements,
  - the duration of the programme, either time or distance,
  - the operating conditions and the service programme expected,
  - the maintenance programme,
  - the special in service tests, if any, to be performed,
  - the batch size of the specimens, if more than one,
  - the inspection programme (nature, number and frequency of inspections, documentation),
  - criteria for tolerable defects and their impact on the programme,
  - the information to be included in the report of the company operating the interoperability constituent in service (see point 2).
5. *The notified body must:*
  - 5.1. examine the technical documentation and the programme for validation by in-service experience,
  - 5.2. verify that the type is representative and has been manufactured in conformity with the technical documentation,
  - 5.3. verify that the programme for validation by in-service experience is well adapted to assess the required performance and in service behaviour of the interoperability constituent,
  - 5.4. agree with the applicant about the programme and the location where the inspections and necessary tests will be carried out and about the body performing the tests (notified body or other competent laboratory),
  - 5.5. monitor and inspect the progress of in service running, operation and maintenance of the interoperability constituent,
  - 5.6. evaluate the report, to be issued by the company (infrastructure manager or railway enterprise) operating the interoperability constituent, and all other documentation and information, gained during the procedure (test reports, maintenance experience, etc.),
  - 5.7. assess, if the in-service behaviour meets the requirements of Directive 96/48/EC and of the TSI.
6. Where the type meets the provisions of the TSI, the notified body must issue a suitability for use certificate to the applicant. The certificate must contain the name and address of the manufacturer, conclusions of the validation, conditions for its validity and the necessary data for identification of the approved type.

The time period of validity shall be no longer than three years.

A list of the relevant parts of the technical documentation must be annexed to the certificate and a copy kept by the notified body.

If the applicant is denied a suitability for use certificate, the notified body must provide detailed reasons for such denial.

Provision must be made for an appeals procedure.

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7. The applicant must inform the notified body that holds the technical documentation concerning the suitability for use certificate of all modifications to the approved product which must receive additional approval where such changes may affect the suitability for use or the prescribed conditions for use of the product. This additional approval is given in the form of an addition to the original suitability for use certificate, or a new certificate will be issued after withdrawal of the old certificate.
8. If no modifications as under point 7 have been made, the validity of an expiring certificate can be extended for another period of validity. The applicant will apply for such a prolongation by a written confirmation that no such modifications have been made and the notified body issues a prolongation for another period of validity as in point 6 if no contrary information exists. This procedure can be reiterated.
9. Each notified body must communicate to the other notified bodies the relevant information concerning the suitability for use certificates it has withdrawn or refused.
10. The other notified bodies will receive copies of the suitability for use certificates issued and/or their additions on request. The annexes to the certificates must be kept at the disposal of the other notified bodies.
11. The manufacturer or his authorised representative established within the Community must keep with the technical documentation copies of suitability for use certificates and their additions for a period of 10 years after the last product has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the product on the Community market.

12. The manufacturer or his authorised representative established within the Community must draw up the EC declaration of suitability for use of the interoperability constituent.

The content of this declaration has to include at least the information, indicated in Directive 96/48/EC, Annex IV(3) and in Article 13(3). The EC declaration of suitability for use and the accompanying documents must be dated and signed.

The declaration must be written in the same language of the technical file and must contain the following:

- the Directive references (Directive 96/48/EC),
- the name and address of the manufacturer or his authorised representative established within the Community (give trade name and full address and in the case of authorised representative also give the trade name of the manufacturer or constructor),
- description of interoperability constituent (make, type, etc.),
- all of the relevant descriptions met by the interoperability constituent and in particular its conditions of use,
- name and address of notified body (bodies) involved in the procedure followed in respect of suitability for use and date of suitability for use certificate together with the duration and conditions of validity of the certificate,

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- reference to this TSI and to any other applicable TSI, and where appropriate reference to European specifications,
  - identification of the signatory having received power to engage the manufacturer or his authorised representative established within the Community.
13. The manufacturer or his authorised representative established within the Community must keep a copy of the EC declaration of suitability for use for a period of 10 years after the last interoperability constituent has been manufactured.

Where neither the manufacturer nor his authorised representative is established within the Community, the obligation to keep the technical documentation available is the responsibility of the person who places the interoperability constituent on the Community market.

#### MODULE SB (EC TYPE-EXAMINATION)

##### **EC verification of rolling stock subsystem**

1. This module describes part of the EC verification procedure whereby a notified body checks and certifies at the request of an adjudicating entity or its authorised representative established within the Community, that a type of a rolling stock subsystem, representative for the production envisaged,
  - complies with this TSI and any other applicable TSI, which demonstrates that the essential requirements of Directive 96/48/EC have been met,
  - complies with the other regulations deriving from the Treaty.
2. The adjudicating entity or its authorised representative established within the Community must lodge an application for EC verification (through type-examination) of the subsystem with a notified body of his choice.

The application includes:

- name and address of the adjudicating entity or its authorised representative
  - the technical documentation, as described in point 3.
3. The applicant must place at the disposal of the notified body a specimen of the subsystem representative of the production envisaged and hereinafter called 'type'.

A type may cover several versions of the subsystem provided that the differences between the versions do not affect the provisions of the TSI.

The notified body may request further specimens if needed for carrying out the test programme.

If so required for specific test or examination methods and specified in the TSI or in the European specifications referred to in Article 10, also a specimen or specimens of a subassembly or assembly or a specimen of the subsystem in a preassembled condition has to be delivered.

The technical documentation must enable the design, manufacture, installation and operation of the subsystem to be understood, and shall enable conformity with the provisions of Directive 96/48/EC and of the TSI to be assessed. It must, as far as relevant for such assessment, cover the design, manufacture and operation of the subsystem.

It must include:

- a general description of the subsystem, overall design and structure,
- the register of rolling stock, including all indications as specified in the TSI

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- conceptual design and manufacturing drawings and schemes of components, subassemblies, assemblies, circuits, etc.,
- descriptions and explanations necessary for the understanding of said drawings and schemes and the operation of the product,
- the technical design specifications, including European specifications, that have been applied,
- the necessary supporting evidence for their adequacy, in particular where European specifications referred to in the TSI and the relevant clauses have not been applied in full,
- a list of the interoperability constituents, to be incorporated into the subsystem,
- technical documentation as regards the manufacturing and the assembling of the subsystem,
- a list of manufacturers, involved in the subsystem's design, manufacturing, assembling and installation,
- conditions for use and maintenance of the subsystem (restrictions of running time or distance, wear limits, etc.),
- a list of the European specifications referred to in Article 10 or in the technical design specification,
- results of design calculations made, examinations carried out, etc.,
- test reports.

If the TSI is requiring further information for the technical documentation, this has to be included.

4. The notified body must:

- 4.1. examine the technical documentation,
- 4.2. if a design review is requested in the TSI, perform an examination of the design methods, the design tools and the design results to evaluate their capability to fulfil the requirements for conformity for the subsystem at the completion of the design process,
- 4.3. if type tests are requested in the TSI, verify that the specimen(s) of the subsystem or of assemblies or subassemblies of the subsystem, required for carrying out type tests, has (have) been manufactured in conformity with the technical documentation, and carry out or have carried out the type tests in accordance with the provisions of the TSI and the European specifications concerned,
- 4.4. identify the elements which have been designed in accordance with the relevant provisions of the TSI and the European specifications referred to in Article 10, as well as the elements which have been designed without applying the relevant provisions of those European specifications,
- 4.5. perform or have performed the appropriate examinations and necessary tests in accordance with points 4.2. and 4.3. to establish whether, where the appropriate European specifications referred to in the TSI have not been applied, the solutions adopted meet the requirements of the TSI,

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- 4.6. perform or have performed the appropriate examinations and necessary tests in accordance with points 4.2. and 4.3 to establish whether, where the relevant European specifications have been chosen, these have actually been applied,
- 4.7. agree with the applicant the location where the examinations and necessary tests will be carried out.
5. Where the type meets the provisions of Directive 96/48 /EC and of the TSI, the notified body must issue a type-examination certificate to the applicant. The certificate must contain the name and address of the adjudicating entity and the manufacturer(s), conclusions of the examination, conditions for its validity and the necessary data for identification of the approved type.

The time period of validity shall be no longer than three years.

A list of the relevant parts of the technical documentation must be annexed to the certificate and a copy kept by the notified body.

If the adjudicating entity or its authorised representative established within the Community is denied a type-examination certificate, the notified body must provide detailed reasons for such denial.

Provision must be made for an appeals procedure.

6. The applicant must inform the notified body that holds the technical documentation concerning the EC type-examination certificate of all modifications to the approved subsystem which must receive additional approval where such changes may affect the conformity with the requirements of Directive 96/48/EC and of the TSI or the prescribed conditions for use of the subsystem. This additional approval is given in the form of an addition to the original type-examination certificate, or a new certificate will be issued after withdrawal of the old certificate.
7. If no modifications as under point 6 have been made, the validity of an expiring certificate can be extended for another period of validity. The applicant will apply for such a prolongation by a written confirmation that no such modifications have been made, and the notified body issues a prolongation for another period of validity as in point 5, if no contrary information exists. This procedure can be reiterated.
8. Each notified body must communicate to the other notified bodies the relevant information concerning the EC type-examination certificates it has withdrawn or refused.
9. The other notified bodies will receive copies of the type-examination certificates issued and/or their additions on request. The annexes to the certificates must be kept at the disposal of the other notified bodies.
10. The adjudicating entity or its authorised representative established within the Community must keep with the technical documentation copies of type-examination certificates and their additions throughout the service life of the subsystem, it must be sent to any other Member State who so requests.

**▼B****MODULE SD (PRODUCTION QUALITY ASSURANCE)****EC verification of rolling stock subsystem**

1. This module describes the EC verification procedure whereby a notified body checks and certifies, at the request of an adjudicating entity or its authorised representative established within the Community, that a rolling stock subsystem, for which an EC type-examination certificate has already been issued by a notified body,

- complies with this TSI and any other applicable TSI, which demonstrates that the essential requirements of Directive 96/48/EC have been met,
- complies with the other regulations deriving from the Treaty and may be put into service.

The notified body carries out the procedure, under the condition that the adjudicating entity and the manufacturers involved satisfy the obligations of point 2.

2. For the subsystem, which is the subject of the EC verification procedure, the adjudicating entity must contract only with manufacturers, whose activities contributing to the subsystem project to be verified (manufacturing, assembling, installation) are subject to an approved quality system for manufacture and final product inspection and testing as specified in point 3 and subject to surveillance as specified in point 4.

