European Railway Agency

Guide for the application of the CR INF TSI

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0. DOCUMENT INFORMATION

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1. SCOPE OF THIS GUIDE

1.1. Scope

1.1.1. This document is an annex to the Guide for the application of TSIs. It provides information on the application of the Technical Specification for Interoperability for the Conventional Rail 'Infrastructure' subsystem adopted by Commission Decision 2011/275/EU of 26 April 2011 ('CR INF TSI').

1.1.2. The guide should be read and used only in conjunction with the CR INF TSI. It is intended to facilitate its application, but does not replace it.
The general part of the 'Guide for the application of TSIs' should also be considered.

1.2. Content of the guide

1.2.1. In section 2 of this document, extracts of the original text of the CR INF TSI are provided, in a shaded text box, and these are followed by a text that gives guidance.

1.2.2. Guidance is not provided for in sections where the original CR INF TSI requires no further explanation.

1.2.3. Guidance is of voluntary application. It does not mandate any requirement in addition to those set out in the CR INF TSI.

1.2.4. Guidance is given by means of further explanatory text and, where relevant, by reference to standards that demonstrate compliance with the CR INF TSI; relevant standards are listed in Annex 1 of this document.

1.3. Reference documents

Reference documents are listed in section 1.4 of the CR LOC&PAS TSI and in the general part of the 'Guide for the application of TSIs'.

1.4. Definitions and abbreviations

Definitions and abbreviations are given in the general part of the 'Guide for the application of TSIs'.

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2. CLARIFICATIONS ON THE CR INF TSI

2.1. Foreword

Geographical scope (section 1.2)

'The geographical scope of this TSI is the trans-European conventional rail system as described in Annex I (1.1) to Directive 2008/57/EC.'

The network of the trans-European conventional rail system will be that of the conventional lines of the trans-European transport network identified in Decision No 661/2010/EU, which repealed and replaced Decision 1692/96/EC.

The scope of the TSI has not yet been extended to the whole conventional rail system as provided for in Article 8 of Directive 2008/57/EC. The basic parameters contained in the TSI have been developed for the TEN only. It will be necessary to reconsider TSI Categories of Line and basic parameters to determine suitability for use on the extended network.

2.2. Essential requirements

The Directive states essential requirements relating to health, safety, reliability, availability, environmental protection and technical compatibility. Table 1 of the TSI lists the basic parameters of the CR infrastructure subsystem which are considered to fulfil these requirements.

2.3. Characteristics of the subsystem

2.3.1. TSI Categories of Line and Performance Parameters

Introduction 4.1

*(**3**) The limiting values set out in the present TSI are not intended to be imposed as usual design values. However the design values must be within the limits set out in this TSI.*

The TSI defines the basic parameters and the minimum levels to be respected in order to meet the essential requirements. The TSI cannot be seen as a design guide as such. For design approval it is advisable that the applicant defines a design guide to be applied. This design guide can be based on standards and should then be reviewed against the TSI requirements. In addition, from the limits given by the TSI, it should be based on good practice values.

TSI Categories of Line (section 4.2.1)

*'(**1**) Annex I (1.1) to the Directive recognises that the conventional rail network may be subdivided into different categories. In order to deliver interoperability cost-effectively, this TSI defines 'TSI Categories of Line'. The functional and technical specifications of this TSI vary according to the TSI Categories of Line.'*

The categorisation of the conventional rail system is more complex than that of the high-speed rail system. Further performance parameters were therefore necessary to describe Categories of Line, in addition to the line speed. Conventional lines are also described by the train length, axle load and gauge.

This will permit, in the long run, the creation of an interoperable European network for interoperable trains which offers appropriate performance levels for each operational sector (e.g. freight traffic on the strategic core network).

TSI Categories of Line are established according to ‘Type of Traffic’ and ‘Type of Line’, which determines the minimum level of the performance parameters.

The numbering scheme adopted combines the Type of Line (indicated by a Roman numeral) with the Type of Traffic (indicated by a capital letter). It continues on from the categorisation system for High Speed, with Type of Line IV to Type of Line VII.

Types of Line IV and V are ‘core lines’ of the TEN and Types of Line VI and VII are ‘other lines’ of the TEN. This distinction is important, as it gives the Member State a choice regarding the target subsystem for new or upgraded lines, and therefore the associated costs.

Types of Line IV and VI are new lines, and Types of Line V and VII are upgraded lines.

The Type of Traffic that the line is designed for is indicated by the letters P, F or M (for Passenger, Freight or Mixed Traffic).

*‘**(2)** The requirements to be met by the infrastructure subsystem are specified for each of the following TSI Categories of Line of the trans-European conventional rail system, as relevant. These categories of lines may be used for the classification of existing lines insofar the relevant performance parameters will be met in consistency with the national migration plan.’*

National migration strategies shall include plans of renewal activities and upgrading projects. For the purpose of those strategies, existing lines may be classified with Types of Line no less than V and VII, which give the minimum levels for line upgrading or renewal. However, it is permissible to adopt parameters for a higher TSI Category of Line in accordance with section 7.3.1 of the TSI.

Meeting requirements means that requirements for all Basic Parameters specified for an assumed TSI Category of Line are fulfilled, also with respect to Performance Parameters setting the limit values for some of the Basic Parameters.

*‘**(3)** Note that passenger hubs, freight hubs and connecting lines (listed in Annex 1 of the Directive) are included in the above TSI Categories of Line, as appropriate.’*

The requirements relating to the open line are also valid for the main tracks passing through passenger hubs, freight hubs and connecting lines. There are few requirements relating to other tracks for passenger hubs, freight hubs and connecting lines only.

Performance parameters (section 4.2.2)

*‘**(1)** The performance levels of the TSI Categories of Line defined in section 4.2.1 are characterised by following Performance Parameters:*

(a) gauge,

(b) axle load,

(c) line speed,

(d) train length.’

The performance parameters for new lines are more ambitious than those for upgraded lines, as higher performance can be achieved with a relatively small additional effort. For example, a new core TEN line for freight traffic (TSI Category of Line IV-F) is to be designed for a maximum axle load of 25 t, whilst an upgraded line only needs to be designed for 22.5 t, to minimise the requirement to rebuild existing structures, which might be costly.

Core TEN lines are intended to be those forming the strategic part of the trans-European conventional rail network, and therefore require higher performance parameters than other lines of the network.

It is permitted for performance parameters of two or more subsystems to be different. However in such cases, the most restrictive parameter of the relevant trackside subsystems will limit the overall performance.

For example, TSI Category of Line V-M with a line speed of 160 km/h will set the minimum performance for the other subsystems. However, the infrastructure subsystem may be designed and assessed for a speed of 200 km/h while the energy subsystem is still limited to 140 km/h. In this case, overall performance of the line remains at 140 km/h when electric traction is used.

*‘**(2)** The performance levels for each category of lines are set out in table 3 here-under.’*

New and upgraded lines of the TEN conventional rail system shall be designed to have at least the performance levels set out in Table 3. This means that parameters set out in Table 3 are the starting point for the INF subsystem design (the basis for deriving values for respective basic parameters).

Performance parameters are not intended to specify actual performance of railway traffic as the complete system.

*‘**(4)** It is permissible for specific locations on the line to be designed for line speed and/or train length less than those set out in Table 3, where duly justified to meet geographical, urban or environmental constraints.’*

The performance parameters are not to be considered as the basic parameters (as specified in section 4.2.3 of the TSI). However, the basic parameters are dependent on the performance parameters chosen for a given section of the line.

In cases where this clause (4) applies, the applicant should provide the reasons to justify the decision within the design submission. For example, where geographical constraints limit the radius of curvature and therefore dictate the need to restrict the line speed, the NoBo should only check whether the reason to justify the lower values of line speed have been provided and then assess whether the basic parameters are correctly applied to the chosen performance parameter.

2.3.2. Explanations about specific Basic Parameters

Requirements for Basic Parameters (section 4.2.3.2)

*'**(3)** The specifications for cant, rate of change of cant, cant deficiency, rate of change of cant deficiency and track twist are applicable to lines having a nominal track gauge of 1435 mm. For a line having another nominal track gauge, the limits on these parameters shall be established in proportion to the nominal distance between the rails.'*

The basic parameters in the TSI are defined on the basis of a nominal track gauge of 1435 mm. The expression of a number of basic parameters changes according to the nominal track gauge.