The term ‘manufacturer’ also includes companies:

- responsible for the whole subsystem project (including in particular responsibility for subsystem integration (main contractor),
- performing assembling (assemblers) and installation of the subsystem.

The main contractor responsible for the whole subsystem project (including in particular responsibility for subsystem integration), must operate in any case an approved quality system for manufacture and final product inspection and testing, as specified in point 3 and which shall be subject to surveillance as specified in point 4.

In the case, that the adjudicating entity is directly involved in the production (including assembling and installation), or that the adjudicating entity itself is responsible for the whole subsystem project (including in particular responsibility for subsystem integration), it has to operate an approved quality system for those activities, as specified in point 3 and subject to surveillance as specified in point 4.

3. *Quality system*

- 3.1. The manufacturer(s) involved and, if involved the adjudicating entity must lodge an application for assessment of their quality system with a notified body of their choice.

The application must include:

- all relevant information for the subsystem envisaged,
- the quality system's documentation,
- the technical documentation of the approved type and a copy of the type-examination certificate, issued after the completion of the type-examination procedure of module SB.

For manufacturers, only involved in a part of the subsystem project, the information is only requested for that specific relevant part.

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- 3.2. For the main contractor the quality system must ensure overall compliance of the subsystem with the type as described in the type-examination certificate and overall compliance of the subsystem with the requirements of the TSI. For other manufacturers (subsuppliers) the quality system has to ensure compliance of their relevant contribution to the subsystem with the type as described in the type-examination certificate and with the requirements of the TSI.

All the elements, requirements and provisions adopted by the applicants must be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. This quality system documentation shall ensure a common understanding of the quality policies and procedures such as quality programmes, plans, manuals and records.

It must contain in particular an adequate description of the following items for all applicants:

- the quality objectives and the organisational structure,
- the corresponding manufacturing, quality control and quality assurance techniques, processes and systematic actions that will be used,
- the examinations, the checking and tests that will be carried out before, during and after manufacture, assembling and installation and the frequency with which they will be carried out,
- the quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.,

and for the main contractor:

- responsibilities and powers of the management with regard to overall subsystem quality, including in particular the subsystem integration management.

The examinations, tests and checking shall cover all of the following stages:

- structure of subsystem, including, in particular, civil-engineering activities, constituent assembly, final adjustment,
- final testing of the subsystem,
- and, where specified in the TSI, the validation under full operation conditions.

- 3.3. The notified body referred to in point 3.1 must assess the quality system to determine whether it satisfies the requirements referred to in point 3.2. It shall presume compliance with these requirements in respect of quality systems that implement the relevant harmonised standard. This harmonised standard shall be EN ISO 9001 — December 2000, completed if necessary to take into consideration the specificity of the subsystem for which it is implemented.

The audit shall be specific for the subsystem concerned, taking into consideration the specific contribution of the applicant to the subsystem. The auditing team must have at least one member experienced as an assessor in the subsystem technology concerned. The evaluation procedure shall include an assessment visit to the applicant's premises.

The decision must be notified to the applicant. The notification must contain the conclusions of the examination and the reasoned assessment decision.

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- 3.4. The manufacturer(s) and if involved the adjudicating entity must undertake to fulfil the obligations arising out of the quality system as approved and to uphold it so that it remains adequate and efficient.

They must keep the notified body that has approved the quality system informed of any intended updating of the quality system.

The notified body must evaluate the modifications proposed and decide whether the amended quality system will still satisfy the requirements referred to in point 3.2 or whether a reassessment is required.

It must notify its decision to the applicant. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

4. *Surveillance of the quality system(s) under the responsibility of the notified body(ies)*

- 4.1. The purpose of surveillance is to make sure that the manufacturer(s) and, if involved the adjudicating entity duly fulfil the obligations arising out of the approved quality system.

- 4.2. The notified body as referred to under point 3.1 must have permanent access for inspection purposes to the locations of building sites, production workshops, locations of assembling and installation, storage areas and, where appropriate, prefabrication or testing facilities and, more general, to all premises which it considers necessary for its task, in accordance with the applicant's specific contribution to the subsystem project.

- 4.3. The manufacturer(s) and, if involved, the adjudicating entity or its authorised representative established within the Community must send the notified body referred to under point 3.1 (or have sent it) all the documents needed for that purpose and in particular the implementation plans and technical records concerning the subsystem (as far as relevant for the specific contribution of the applicant to the subsystem), in particular:

— the quality system documentation, including the particular means implemented to ensure that:

— (for the main contractor) overall responsibilities and powers of the management for the compliance of the whole entire subsystem are sufficiently and properly defined,

— the quality systems of each manufacturer are correctly managed for achieving integration at subsystem level,

— the quality records as foreseen by the manufacturing part (including assembling and installation) of the quality system, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.

- 4.4. The notified body(ies) must periodically carry out audits to make sure that the manufacturer(s) and, if involved the adjudicating entity maintain and apply the quality system and must provide an audit report to them.



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The frequency of the audits shall be at least once a year, with at least one audit during the time period of performing relevant activities (manufacture, assembling or installation) for the subsystem being the subject of the EC verification procedure mentioned under point 6.

- 4.5. Additionally the notified body(ies) may pay unexpected visits to the sites mentioned under point 4.2. of the applicant(s). At the time of such visits, the notified body may conduct complete or partial audits and may carry out or cause to be carried out tests, in order to check the proper functioning of the quality system where necessary. It must provide the applicant(s) with an inspection report and also, if an audit has been carried out, with an audit report, and, if a test has been carried out with a test report.
5. The manufacturer(s) and, if involved the adjudicating entity must, for a period of 10 years after the last subsystem has been manufactured, keep at the disposal of the national authorities:
  - the documentation referred to in the second indent of the second subparagraph of point 3.1,
  - the updating referred to in the second subparagraph of point 3.4,
  - the decisions and reports from the notified body which are referred to in the final subparagraph of point 3.4, points 4.4 and 4.5.

6. *EC verification procedure*

- 6.1. The adjudicating entity or its authorised representative established within the Community must lodge an application for EC verification of the subsystem (through production quality assurance), including coordination of the surveillance of the quality systems as under point 6.5., with a notified body of its choice. The adjudicating entity or his authorised representative within the Community must inform the manufacturers involved of this choice and of the application.
- 6.2. The application must enable the design, manufacture, assembling, installation and operation of the subsystem to be understood, and shall enable conformity with the requirements of Directive 96/48/EC and of the TSI to be assessed.

It must include:

- the technical documentation regarding the approved type, including the type-examination certificate, as issued after completion of the procedure defined in module SB,
- and, if not included in this documentation,
- the technical design specifications, including European specifications, that have been applied,
  - the necessary supporting evidence for their adequacy, in particular where the European specifications referred to in Article 10 have not been applied in full. This supporting evidence must include the results of tests carried out by the appropriate laboratory of the manufacturer or on his behalf.

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- the technical documentation as regards the manufacturing and the assembling of the subsystem,
- a list of the interoperability constituents, to be incorporated into the subsystem,

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- a list of all manufacturers, involved in the subsystem's design, manufacturing, assembling and installation,
  - the demonstration, that all stages, as mentioned under point 3.2, are covered by quality systems of the manufacturers and/or of the adjudicating entity involved and the evidence of their effectiveness,
  - indication of the notified body(ies), responsible for the approval and surveillance of these quality systems.
- 6.3. The notified body must examine the application concerning the validity of the typeexamination and the typeexamination certificate.
- 6.4. The notified body must then examine if the approval and surveillance of the quality system(s) of the applicant(s) as mentioned in the last subparagraph of point 3.2 sufficiently and properly cover all stages of the subsystem.

If the conformity of the subsystem with the type as described in the EC type-examination certificate and the compliance of the subsystem with the requirements of Directive 96/48/EC and the TSI is based on more than one quality system, it has to examine in particular,

- if the relations and interfaces between the quality systems are clearly documented,
  - if overall responsibilities and powers of the management for the compliance of the whole entire subsystem for the main contractor are sufficiently and properly defined.
- 6.5. The notified body responsible for the EC verification, if not carrying out the surveillance of the quality system(s) concerned as under point 4, must coordinate the surveillance activities of any other notified body responsible for that task, in order to be ensured that correct management of interfaces between the different quality systems in view of subsystem integration has been performed. This coordination includes the right of the notified body responsible for the EC verification,
- to receive all documentation (approval and surveillance), issued by the other notified body(ies),
  - to witness the surveillance audits as under point 4.4,
  - to initiate additional audits as under point 4.5 under its responsibility and together with the other notified body(ies).
- 6.6. Where the subsystem meets the requirements of the TSI, the notified body must then, based on the type-examination and the approval and surveillance of the quality system(s), draw up the certificate of EC verification intended for the adjudicating entity or its authorised representative established within the Community, which in turn draws up the EC declaration of verification intended for the supervisory authority in the Member State within which the subsystem is located and/or operates.

The EC declaration of verification and the accompanying documents must be dated and signed. The declaration must be written in the same language of the technical file and must contain at least the information included in Annex V to Directive 96/48/EC.

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6.7. The notified body shall be responsible for compiling the technical file that has to accompany the EC declaration of verification. The technical file has to include at least the information indicated in Directive 96/48/EC, Article 18(3), and in particular as follows:

- all necessary documents relating to the characteristics of the subsystem,
- list of interoperability constituents incorporated into the subsystem,
- copies of the EC declarations of conformity and, where appropriate, of the EC declarations of suitability for use, which said constituents must be provided in accordance with Article 13 of the Directive, accompanied, where appropriate, by the corresponding documents (certificates, quality system approval and surveillance documents) issued by the notified bodies on the basis of the TSI,
- all elements relating to the conditions and limits for use,
- all elements relating to the instructions concerning servicing, constant or routine monitoring, adjustment and maintenance,
- the type-examination certificate for the subsystem and the accompanying technical documentation,
- certificate of EC verification of the notified body as mentioned under point 6.5, accompanied by corresponding calculation notes and countersigned by itself, stating that the project complies with the Directive and the TSI, and mentioning, where appropriate, reservations recorded during performance of the activities and not withdrawn; the certificate should also be accompanied by the inspection and audit reports drawn up in connection with the verification, as mentioned under points 4.4 and 4.5. ► **M1** — ◀

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7. The complete records accompanying the certificate of EC verification must be lodged with the adjudicating entity or its authorised representative in support of the certificate of EC verification issued by the notified body and must be attached to the EC declaration of verification drawn up by the adjudicating entity intended for the supervisory authority.
8. The adjudicating entity or its authorised representative within the Community must keep a copy of the records throughout the service life of the subsystem; it must be sent to any other Member State who so requests.