As an example, cant is conventionally expressed as the vertical difference in the level of the rails. The method of calculation is set out in EN 13848-1:2003, section 4.4.1, referred to as cross level. However, the underlying parameter is the angle of inclination of the plane of the rails. Therefore, for a given limiting angle, the equivalent vertical difference in level of the rails varies in proportion to the distance between the rails. The guidelines for calculations of different track gauges are set out in Annex C of prEN 13803-1.

*'**(4)** In case of multi-rail track, requirements of this TSI are to be applied separately to each pair of rails designed to be operated as separate track.'*

The assessment and verification need not be applied to all the tracks at the same time. Consequently, the EC declaration of verification may be issued separately for each track.

This would permit for example in a three-rail system one pair of rails to be assessed as one track and the option to reassess a track with the third rail at any time in the future or not to assess it at all.

Requirements for Basic Parameters (section 4.2.3.2)

***(6)** A short section of track with devices to allow transition between different nominal track gauges is permitted. The location and type of transitions shall be published in the Register of Infrastructure.*

Devices mentioned in this clause include equipment for: automatic change of wheelset gauge without stopping, exchange of wheelsets, exchange of bogies or any other method allowing transition.
The three-rail system is a particular case of a multi-rail track, where one rail is common for two track gauges.

Structure gauge (section 4.2.4.1)

*'**(2)** Calculations of the structure gauge shall be done using the kinematic method in accordance with the requirements of chapters 5, 7, 10 and the Annex C of EN 15273-3:2009.'*

The structure gauge used on a certain project is generally the same for other projects. Therefore it will be useful to have the calculations verified once. These verifications can be performed, based on EN 15273-3:2009. The conditions of use, such as the applied gauge (GA, GB, GC and others, e.g. national gauges), minimum radius, maximum cant and cant deficiency, track quality, etc., are to be mentioned in the calculation note. The resulting structure gauge profile that will be used for the verification of the obstacles should clearly mention these points, too.

In particular, the definition of a uniform gauge and its verification by the NoBo may be very useful in order to permit quick and efficient project verifications, thus avoiding a very time-consuming calculation for any location and any potential obstacle.

The definition and verification of an installation limit gauge can help in a similar way. Individual calculation for every obstacle will remain necessary, but the complexity of the calculations will be reduced compared to the full calculations.

Distance between track centres (section 4.2.4.2)

> *'**(2)** Where appropriate the minimum distance between track centres shall also take into account aerodynamic effects.'*

National rules apply because this is an open point for CR.

According to the HS INF TSI, applying a distance of at least 4 m at speeds of up to 200 km/h avoids the need to take specific account of aerodynamic effects.

If, because of any local constraint, it is not possible to achieve this distance, an IM may apply the aerodynamics standard EN 14067-4:2005 with a speed restriction to obtain the safe distance between track centres.

Determination of immediate action, intervention and alert limits (section 4.2.9.1)

> ***(1)** The Infrastructure Manager shall determine appropriate immediate action, intervention and alert limits for the following parameters:*
> *(a) …. (h) ….*

As the mean values are very close to zero, zero to peak values may be used instead of mean to peak values for the evaluation of the longitudinal level and lateral alignment.

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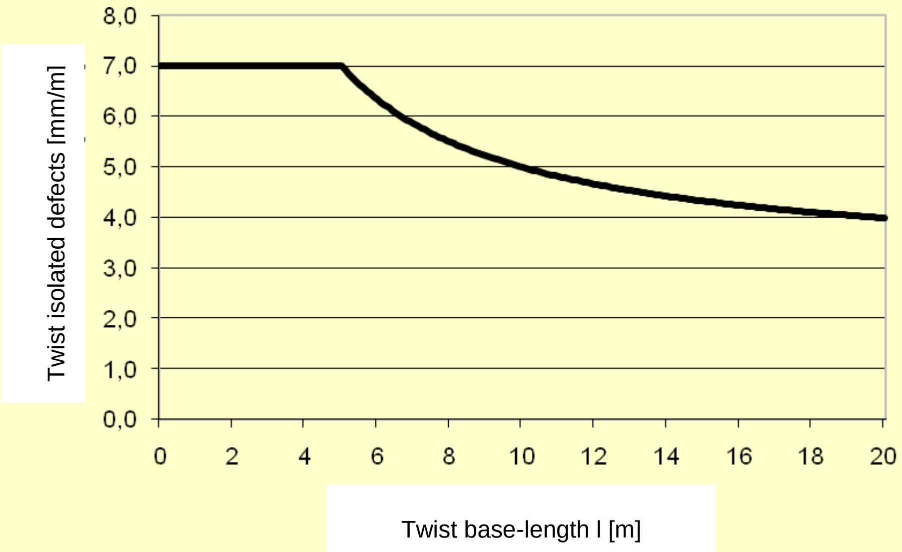
The immediate action limit for track twist (section 4.2.9.2)

***(2)** The track twist limit is a function of the measurement base applied (l) according to the formula:*

Limit twist = (20/l + 3)

where l is the measurement base (in m), with 1.3 m ≤ l ≤ 20 m,

with a maximum value of 7 mm/m.



The general case for track twist (clause (2) of section 4.2.9.2) is applicable to all curve radii having the cant D < (R-100)/2 and for all cants when the radius is more than 420 m.

For higher values of cant in small radius curves (clause (4) of section 4.2.9.2), the formula giving the limit value of 6 mm/m shall be used.

The formula for small radius curves differs from the formula published in ORE B55 RP 8 (where D > (R-50)/1,5).

Fixed installation for servicing trains (4.2.13)

4.2.13.1. GENERAL

(1) This section 4.2.13 sets out the infrastructure elements of the maintenance subsystem required for servicing trains.

(2) The location and type of fixed installations for servicing trains shall be published in the Register of Infrastructure.

Fixed installations for servicing trains are optional. The Member State decides which elements belong to the interoperable network.

Requirements are valid when installations exist and are included in the content of the line which is the subject of the EC verification procedure.

2.3.3. Explanations about Interoperability Constituents (ICs)

Clauses (1) and (2) of section 5.1 and clauses (1) and (3) of section 5.2 define precisely what elements of the track are understood as interoperability constituents of the infrastructure subsystem.

According to section 5.2 the following goods, among others, <u>are not considered</u> to be interoperability constituents:
a) steel sleepers (or any material which is not concrete or wood);
b) specific fastenings such as low restraint fastenings, high resilient fastenings, noise and vibration mitigation, etc.;
c) any elements specifically used only on non-ballasted track (slab track, track on bridges, track with embedded rail, etc.).

These elements are not classified as ICs in the TSI for one or more of the following reasons:
- there are no harmonised specifications for these elements;
- the elements are not commonly used or are used in specific locations and conditions only;
- the small volume of the production does not bring the benefits to the opening market;
- a large variety of technical solutions exists for these types of element.

Components which function like ICs, but which are excluded from list of ICs, shall be assessed at subsystem level (together with the subsystem).

The existing ICs which have been in use prior to publication of the TSI can be reused according to the conditions set out in section 6.6. of the TSI.

The rail fastening system (section 5.3.2)

‘**(2)** *The rail fastening system shall comply in laboratory test conditions with the following requirements:*

(a) the longitudinal force required to cause the rail to begin to slip (i.e. move in an inelastic way) through a single rail fastening assembly shall be at least 7kN,

(b) the rail fastening shall resist application of 3 000 000 cycles of the typical load applied in a sharp curve, such that the performance of the fastening in terms of clamping force and longitudinal restraint is not degraded by more than 20% and vertical stiffness is not degraded by more than 25%. The typical load shall be appropriate to:

i. the maximum axle load the rail fastening system is designed to accommodate,

ii. the combination of rail, rail inclination, rail pad and type of sleepers with which the fastening system may be used.’

<u>Tests on rail fastenings</u>

When the CH module is selected, quality control tests to confirm the performance of rail fastenings must be adapted to suit each proprietary rail fastening design. It is the responsibility of the organisation signing the declaration of conformity to be able to demonstrate that quality control procedures are in place which ensure that fastenings supplied have a performance consistent with the requirements set out in section 5.3.2 of the

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TSI, which are, by their nature, requirements which can only be demonstrated directly in type approval tests.