#### MODULE SF (PRODUCT VERIFICATION)

##### EC verification of a rolling stock subsystem

1. This module describes the EC verification procedure whereby a notified body checks and certifies at the request of an adjudicating entity or its authorised representative established within the Community, that a rolling stock subsystem, for which an EC type-examination certificate has already been issued by a notified body,
  - complies with this TSI and any other applicable TSI, which demonstrates that the essential requirements of Directive 96/48/EC have been met,
  - complies with the other regulations deriving from the Treaty and may be put into service.
2. The adjudicating entity or its authorised representative established within the Community must lodge an application for EC verification (through product verification) of the subsystem with a notified body of his choice.

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The application includes:

- name and address of the adjudicating entity or its authorised representative,
  - the technical documentation.
3. Within that part of the procedure the adjudicating entity or his authorised representative established within the Community checks and attests that the subsystem concerned is in conformity with the type as described in the EC type-examination certificate and satisfies the requirements of Directive 96/48/EC and of the TSI that apply to them.
  4. The adjudicating entity must take all measures necessary in order that the manufacturing process (including assembling and integration of interoperability constituents) ensures conformity of the subsystem with the type as described in the EC type-examination certificate and with the requirements that apply to them.
  5. The technical documentation must enable the design, manufacture, installation and operation of the subsystem to be understood, and shall enable conformity with the type as described in the type-examination certificate and the requirements of the Directive and the TSI to be assessed.

It must include:

- the type-examination certificate and its accompanying documents and additions, and, as far as not included in the documents accompanying the EC type-examination certificate,
- a general description of the subsystem, overall design and structure,

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- conceptual design and manufacturing drawings and schemes of subassemblies, circuits, etc.,
  - technical documentation as regards the manufacturing and the assembling of the subsystem,
  - the technical design specifications, including European specifications, that have been applied,
  - the necessary supporting evidence for their adequacy, in particular where European specifications have not been applied in full,
  - a list of the interoperability constituents to be incorporated into the subsystem,
  - a list of manufacturers involved in the subsystem's design, manufacturing, assembling and installation,
  - a list of the European specifications. If the TSI requires further information for the technical documentation, this has to be included.
6. The notified body must carry out the appropriate examinations and tests in order to check the conformity of the subsystem with the type as described in the EC type-examination certificate and with the requirements of the TSI by examination and testing of every subsystem, manufactured as a serial product, as specified under point 4.
  7. *Verification by examination and testing of every subsystem (as a serial product)*

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- 7.1. The notified body must carry out the tests, examinations and verifications, to ensure conformity of the subsystem as serial products with the essential requirements of the Directive as provided for in the TSI. The examinations, tests and checking shall extend to the following stages as provided for in the TSI:
- structure of subsystem, including constituent assembly and overall adjustments,
  - final testing of the subsystem,
  - and, whenever specified in the TSI, the validation under full operational conditions.
- 7.2. All subsystems (as serial products) must be individually examined and appropriate tests and verifications as set out in the TSI and in the relevant European specifications (or equivalent tests) shall be carried out in order to verify their conformity with the type as described in the type-examination certificate and the requirements of the TSI that apply to them.
8. The notified body may agree with the adjudicating entity the locations where the tests will be carried out and may agree that final testing of the subsystem and, whenever required in the TSI, tests or validation under full operating conditions, are carried out by the adjudicating entity under direct supervision and attendance of the notified body.
9. The notified body must have permanent access for testing and verification purposes to production workshops, locations of assembling and installations, and where appropriate, prefabrication and testing facilities in order to carry out its tasks as provided for in the TSI.
10. Where the subsystem meets the requirements of the Directive 96/48/EC and of the TSI, the notified body must then, based on the tests, verifications and checking carried out on all serial products as indicated in point 7 and required in the TSI and in the European specifications referred to in Article 10, draw up the certificate of EC verification intended for the adjudicating entity or its authorised representative established within the Community, which in turn draws up the EC declaration of verification intended for the supervisory authority in the Member State where the subsystem is located and/or operates. The EC declaration of verification and the accompanying documents must be dated and signed. The declaration must be written in the same language of the technical file and must contain at least the information included in Annex V to Directive 96/48/EC.
11. The notified body shall be responsible for compiling the technical file that has to accompany the EC declaration of verification. The technical file has to include at least the information indicated in Directive 96/48/EC, Article 18(3), and in particular as follows:
- all necessary documents relating to the characteristics of the subsystem,

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- list of interoperability constituents incorporated into the subsystem,
- copies of the EC declarations of conformity and, where appropriate, of the EC declarations of suitability for use, which said constituents must be provided in accordance with Article 13 of the Directive, accompanied, where appropriate, by the corresponding documents (certificates, quality system approval and surveillance documents) issued by the notified bodies on the basis of the TSI,

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- all elements relating to conditions and limits of use,
  - all elements relating to the instructions concerning servicing, constant or routine monitoring, adjustment and maintenance,
  - EC type-examination certificate and accompanying technical documentation,
  - certificate of EC verification of the notified body as mentioned under point 10, accompanied by corresponding calculation notes and countersigned by itself, stating that the project complies with the Directive and the TSI, and mentioning, where appropriate, reservations recorded during performance of activities and not withdrawn; the certificate should also be accompanied, if relevant, by the inspection and audit reports drawn up in connection with the verification.
12. The complete records accompanying the certificate of EC verification must be lodged with the adjudicating entity, or its authorised representative, in support of the certificate of EC verification issued by the notified body and must be attached to the EC declaration of verification drawn up by the adjudicating entity intended for the supervisory authority.
  13. The adjudicating entity or its authorised representative within the Community must keep a copy of the records throughout the service life of the subsystem; it must be sent to any other Member State who so requests.

#### MODULE SH2 (FULL QUALITY ASSURANCE WITH DESIGN EXAMINATION)

##### **EC verification of rolling stock subsystem**

1. This module describes the EC verification procedure whereby a notified body checks and certifies, at the request of an adjudicating entity or its authorised representative established within the Community, that a rolling stock subsystem
  - complies with this TSI and any other applicable TSI, which demonstrates that the essential requirements of Directive 96/48/EC have been met,
  - complies with the other regulations deriving from the Treaty and may be put into service.

The notified body carries out the procedure, including a design examination of the subsystem under the condition, that the adjudicating entity and the manufacturers involved satisfies the obligations of point 2.
2. For the subsystem, subject of the EC verification procedure, the adjudicating entity must contract only with manufacturers, whose activities contributing to the subsystem project to be verified (design, manufacturing, assembling, installation) are subject to an approved quality system for design, manufacture and final product inspection and testing as specified in point 3 and which shall be subject to surveillance as specified in point 4.

The term ‘manufacturer’ also includes companies:

- responsible for the whole subsystem project (including in particular responsibility for subsystem integration (main contractor),
- performing design services or studies (e.g. consultants),
- performing assembling (assemblers) and installation of the subsystem. For manufacturers, performing only assembling and installation, a quality system for manufacture and final product inspection and testing is sufficient.

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The main contractor responsible for the whole subsystem project (including in particular responsibility for subsystem integration), must operate in any case an approved quality system for design, manufacture and final product inspection and testing, as specified in point 3 and which shall be subject to surveillance as specified in point 4.

Where the adjudicating entity is directly involved in the design and/or production (including assembling and installation), or that the adjudicating entity itself is responsible for the whole subsystem project (including in particular responsibility for subsystem integration), it has to operate an approved quality system for those activities, as specified in point 3 and subject to surveillance as specified in point 4.

### 3. *Quality system*

- 3.1. The manufacturer(s) involved and, if involved, the adjudicating entity must lodge an application for assessment of their quality system with a notified body of their choice.

The application must include:

- all relevant information for the subsystem envisaged,
- the quality system's documentation.

For manufacturers, only involved in a part of the subsystem project, the information is only requested for that specific relevant part.

- 3.2. For the main contractor the quality system must ensure overall compliance of the subsystem with the requirements of the Directive 96/48/EC and of the TSI. For other manufacturers (subsuppliers) the quality system has to ensure compliance of their relevant contribution to the subsystem with the requirements of the TSI.

All the elements, requirements and provisions adopted by the applicants must be documented in a systematic and orderly manner in the form of written policies, procedures and instructions. This quality system documentation shall ensure a common understanding of the quality policies and procedures such as quality programmes, plans, manuals and records.

It must contain in particular an adequate description of the following items:

for all applicants:

- the quality objectives and the organisational structure,
- the corresponding manufacturing, quality control and quality assurance techniques, processes and systematic actions that will be used,
- the examinations, the checking and tests that will be carried out before, during and after manufacture, assembling and installation and the frequency with which they will be carried out,
- the quality records, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.,

for the main contractor and for the subsuppliers (only as far as relevant for their specific contribution to the subsystem project):

- the technical design specifications, including European specifications, that will be applied and, where the European specifications referred to in the TSI will not be applied in full, the means that will be used to ensure that the requirements of the TSI that apply to the subsystem will be met,

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- the design control and design verification techniques, processes and systematic actions that will be used when designing the subsystem,
- the means to monitor the achievement of the required design and subsystem quality and the effective operation of the quality system,

and for the main contractor:

- responsibilities and powers of the management with regard to overall design and subsystem quality, including in particular the subsystem integration management.

The examinations, tests and checking shall cover all of the following stages:

- overall design,
- structure of subsystem, including, in particular, civil-engineering activities, constituent assembly, final adjustment,
- final testing of the subsystem,
- and, where specified in the TSI, the validation under full operation conditions.

- 3.3. The notified body referred to in point 3.1 must assess the quality system to determine whether it satisfies the requirements referred to in point 3.2. It shall presume compliance with these requirements in respect of quality systems that implement the relevant harmonised standard. This harmonised standard shall be EN ISO 9001 — December 2000, completed if necessary to take into consideration the specificity of the subsystem for which it is implemented.

For applicants, which are only involved in assembling and installation, the harmonised standard shall be EN 29002, completed if necessary to take into consideration the specificity of the subsystem for which it is implemented.

The audit shall be specific for the subsystem concerned, taking into consideration the specific contribution of the applicant to the subsystem. The auditing team must have at least one member experienced as an assessor in the subsystem technology concerned. The evaluation procedure shall include an assessment visit to the applicant's premises.

The decision must be notified to applicant. The notification must contain the conclusions of the examination and the reasoned assessment decision.

- 3.4. The manufacturer(s) and, if involved the adjudicating entity must undertake to fulfil the obligations arising out of the quality system as approved and to uphold it so that it remains adequate and efficient.

They must keep the notified body that has approved their quality system informed of any intended updating of the quality system.

The notified body must evaluate the modifications proposed and decide whether the amended quality system will still satisfy the requirements referred to in point 3.2 or whether a reassessment is required.

It must notify its decision to the applicant. The notification shall contain the conclusions of the examination and the reasoned assessment decision.

4. *Surveillance of the quality system(s) under the responsibility of the notified body(ies)*



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- 4.1. The purpose of surveillance is to make sure that the manufacturer(s) and if involved the adjudicating entity duly fulfil the obligations arising out of the approved quality system.
- 4.2. The notified body(ies) as referred to under point 3.1 must have permanent access for inspection purposes to the locations of design, building sites, production workshops, locations of assembling and installation, storage areas and, where appropriate, prefabrication or testing facilities and, more general, to all premises which it considers necessary for its task, in accordance with the applicant's specific contribution to the subsystem project.
- 4.3. The manufacturer(s) and, if involved the adjudicating entity or its authorised representative established within the Community must send the notified body referred to under point 3.1 (or have sent it) all the documents needed for that purpose and in particular the implementation plans and technical records concerning the subsystem (as far as relevant for the specific contribution of the applicant to the subsystem), in particular:
  - the quality system documentation, including the particular means implemented to ensure that:
    - (for the main contractor) overall responsibilities and powers of the management for the compliance of the whole entire subsystem are sufficiently and properly defined,
    - the quality systems of each manufacturer are correctly managed for achieving integration at subsystem level,
    - the quality records as foreseen by the design part of the quality system, such as results of analyses, calculations, tests, etc.,
    - the quality records as foreseen by the manufacturing part (including assembling and installation) of the quality system, such as inspection reports and test data, calibration data, qualification reports of the personnel concerned, etc.
- 4.4. The notified body(ies) must periodically carry out audits to make sure that the manufacturer(s) and, if involved the adjudicating entity maintain and apply the quality system and shall provide an audit report to them.

The frequency of the audits shall be at least once a year, with at least one audit during the period of performing relevant activities (design, manufacture, assembling or installation) for the subsystem being the subject of the EC verification procedure mentioned under point 6.

- 4.5. Additionally the notified body(ies) may pay unscheduled visits to the sites mentioned under point 4.2 of the applicant(s). At the time of such visits, the notified body may conduct complete or partial audits in order to check the proper functioning of the quality system where necessary; it must provide the applicant(s) with an inspection report and, if an audit has been carried out, with an audit report.

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5. The manufacturer(s) and, if involved the adjudicating entity must, for a period of 10 years after the last subsystem has been manufactured, keep at the disposal of the national authorities:
  - the documentation referred to in the second indent of the second subparagraph of point 3.1,
  - the updating referred to in the second subparagraph of point 3.4,
  - the decisions and reports from the notified body which are referred to in the final subparagraph of point 3.4, points 4.4 and 4.5.
6. *EC verification procedure*
  - 6.1. The adjudicating entity or its authorised representative established within the Community must lodge an application for EC verification of the subsystem (through full quality assurance with design examination), including coordination of surveillance of the quality systems as under points 4.4 and 4.5, with a notified body of its choice. The adjudicating entity or its authorised representative established within the Community must inform the manufacturers involved of his choice and of the application.
  - 6.2. The application must enable the design, manufacture, installation and operation of the subsystem to be understood, and shall enable conformity with the requirements of the TSI to be assessed.

It must include:

- the technical design specifications, including European specifications, that have been applied,
  - the necessary supporting evidence for their adequacy, in particular where the European specifications referred to in the TSI have not been applied in full. This supporting evidence must include the results of tests carried out by the appropriate laboratory of the manufacturer or on his behalf.
  - the register of rolling stock, including all indications as specified in the TSI,
  - the technical documentation as regards the manufacturing and the assembling of the subsystem,
  - a list of the interoperability constituents, to be incorporated into the subsystem,
  - a list of all manufacturers, involved in the subsystem's design, manufacturing, assembling and installation,
  - the demonstration, that all stages, as mentioned under point 3.2, are covered by quality systems of the manufacturer(s) and/or of the adjudicating entity involved, and the evidence of their effectiveness,
  - indication of the notified body(ies), responsible for the approval and surveillance of these quality systems.
- 6.3. The notified body must examine the application concerning the design examination and where the design meets the provisions of Directive 96/48/EC and of the TSI that apply to it must issue a design examination report to the applicant. The report shall contain the conclusions of the design examination, conditions for its validity, the necessary data for identification of the design examined and, if relevant, a description of the subsystem's functioning.
  - 6.4. The notified body must, concerning the other stages of the EC verification examine, if all stages of the subsystem as mentioned under point 3.2 are sufficiently and properly covered by the approval and surveillance of quality system(s).

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If the compliance of the subsystem with the requirements of the TSI is based on more than one quality system, it has to examine in particular,

- if the relations and interfaces between the quality systems are clearly documented,
- and if overall responsibilities and powers of the management for the compliance of the whole entire subsystem for the main contractor are sufficiently and properly defined.

6.5. The notified body responsible for the EC verification, if not carrying out the surveillance of the quality system(s) concerned as under point 4, must coordinate the surveillance activities of any other notified body responsible for that task, in order to be ensured that correct management of interfaces between the different quality systems in view of subsystem integration has been performed. This coordination includes the right of the notified body responsible for the EC verification,

- to receive all documentation (approval and surveillance), issued by the other notified body(ies),
- to witness the surveillance audits as under point 4.4,
- to initiate additional audits as under point 4.5 under its responsibility and together with the other notified body(ies).

6.6. Where the subsystem meets the requirements of the TSI, the notified body must then, based on the design examination and the approval and surveillance of the quality system(s), draw up the certificate of EC verification intended for the adjudicating entity or its authorised representative established within the Community, which in turn draws up the EC declaration of verification intended for the supervisory authority in the Member State within which the subsystem is located and/or operates.

The EC declaration of verification and the accompanying documents must be dated and signed. The declaration must be written in the same language as the technical file and must contain at least the information included in Annex V to Directive 96/48/EC.

6.7. The notified body shall be responsible for compiling the technical file to accompany the EC declaration of verification. The technical file has to include at least the information indicated in Directive 96/48/EC, Article 18(3), and in particular:

- all necessary documents relating to the characteristics of the subsystem,
- list of interoperability constituents incorporated into the subsystem,
- copies of the EC declarations of conformity and, where appropriate, of the EC declarations of suitability for use, which said constituents must be provided in accordance with Article 13 of the Directive, accompanied, where appropriate, by the corresponding documents (certificates, quality system approval and surveillance documents) issued by the notified bodies on the basis of the TSI,
- all elements relating to the conditions and limits for use,
- all elements relating to the instructions concerning servicing, constant or routine monitoring, adjustment and maintenance

**▼B**

- certificate of EC verification of the notified body as mentioned under point 6.6, accompanied by corresponding calculation notes and countersigned by itself, stating that the project complies with the Directive and the TSI, and mentioning, where appropriate, reservations recorded during performance of the activities and not withdrawn; the certificate should also be accompanied by the inspection and audit reports drawn up in connection with the verification, as mentioned under points 4.4 and 4.5.

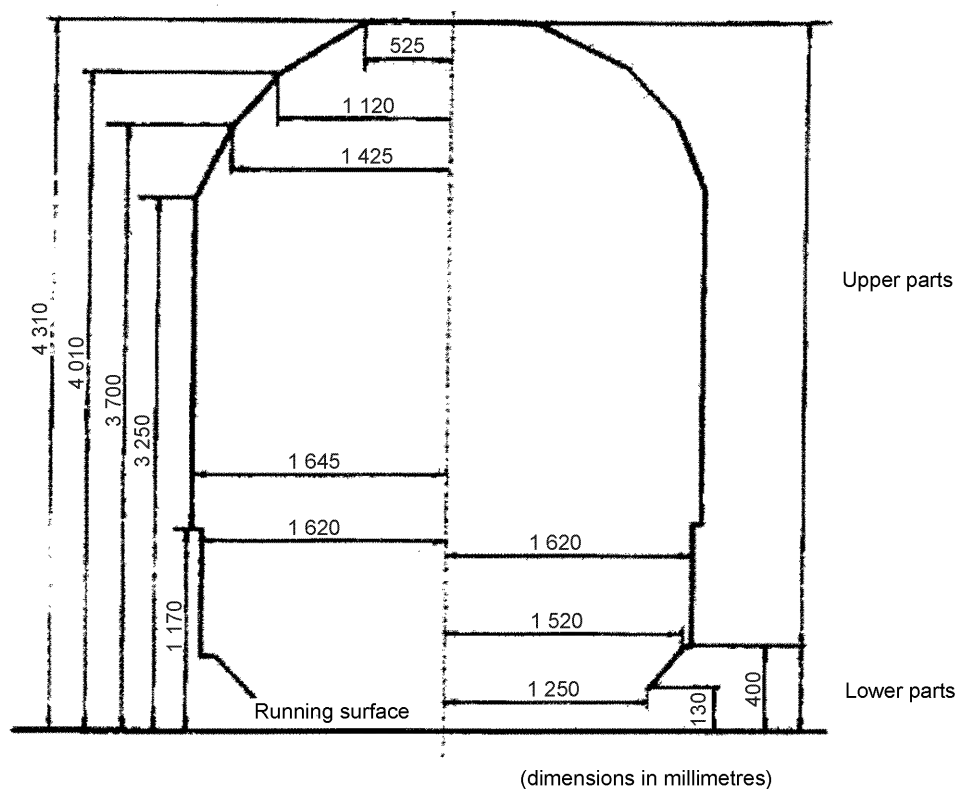
**▼M1****▼B**

7. The complete records accompanying the certificate of EC verification must be lodged with the adjudicating entity, or its authorised representative, in support of the certificate of EC verification issued by the notified body and must be attached to the EC declaration of verification drawn up by the adjudicating entity intended for the supervisory authority.
8. The adjudicating entity or its authorised representative within the Community must keep a copy of the records throughout the service life of the subsystem; it must be sent to any other Member State who so requests.