Longitudinal restraint

For the purposes of using the TSI and in associated ENs, the longitudinal restraint is defined as the minimum force required causing non-elastic slip of the rail through the fastening system. For general applications in plain line, this value should be at least 7kN. A method for determining this characteristic at the type approval testing stage is given in EN 13146-1. Caution should be taken when using some alternative methods which are based on the force required to cause gross slip of the rail. This force may be substantially higher than the force defined in these European documents, e.g. some rail fastening assemblies which comply with the typical North American requirement for 10.7kN ‘creep resistance’ (based on gross slip) may fail the European requirement for 7kN (based on the beginning of slip).

For some applications other values of longitudinal restraint may be appropriate. For high-speed and heavy axle load applications, a value of at least 9kN is required (see High Speed INF TSI and related ENs). For applications on some structures, it may be desirable to allow controlled slip of the rail in the vicinity of structural movement joints, and so special fastenings with reduced, or zero, longitudinal restraint may be required.

These are not ICs as they do not fulfil the requirements for longitudinal force – they may be used only according to section 5.2(3) of the TSI.

When a CH module is selected, for quality control it is necessary to ensure that the mean values of the relevant properties of the components supplied are always consistent with the properties measured in the type approval test. The details of such tests will depend on the proprietary design of the rail fastening system, but they must include control of the geometric features which define the clamping force, e.g. geometry of any spring steel rail clip, position of anchoring devices in the sleeper and thickness of rail pads and insulators.

Resistance to cyclic load.

The resistance to cyclic load is demonstrated in a type approval test in which a complete rail fastening assembly is subjected to an appropriate combination of vertical load and loading applied through a piece of rail. An acceptable test method is set out in EN 13146-4. With this standard, loading according to the ‘Main Line’ classification (2002 version of the standard EN 13481) or ‘Category C’ classification (proposed 2010 version) is relevant to European Conventional Rail applications. This method is consistent with the requirement for 20% permitted change in clamping force and longitudinal restraint, and 25% change in stiffness of low or medium-stiffness rail pads.

When the CH module is selected as in the paragraph ‘Tests of fastenings’, the quality control tests which are used must be adapted according to the details of the proprietary rail fastening system design, but it must be possible to demonstrate that these quality controlchecks ensure that the rail fastenings supplied are the same as the fastening subjected to the type approval test. This should include regular measurement of the critical dimensions of all of the rail fastening components and of the key mechanical and material properties. This may include subjecting samples of some elements such as spring steel clips to routine fatigue testing, but it is recognised that repeated load testing of complete rail fastening assemblies can only be carried out at the type approval stage.

Track sleepers (section 5.3.3)

(1) Track sleepers shall be designed such that when they are used with a specified rail and rail fastening system they will have properties that are consistent with the requirements of 4.2.5.1 for 'Nominal track gauge', section 4.2.5.5.2 for 'Requirements for controlling equivalent conicity in service (table 5: minimum values of mean track gauge)', section 4.2.5.7 for 'Rail inclination' and section 4.2.7 for 'Track resistance to applied loads'.

According to section 6.1.4.4 of the TSI, the EC declaration of conformity for track sleepers must include the statement setting out the combinations of rail, rail inclination and type of rail fastening system with which the sleeper may be used.
The applicant has to present, and the NoBo has to verify, whether construction and geometry of the sleeper allow for applying the declared elements of those combinations.

Additionally, the sleeper has to fulfil the requirements referred to in section 5.3.3 of the TSI:
a) in reference to section 4.2.5.1 – whether the sleeper is designed for 1435 mm nominal track gauge;
b) in reference to section 4.2.5.5.2 – whether geometrical parameters of the sleeper allow provision of the minimum mean gauge within the limits set out in Table 5 of the TSI (or otherrequirements notified by the Member State);
c) in reference to section 4.2.5.7 – whether the sleeper construction allows for keeping the rail inclination within the permitted range.

The conformity assessment in relation to the requirements of section 4.2.7 'Track resistance to applied loads' shall also be carried out for the scope of application declared by the manufacturer. This means that normally manufacturers declare the maximum axle load which may be applied to the sleeper or the maximum bending moment assumed in the sleeper – as the result of the maximum vertical force permitted. The resistance to longitudinal and transversal forces relates to the types of fastenings which are assumed to be installed on the sleepers – manufacturers have to guarantee resistance to actions exerted by fastenings.

2.3.4 Interfaces

[No comments]

2.4. Conformity assessment

2.4.1. Interoperability Constituents

The ICs 'rail' and 'rail fastening systems' which are checked against the HS INF TSI automatically fulfil the requirements of the CR INF TSI. The certificate of the ICs for HS INF TSI can be used for issuing the EC declaration of conformity and subsystem assessment – both according to the CR INF TSI. An extra certificate according to the CR INF TSI is not necessary if the conditions of use to be given in the EC declaration of conformity are no wider than those defined in the EC declaration of conformity for the IC as for the HS TSI. A statement with the information required according to sections 6.1.4.2 and 6.1.4.3 of the CR INF TSI has to be added to the EC declaration of conformity.

The IC track sleeper has different requirements for the HS INF TSI than for the CR INF TSI, so consequently separate assessments have to be carried out, leading to separate certificates (however, separate certificates may be issued as one single document).

2.4.2. Interoperability subsystems

Assessment of cant deficiency (section 6.2.4.3)

*'**(1)** (Section 4.2.5.4.1 states that 'It is permissible for trains specifically designed to travel with higher cant deficiency (multiple units with lower axle loads; trains equipped with a cant deficiency compensation system) to run with higher cant deficiency values, subject to a demonstration that this can be achieved safely'.'*

The IM can require tests for specific rolling stock equipment (such as multiple units with lower axle loads; trains equipped with a cant deficiency compensation system) based on calculations to demonstrate the safe operation of the line.

For gauging, verification has to be performed according to section 14 of EN 15273-3:2009. For testing, the acceptance of running characteristics prEN 15686:2009 can be used.

Assessment of design values for equivalent conicity (section 6.2.4.4)

*'**(1)** Assessment of design values for equivalent conicity is to be made using the results of calculations made by the Infrastructure Manager or the contracting entity on the basis of EN 15302:2008.'*

In chapter 6 the HS INF TSI gives three combinations of rail profile, rail inclination and track gauge which give presumption of conformity with the design requirements of equivalent conicity.

For the conventional rail system, similar calculations were carried out with a wider range of rail profiles, leading to a larger number of possible combinations. The track configurations fulfilling the TSI requirements for design equivalent conicity are presented as the table for different types of rail profiles, which is attached to this guide as Annex 2. This information concerns mostly applied track combinations for track gauges of 1435 mm, 1524 mm and 1668 mm.

Calculations were executed for a wide range of the most popular combinations of rail profile, rail inclination and track gauge. If none of the results of the calculations for a specific combination and for all modelled wheelsets (according to clause 4.2.5.5.1(2) of the TSI) exceeds the limit given in Table 4 of the TSI, the result is understood as positive.

The positive result of the calculations gives presumption of conformity to the TSI for the track configuration in question.

Assessment of geometry of switches and crossings (section 6.2.4.7)

*'**(1)** Assessment of switches and crossings at the design phase is required to verify that the design values used are consistent with the in-service limiting values set out in section 4.2.6.2.'*

Assessment of switches and crossings at the design phase can be made by using the geometric type design, without checking the individual switches and crossings.

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2.5. Implementation

Application of this TSI to new conventional rail lines (section 7.2)

*‘**(3)** For the purpose of this TSI a ‘New line’ means a line that creates a route where none currently exists.*

***(4)** The following situations, for example to increase speed or capacity, may be considered as the construction of an upgraded line rather than a new line:*

(a) the realignment of part of an existing route,

(b) the creation of a bypass,

the addition of one or more tracks on an existing route, regardless of the distance between the original tracks and the additional tracks.’

The Member State can determine whether a project is the construction of a new line or upgrading or renewal of an existing line. The TSI does not restrict or impose any requirements on the Member State when making this decision, but the TSI establishes the provisions once the decision has been made.

The distinction between new and upgraded lines looks obvious at first sight. However, a parallel line between two existing stations can be seen either as a new line or as an upgrading of an existing line, for example. Also, if there is no change in the performance parameters vis-à-vis those of the existing line, it can even be seen as a renewal, even if the line is partly lying in a completely new alignment.