**▼B***ANNEX G***GAUGE**

505-1

PART COMMON TO ALL VEHICLES

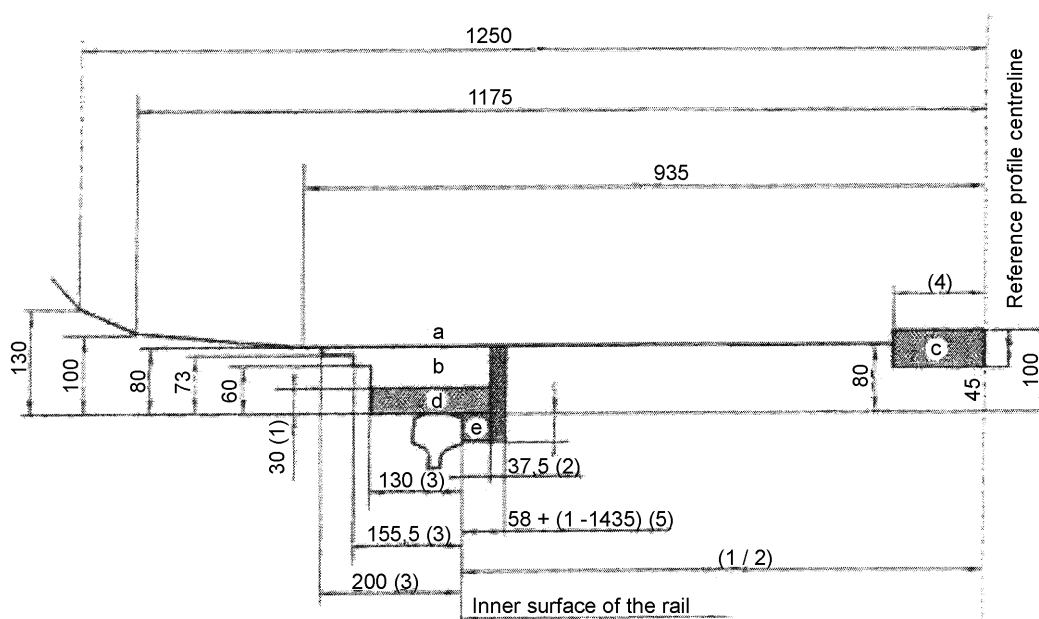


## ▼B

505-1

**Part below 130 mm on vehicles which must not pass over shunting humps or negotiate rail brakes and other activated shunting and stopping devices**

Certain gauge restrictions must be observed at right angles to the axles when vehicles are placed on an under-floor lathe for wheel reprofiling.



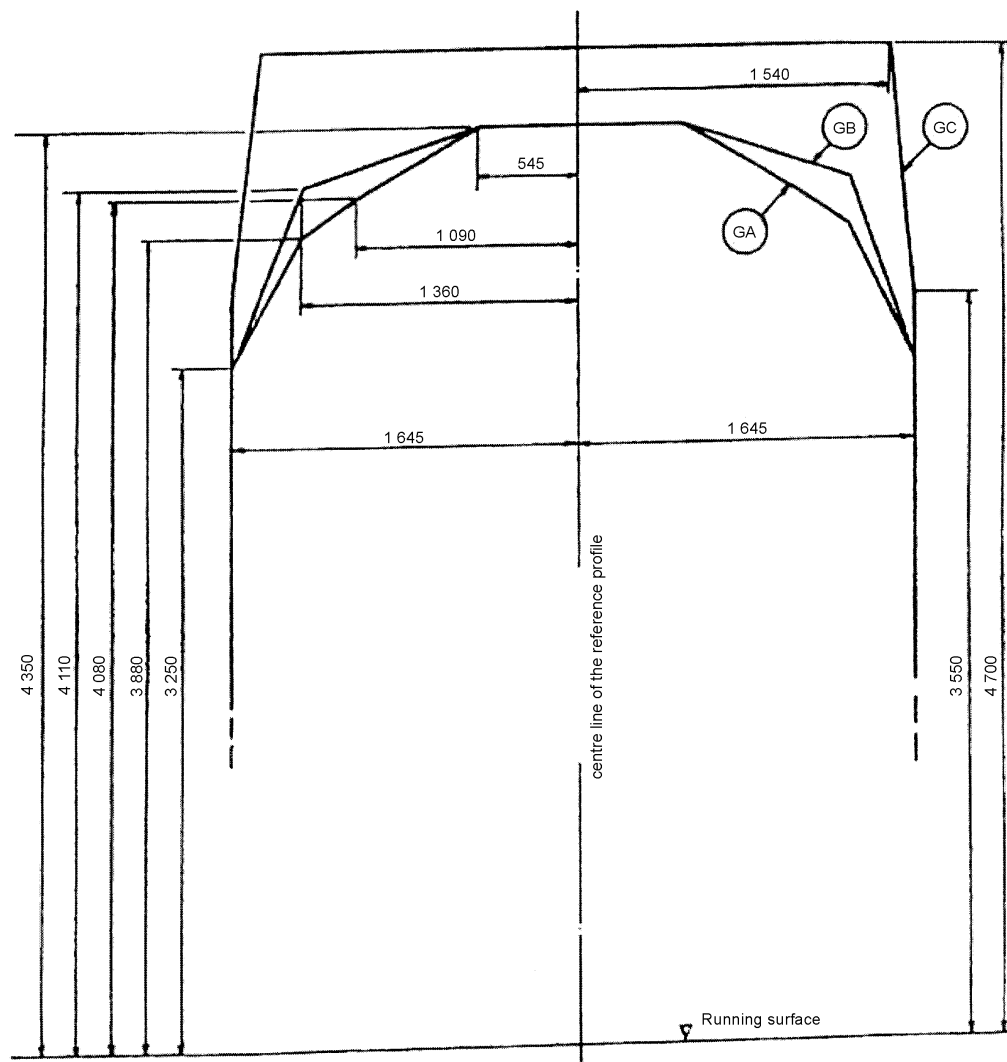
(Dimensions in millimetres)

- (a) zone for equipment away from wheels
  - (b) zone for equipment in immediate proximity of wheels
  - (c) zone for contact ramp brushes
  - (d) zone for wheels and other parts coming into contact with the rails
  - (e) zone occupied exclusively by the wheels
  - (1) Limit for parts located outside the axle ends (guard irons, sanders, etc.) not to be exceeded for running over detonators. This limit may however be disregarded for parts located between the wheels, provided these parts remain within the wheel track.
  - (2) Maximum theoretical width of the flange profile in the case of check-rails
  - (3) Effective limit position of the outside surface of the wheel and of the parts associated with this wheel
  - (4) When the vehicle is in any position whatsoever on a curve of radius  $R = 250$  m (minimum radius for contact rampo installation) and a track width of 1 465 mm, no part of the vehicle likely to descend to less than 100 mm from the running surface, except for the contact brush, should be less than 125 mm from the track centre.
- For parts located inside the bogies, this dimension is 150 mm.
- (5) Effective limit position of the internal surface of the wheel when the axle is against the opposite rail. This dimension varies with gauge widening.

▼ B

## GA, GB AND GC, KINEMATIC GAUGES

## Reference profiles

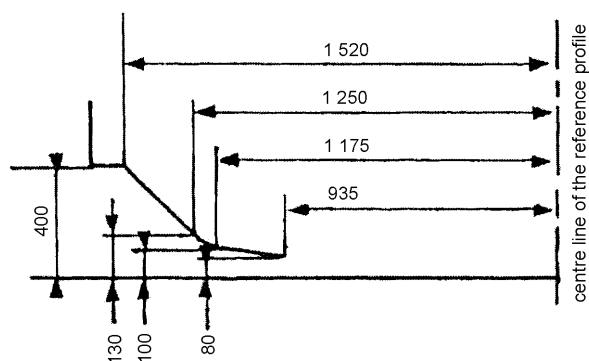


*N.B.:* Up to a height of 3 250 mm, the reference profile of GA, GB and GC gauges is identical.

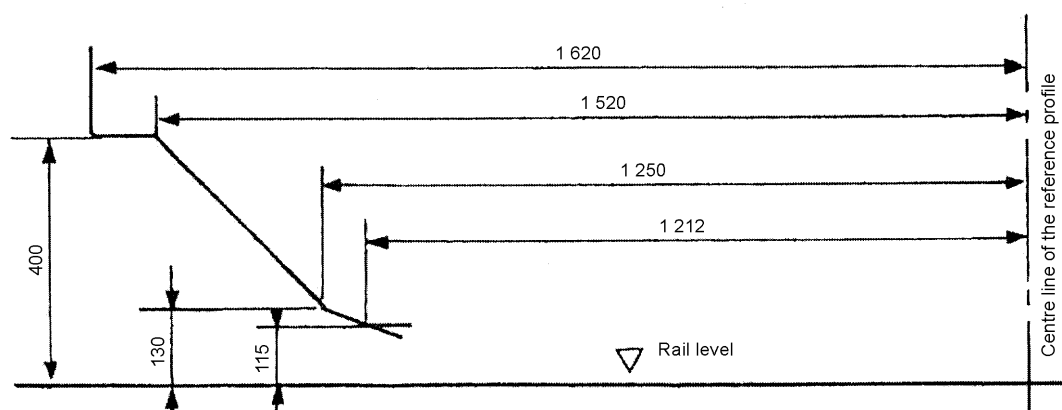
▼ B

## LOWER PARTS

## A. Lines over which powered units used on international services run



## B. Lines over which coaches, vans and wagons used on international services run (with the exception of powered units used on international services)



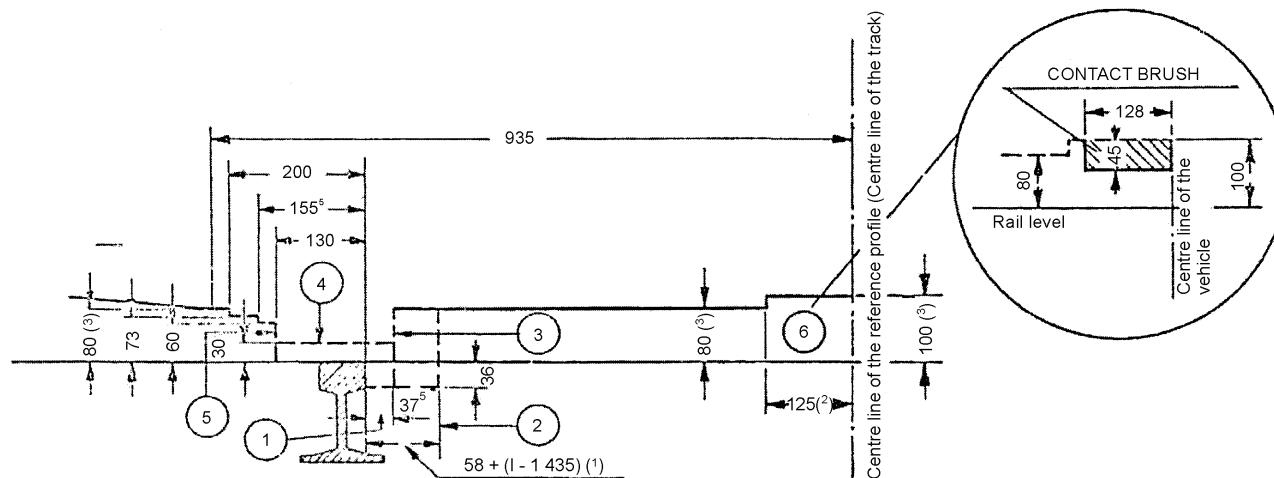
*Note:* On inclined connections with a radius  $R \geq 500$  m, the vertical measurements shown in diagrams A and B above must be reduced by  $\frac{50000}{R}$  mm ( $R$  in m). If  $625 \geq R \geq 500$  m, the measurement 80 in diagram A is cancelled.