Upgrading of a line (section 7.3.1)

***(1)** In accordance with Directive 2008/57/EC, Article 2 (m), ‘upgrading’ means any major modification work on a subsystem or part of a subsystem which improves the overall performance of the subsystem.*

This clause gives the general definition set out in the Directive. The meaning of upgrading for the purpose of the CR INF TSI is given in clause 7.3.1(2). The meaning for the INF subsystem and for rules given in INF TSI is more specific, but still inside the definition given in the Directive.

*‘**(2)** The infrastructure subsystem of a line is considered to be upgraded when at least the performance parameters axle load and gauge as defined in section 4.2.2 are met.’*

In this respect, the classification of the TEN according to the TSI Categories of Line is very important. When the extent of works requires the application of the TSI on a line, at least the Performance Parameters, both for axle load and gauge, according to the line classification, have ultimately to be met. If one of these two parameters is already fulfilled by the existing line, it is only necessary to carry out a project to enhance the other parameter.

Requirements for a Performance Parameter are met when all Basic Parameters relating to this Performance Parameter are within the requirements of the TSI.

In order to authorise the placing into service where it is not possible to meet these Performance Parameters, a respective derogation is required.

> ***(2.2)*** *Upgrading of existing Other TEN lines shall be in accordance with the requirements of TSI Category of Line VII-P, VII-F or VII-M. (An upgrade to the requirements of Type of Line VI is permissible.)*

Sub-clause (2.2) does not prevent the application of performance levels of Type of Line IV or Type of Line V for the upgrade of existing Other TEN Lines in accordance with clause 4.2.2(3).

> ***(2.3)*** *For other TSI parameters, according to article 20.1 of the Directive 2008/57, the Member State decide to what extent the TSI need to be applied to the project.*

In the case of Basic Parameters relating to Performance Parameters other than axle load and gauge, the Member State will decide the level of fulfilment of the TSI.

> *(3) Where article 20.2 of the Directive 2008/57/EC applies because the upgrading is subject of an authorisation of placing into service, the Member State decides which requirements of the TSI must be applied taking into account the migration strategy referred to in section 7.1.*

This paragraph applies to any upgrading works (not only those where axle load and gauge performance parameters are met).

Existing lines that are not subject to a renewal or upgrading project (section 7.3.4)

> *'(1) An existing subsystem may allow the circulation of TSI-conform vehicles whist meeting the essential requirements of Directive 2008/57/EC. The infrastructure manager should be able in this case, on a voluntary basis, to complete the Register of Infrastructure set out in Article 35 of Directive 2008/57 in accordance with Annex D of this TSI.*
>
> *(2) The procedure to be used for the demonstration of the level of compliance with the basic parameters of the TSI shall be defined in the specification of the Infrastructure Register to be adopted by the Commission in accordance with that Article.'*

The Directive does not provide for the procedure of EC verification of an existing line without a renewal or upgrading project. Nevertheless, the performance parameters and values of relevant basic parameters of an existing line may be published in the Register of Infrastructure.

The process to demonstrate compliance with the requirements of the TSI to fulfil essential requirements of interoperability will be described in the specification of Register of Infrastructure. Generally speaking, this process will be used on voluntary basis when the subsystem of a line has not been verified by the procedure required for issuing an EC declaration of verification.

Compatibility of infrastructure and rolling stock (section 7.5)

*'**(2)** The design of the TSI Categories of Line as defined in chapter 4 is generally compatible with the operation of vehicles categorised in accordance with EN 15528:2008 at up to the maximum speed as shown in Annex E. However there may be a risk of excessive dynamic effects including resonance in certain bridges which may further impact the compatibility of vehicles and infrastructure.'*

There are no harmonised tools for analysing dynamic effects due to a lack of appropriate load models in EN 1991-2:2003. Any national rule can be used to deal with this subject.