▼B

KINEMATIV GAUGE FOR THE LOWER PARTS IN THE AREA OF THE RAIL, THE AREA TAKEN UP BY TRACK BRAKES AND THE AREA OF THE CENTRE LINE OF THE TRACK

A. Lines over which powered units used on international services run



- ① Maximum theoretical width of the flange profile, taking into account the possible obliquity of the axle in the track.
- ② Gauge (maximum actual position) for the inside surface of the tyre when the axle is pressed against the opposite rail.
- ③ Maximum positioning of check-rails.
- ④ Gauge (maximum position) for the parts of the rolling stock adjacent to the wheels.
- ⑤ Gauge (maximum position) for the outside surface of the wheel.
- ⑥ Area for fixing contact ramps.

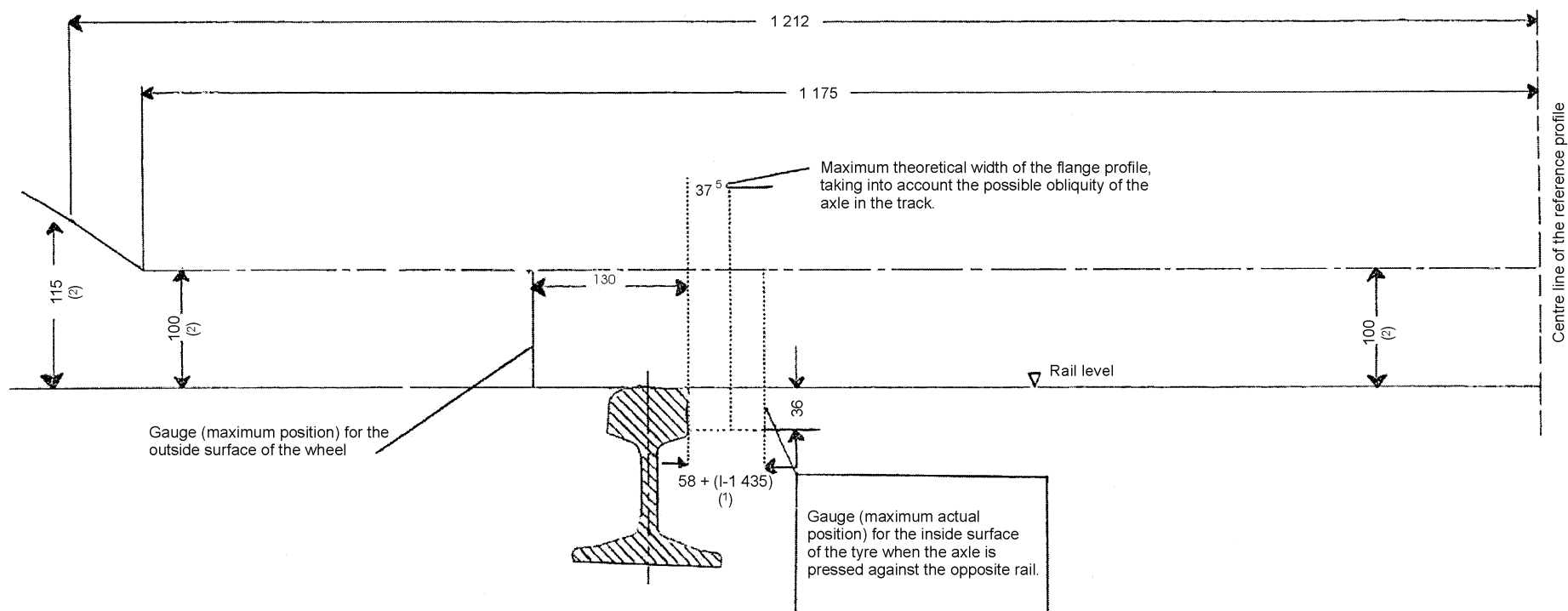
(1)  $l$  = width of track.

(2) Irrespective of radius  $R \geq 250$  m and width of track  $l \leq 1\,465$  m.

(3) These dimensions are valid for flat track. They must be reduced by  $\frac{50\,000}{R}$  mm. ( $R$  in m) for inclined connections with a radius  $R \geq 625$  m and cancelled if  $625 \geq R \geq 500$  m.

## KINEMATIC GAUGE FOR THE LOWER PARTS

## B. Lines over which coaches, vans and wagons used on international services run, excluding powered units



(1)  $l$  = width of track.

(2) On concave or convex inclined connections with a radius  $R \geq 500$  m, this dimension must be reduced by  $\frac{50000}{R}$  mm.

**▼B***ANNEX H***FRONT AND REAR LAMPS****Tail lamps**

Two indicator lamps shall be provided at each end of the trainset, arranged on the horizontal axis at the same height above the railhead, symmetrical to the centre line, and at least 1 300 mm apart.

It is recommended that the indicator lamps be mounted level between 1 600 mm and 2 000 mm above the railhead. As a general rule each lamp shall provide a source of red light at least 170 mm in diameter.

Should available space be limited then a horizontal width down to 110 mm may be permitted, as long as the technical performance of the lamp is not compromised.

A single switch shall be provided to allow both tail lamps at the extremity of the train to be extinguished simultaneously. It is permitted to provide a means of changing the colour aspect of the lamps.

The optical system of the tail lamps shall be designed to provide a red light intensity of:

- at least 15 candelas in the direction of travel,
- at least 7,5 candelas at an angle of 15° to the horizontal and 5° to the vertical in the direction of travel.

**Fixed indicator lamps**

Two electric fixed indicator lamps shall be provided at each end of interoperable trainsets mounted level on the same horizontal axis between 1 600 mm and 2 000 mm above the railhead.

The distance between the two indicator lamps shall be as great as possible, without falling below 1 300 mm; in exceptional cases this distance can be brought down to 1 000 mm for rolling stock with tapered nose cones.

In addition, interoperable trainsets must be built to accept at each extremity a third fixed electric indicator lamp situated on the centre line above the wind-screen.

The lower two fixed lamps shall contain a device to provide either a white or a red aspect, except when the lamps contain superimposed optical elements.

It is recommended that the switch to change the colour aspect be situated inside the vehicle. In addition, it is recommended that separate controls for the electrical signals be provided with lamps able to accept colour screens (yellow or green).

Lamps can be equipped with an electrical commutation device to allow them to act as headlights.

**▼B****Headlight controls**

Headlamps on rolling stock designed for high speed operation shall be provided with the following functions:

- off,
- dimmed sidelight,
- full sidelight,
- dimmed headlight,
- full-beam headlight.

Measured along the centre line, the luminosity of each lamp in each set of lamps shall correspond to the values indicated in the table below:

Luminous intensity in cd (candela) (charged battery)

Sets position	Dimmed side-light	Full sidelight	Dimmed headlight <sup>(a)</sup>	Full-beam headlight
Lower headlights	100	300/700	12 000/16 000	50 000/70 000
Front lights	50	150/350	12 000/16 000	12 000/16 000

<sup>(a)</sup> The upper limit of the beam is at a downward angle of 5° 30' to the horizontal centre line.

**▼ M1***ANNEX I*

The data to be provided for the register provided for in Article 34 of Directive 2008/57/EC of the European Parliament and of the Council <sup>(1)</sup> are those indicated in Commission Implementing Decision 2011/665/EU of 4 October 2011 on the European register of authorised types of railway vehicles <sup>(2)</sup>.

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<sup>(1)</sup> OJ L 191, 18.7.2008, p. 1.

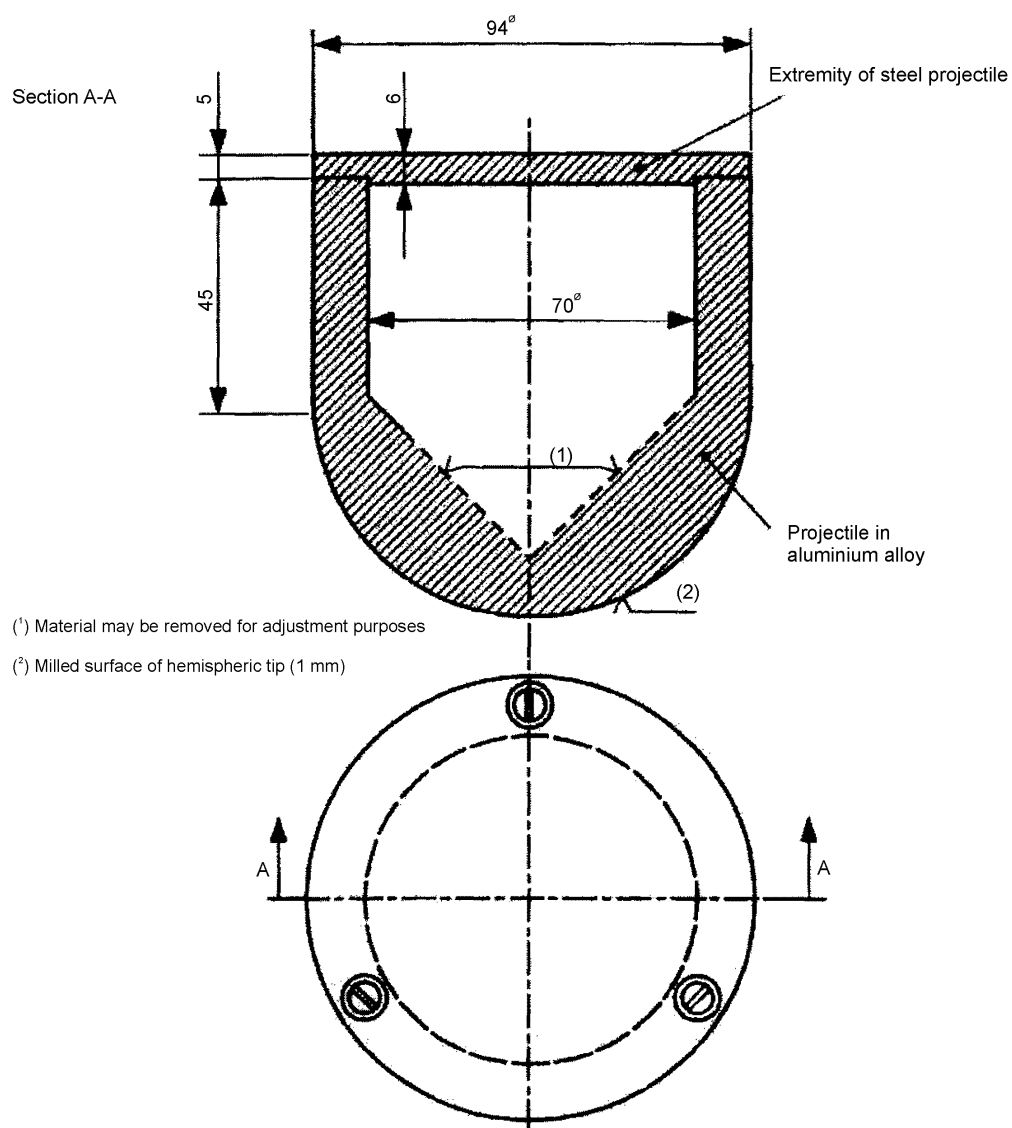
<sup>(2)</sup> OJ L 264, 8.10.2011, p. 32.

▼ B

## ANNEX J

## PROJECTILE TO TEST THE FRONT WINDOW OF THE CAB

Diagram of projectile (mass: 1 000 g)



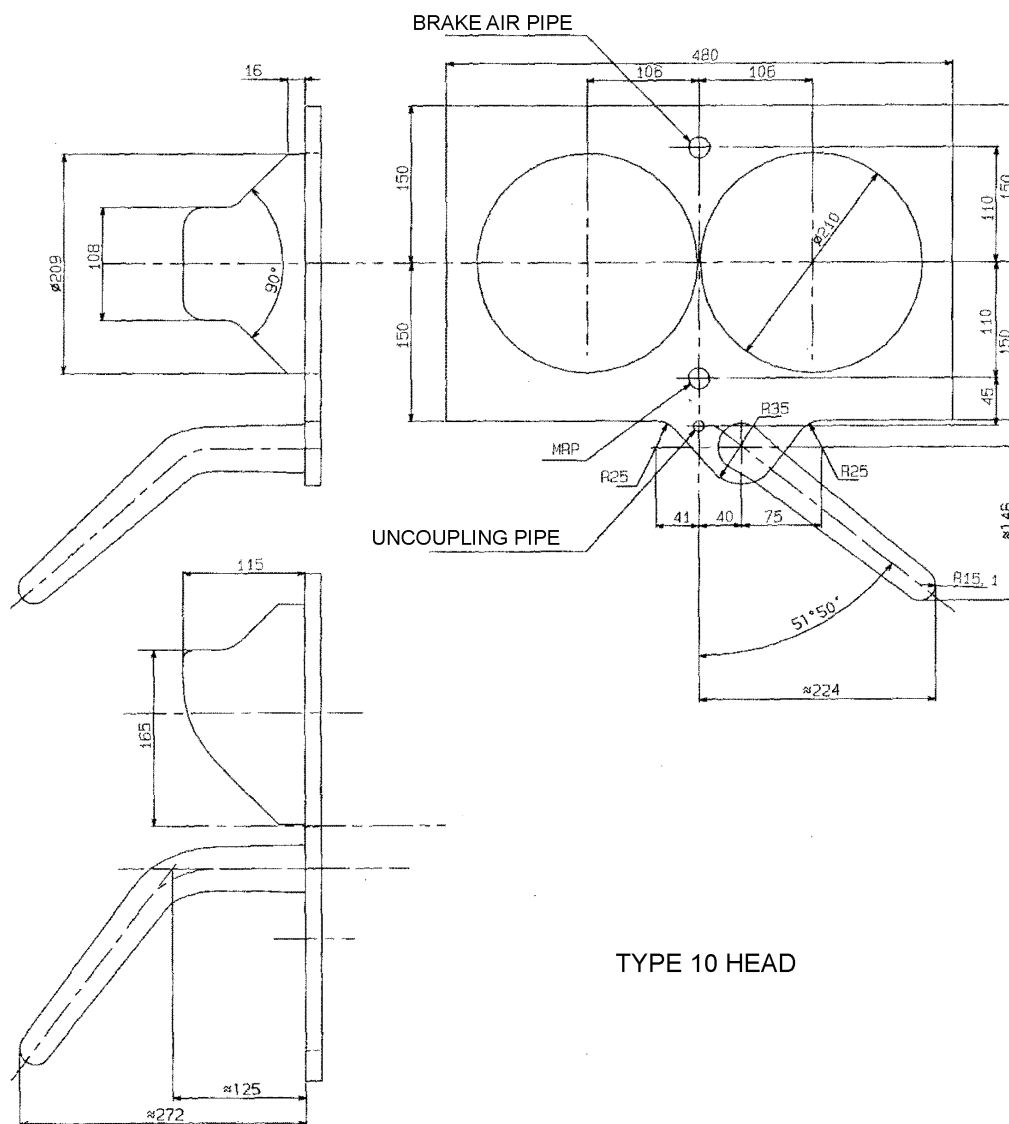
Scale: 1:1



## ANNEX K

## COUPLER

## K.1 Schematic of the coupler



The horizontal axle of the coupler shall be placed at a height of 1 025 mm above the running surface.

## K.2 Operating conditions

(reserved)



## ANNEX L

### ASPECTS NOT SPECIFIC TO HIGH SPEED AND FOR WHICH NOTIFICATION OF NATIONAL RULES IS REQUIRED

#### Geometrical and mechanical compatibility with the railway infrastructure

Respect of the gauge (particularities related to tilting bodies and to exceptional transports)

Insertion of the rolling stock in curves and sinuous layouts

Insertion in longitudinal profile

Running over track twists

Running over switches and crossings

Cowcatcher/obstacles-plough

#### Body, bogie, axles

Bogies: design, fabrication and approval — steel grade used — resistance — vibrations dampening, critical twisting resonance (traction unit)

Mounted axles: design, fabrication and approval — defaults of bearing table admitted in operation

Equipment attached to vehicle bodies, bogie frames and axleboxes

Reliability and resistance of hydraulic systems (if any)

Resistance to fatigue loads

Missile protection — resistance to impacts related to natural events or to acts of malevolence

Design and construction of the tanks of tank wagons

Suitability for gravity shunting: couplers, passing over shunting bumps, resistance to shunting shocks

Marking — identification of rail vehicles

#### Braking

Compressed-air brake: characteristics (including automatic immobilisation in case of coupling rupture)

Other brake types

Elements composing the braking system

Use of the air of the brake system (*inter alia*, tap of the mechanic, emergency braking command, CG vent to the atmosphere, automatic mechanism of play take-up)

Capacity of production and storage of compressed air — residual performance of self-propelled trains (exceptional use): energy supply to the braking equipment of another train and start in a slope

Sandboxes operation in case of emergency braking or jamming detection

Automatic mechanism of play take-up

#### Traction/energy

Autonomy of self propelled equipment

Operation of level crossings (restriction to the traction performances)

Electrical protection of the train: circuit breaker location, damages downstream from the circuit breaker of the train



**▼B**

Command of the pantographs, backup mechanism for raising the pantograph in the absence of air in the main tank

Safeguarding the catenary: escape at high temperature

Characteristics/performances of steam locomotives and internal combustion engines

Insulation characteristics

Main transformer

Characteristics of earthing and current return circuits

Traction unit: cooling, regulation

Traction systems behaviour under minimum and maximum voltage conditions on the network and when entering a section with earthed catenary

Battery charging

Electrical components thermal characteristics

**Control-command (interfaces with signalling)**

Distance between consecutive axles

Mechanism of aid for shunting

Sandboxes throughput

Presence of metal parts (other than wheel flanges) in the area of sensitivity of electronic pedals

Inhibition of traction by braking

Ergonomy of the command, control and emergency mechanisms

Characteristics and performance of security mechanisms for components susceptible to separation

Equipment for single driver operation — command of the passengers' access doors

Remote control

Bus of a vehicle and bus of the train (command of the train)

Semi-automation or automation of system transition

Software (systems controlled by software) (EN 50128)

Safety systems

Diagnostic mechanisms/transmission of the data

Diagnostic system failure

Head or tail lights failure

**Safety and health of persons**

Prevention of explosions

No internal or external sharp edges, slipping prevention, indication of steps in the train

Emission of gasses other than carbon monoxide and dioxide <sup>(1)</sup>

<sup>(1)</sup> Health issues that are not railway specific but need specification. Take account of system failure and/or loss of power supply. The TSIs do not discuss air-conditioning, heating and ventilation for passengers.

**▼B**

Stability problems related to train accelerations ( $\text{m/s}^2$ ) and jolts ( $\text{m/s}^3$ ) — physical damage due to vibrations

Visibility of the train and sound signalling devices

*25KV Transformers*

Audible warning sound before closing doors, presence of windows on all doors

Instruction to passengers for a safety-conscious behaviour

Evacuation and emergency message: information on train position for the driver

Indication on evacuation procedures and use of emergency exits in adequate languages

Exits of each compartment to two platforms

Ensure that the opening of the doors is possible in emergencies

Food preparation and storage <sup>(1)</sup>

Electromagnetic compatibility with pacemakers <sup>(1)</sup>

Flashing lights <sup>(1)</sup>

Respiratory problems or intoxication due to bad quality of air <sup>(1)</sup>

Health damages due to radiant heat, hot air, extreme high or low temperature conditions <sup>(1)</sup>

**Environment**

Exhaust gases of thermic engines

Use of prohibited or restricted materials and products (asbestos, PCB, CFC, etc.)

*Operation*

Vehicle and route acceptance

Certification processes for non destructive testing

Post incident and accident testing of vehicles and train protection systems

Vehicle recovery

<sup>(1)</sup> Health issues that are not railway specific but need specification. Take account of system failure and/or loss of power supply. The TSIs do not discuss air-conditioning, heating and ventilation for passengers.

▼B

*ANNEX M*

**(p.m.)**

*ANNEX N***EMERGENCY LIGHTING REQUIREMENTS****N.1. General points**

Emergency lighting has to allow for the continued occupation or evacuation of a vehicle in complete safety.

The emergency lighting system shall provide the minimum number of lights to allow passengers to move around inside vehicles and to evacuate them while being able to identify the presence of obstacles.

Reduced visibility caused by, for example, the presence of smoke, should be taken into account.

Emergency lighting shall be activated automatically if required and its automatic settings shall not be accessible to passengers.

**N.2. Electrical supply**

The emergency lighting system shall be fed from the vehicle battery by at least one dedicated wiring circuit. If the vehicle is not equipped with its own battery and if it can be uncoupled in normal service, the emergency lighting system must be provided with its own source of supply.

**N.3. Illumination levels**

The minimum average illumination level of the emergency lighting has to be  $\geq 5$  lux and this value must be measured at floor level and along the central axis of the gangway.

The minimum value at the evacuation thresholds has to be  $\geq 30$  lux.

The minimum value for the evacuation signs has to be  $\geq 50$  lux.

All the values must be measured according to methods indicated in Chapter 6 of this present TSI.

**N.4. Uniformity of illumination**

The mean lighting level for the sustained lighting measured according to the requirements of Chapter 6 of this present TSI must be between 0,2 and 10.

**N.5. Limitation of the dazzle phenomena**

To minimise the effect of dazzle, the intensity of the illumination of the emergency lamps shall not exceed  $400 \text{ cd/m}^2$  in the generally visible zone (up to  $60^\circ$  over the horizontal plane of the lamp).

**N.6. Performance on ignition**

The performance on ignition of the sustained lighting has to reach 50 % of the required illumination levels within five seconds and 100 % of the illumination level required in the 15 seconds.

**▼B****N.7. Operating duration**

Except where otherwise agreed between the user and the manufacturer, the emergency lighting shall continue to operate for:

- at least one hour on railway vehicles intended for the public transport systems,
- at least three hours other railway vehicles.

After the failure of the electric supply in the vehicle, e.g. the battery charging system.

Note: the specified durations apply to a battery completely charged under conditions agreed between the buyer and the manufacturer.

**N.8. Layout of the emergency lighting**

The emergency lights must be arranged as follows:

- at least in every autonomous zone, e.g. compartments, toilet, driver's cab, kitchen,
- next to doors and steps, in particular at emergency exits,
- in the zones where obstacles can be present, e.g. presence of luggage in the side aisles, the hallways,
- in the neighbourhood of breaks or changes of direction in the central aisles or the side aisles,
- at every change in floor level.



## *ANNEX O*

### **EARTH PROTECTION OF THE VEHICLES' METAL PARTS**

#### **0.1. EARTHING PRINCIPLES**

All the metal parts of the vehicle:

- likely to be touched by persons, or possibly by animals, and at risk of becoming a source of excessive contact voltages, as the result of a fault in the vehicles electrical installation or because of parts of the catenary becoming detached, or
- an accident risk as a result of the arcing of switch-gear subjected to high currents in the presence of dangerous materials,

shall be set at the same potential as the rail through connections offering the lowest possible resistance.

#### **0.2. EARTHING OF THE VEHICLE BODYSHELL**

Electric resistance between metal parts and the rail for a two-axle vehicle shall be less than or equal to 0,05 Ohm. This value is measured with a constant sustained current of 50 amps and a voltage equal or lower than 50 volts.

#### **0.3. EARTHING OF THE VEHICLE PARTS**

The metal parts in the roof must be bonded to all conductive elements inside the vehicle, where they might be accessible, and must be bonded to the body of the vehicle in a safe way.

#### **0.4. EARTHING OF ELECTRIC INSTALLATIONS**

All the electrical installations and are connected to the main power circuit, and have metal parts which are likely to be touched and are not switched under power must have their metal components bonded with the mass of the vehicle in a safe way.

All the metal parts of a vehicle (other than those covered in the previous point) which are susceptible to be touched and, although not switched under power, risk being switched accidentally, shall be bonded in a safe way if the nominal voltage of the part concerned is greater than:

- 50 V direct current
- 24 V alternating current
- 24 V between phases for three phase current where the neutral is not bonded and
- 42 V between phases for three phase current when the neutral is bonded.

The cross-section of earthing bond is a function of current to be conducted; it must be sized so as to guarantee the safe functioning of the circuit breakers if tripped.

#### **0.5. ANTENNAE**

Antennae fitted outside vehicles have to fulfil the following conditions:

- the conductive parts of the antenna must be fully protected from catenary voltages by a protective device immune to impacts,

**▼ B**

- the antenna system has to provide be provided with a single point earth connection (antenna with static earthing),
- an antenna fitted outside the vehicle that does not respond to the previous conditions must be isolated, by means of high voltage capacitors connected to other over-voltage devices, connected to the inside of the vehicle.



## ANNEX P

## LINE VOLTAGE

The characteristics of the main traction voltage systems (with the exception of over-voltages) are described in detail in the following table:

## Nominal voltages and their acceptable limits in value and in duration.

Electrification system	Lowest non-permanent voltage	Lowest permanent voltage	Nominal voltage	Highest permanent voltage	Highest non-permanent voltage
	$U_{\min 2}$ (V)	$U_{\min 1}$ (V)	$U_n$ (V)	$U_{\max 1}$ (V)	$U_{\max 2}$ (V)
DC (mean values)	400 <sup>(1)</sup>	400	600	720	800 <sup>(2)</sup>
	400 <sup>(1)</sup>	500	750	900	1 000 <sup>(2)</sup>
	1 000 <sup>(1)</sup>	1 000	1 500	1 800	1 950 <sup>(2)</sup>
	2 000 <sup>(1)</sup>	2 000	3 000	3 600	3 900 <sup>(2)</sup>
AC (effective values)	11 000 <sup>(1)</sup>	12 000	15 000	17 250	18 000 <sup>(2)</sup>
	17 500 <sup>(1)</sup>	19 000	25 000	27 500	29 000 <sup>(2)</sup>

<sup>(1)</sup> The duration of voltages between  $U_{\min 1}$  and  $U_{\min 2}$  shall not exceed two minutes.

<sup>(2)</sup> The duration of voltages between  $U_{\max 1}$  and  $U_{\max 2}$  shall not exceed five minutes.

— The voltage of the collection bar in the substation including the line circuit breakers shall not exceed  $U_{\max 1}$ ,

— voltages, in normal operating conditions, have to stay in the range between  $U_{\min 1}$  and  $U_{\max 2}$ ,

— when operating conditions are interrupted, voltages in the range  $U_{\min 1}$  to  $U_{\min 2}$  are acceptable.

Relationship  $U_{\max 1}/U_{\max 2}$ 

Every occurrence of  $U_{\max 2}$  must be followed by a level not exceeding  $U_{\max 1}$  for an indefinite duration.

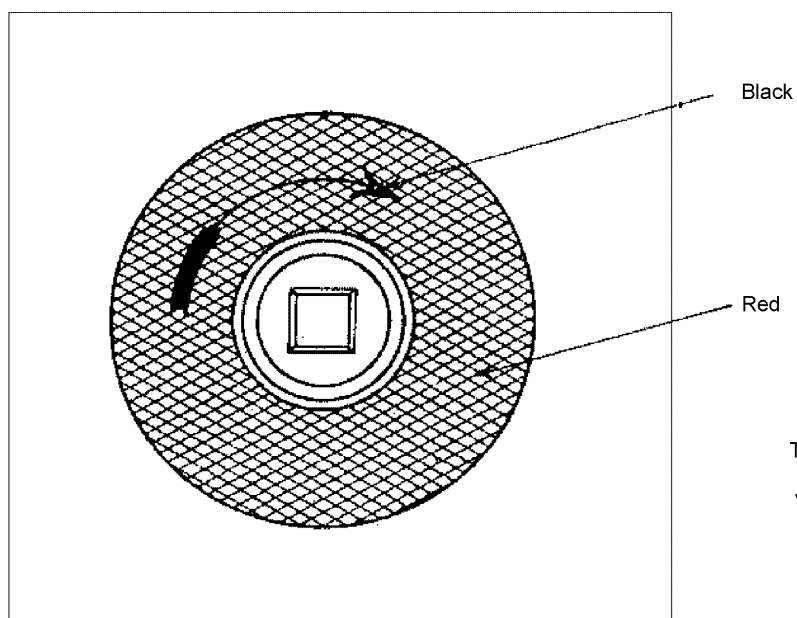
## Lowest tension of service

When the operating conditions are interrupted,  $U_{\max 2}$  will be the lower voltage limit for the air breakers when trainsets can run.

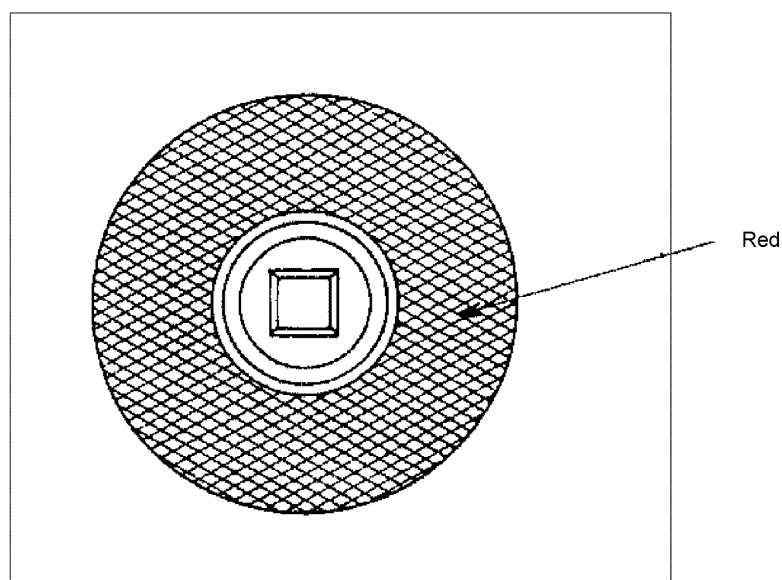
*Note:* Values recommended for under-voltage tripping.

The under-voltage breakers with fixed or adjustable trips can be adjusted for values between 85 % and 95 % of  $U_{\min 2}$ .



**▼B***ANNEX Q***SIGNS INDICATING THE CASKET WHICH CONTAINS THE  
EQUIPMENT OF ALARM DEVICE REMINDER****Figure 1**

The return maneuver  
is done directly  
with the square key.

**Figure 2**

The return maneuver  
requires the opening  
of the casket.