*'**(3)** Checks, based on specific operational scenarios agreed between the Infrastructure Manager and the Railway Undertaking, may be undertaken to demonstrate the compatibility of vehicles operating above the maximum speed shown in Annex E.'*

When evaluating the compatibility between a given line and a particular type of rolling stock, the mass of the rolling stock used will take account of the actual maximum operational load condition, defined by the Railway Undertaking (RU), appropriate to the intended service and operational controls. Operational measures, such as seat booking systems, may cause the maximum operational load of the rolling stock to be lower than the design mass under exceptional payload. As a result, the rolling stock may fall into a lower EN Line Category, with the potential benefit of greater compatibility with the infrastructure.

In this clause, 'vehicle' is understood in terms of the Directive.

2.6. Some practical cases

[To be completed after return of experience.]

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3. APPLICABLE SPECIFICATIONS AND STANDARDS

3.1. Explanation of the use of the standards

The pre-standard prEN13848-5: 2005 'Track geometry quality – Part 5: Geometric quality assessment' is excluded from the set of standards referred to in the Application Guide as its scope of application is different to the scope of the TSI – requirements for the Trans-European Network are higher than for all railway systems described in the prEN.

As currently any standard (including this one) may be applied for subsystem assessment, it is necessary to underline that the application of the values listed in prEN 13848-5:2005 for setting limits according to section 4.2.9 of the CR INF TSI is directly against the intention of the authors of this TSI.

3.2. List of applicable standards

The list of standards recommended as relevant for subsystem conformity assessment is set out in Annex 1.

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4. LIST OF ANNEXES

1. Applicable standards and other documents

1.1. Standards referred to in the TSI, and therefore mandatory

1.2. Voluntary standards that give presumption of conformity

2. Track element configurations which fit requirements for the track design against equivalent conicity

ANNEX 1

Applicable standards

1.1. Standards referred to in the TSI, and therefore mandatory

All standards referred to in the text of CR INF TSI are listed in Table 26 'List of referenced standards', which is attached as Annex H to this TSI.

1.2. Voluntary standards that give presumption of conformity

The tables below contain the set of European standards relevant for conformity assessment of basic parameters against the respective TSI requirements. This table has been prepared in cooperation with the European Committee for Standardization (CEN).

Table 2: CEN Standards relevant for conformity assessments

No	Section of CR INF TSI	Recommended standard	Comments
1	4.2.4.1 Minimum structure gauge	EN 15273 –1:2009, Railway applications – Gauges – Part 1: General – Common rules for infrastructure and rolling stock	
		EN 15273 –1:2009, Railway applications – Gauges – Part 3: Structure gauges	
2	4.2.4.2 Distance between track centres	EN 15273 –1:2009, Railway applications – Gauges – Part 3: Structure gauges	The influence of aerodynamic effects is the open point
3	4.2.4.4 Minimum radius of horizontal curve	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	With Amendment A1:2009

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4	4.2.4.5 Minimum radius of vertical curves	prEN 13803-1:June 2007, Railway applications – Track - Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	With Amendment A1:2009
5	4.2.5.1 Nominal track gauge	EN 13848-1:2003, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry	With Amendment A1:2008
6	4.2.5.2 Cant	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	With Amendment A1:2009
		EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
7	4.2.5.4.1 Cant deficiency on plain track and on the through route of switches and crossings	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track	With Amendment A1:2009

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		alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	
		EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
8	4.2.5.4.2 Abrupt change of cant deficiency on diverging track of switches	EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
9	4.2.5.5.2 Minimum value of mean track gauge	EN 13848-1:2003, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry	With Amendment A1:2008
10	4.2.9 Track geometrical quality and limits on isolated defects	EN 13848-1:2003, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry	With Amendment A1:2008
11	4.2.6.1 Means of locking	EN 13232-4: 2005, Railway applications – Track – Switches and crossings – Part 4: Actuation, locking and detection	
12	4.2.6.2 In service geometry of switches and crossings	EN 13232-2:2003, Railway applications – Track – Switches and crossings – Part 2: Requirements for geometric design	
		EN 13232-5:2005, Railway applications – Track – Switches and crossings – Part 5: Switches	
		EN 13232-9:2006, Railway applications – Track – Switches and crossings – Part 9: Layouts	
		EN 15273 –3:2009, Railway applications – Gauges – Part 3:	

		Structure gauges	
13	4.2.6.3 Maximum unguided length of fixed obtuse crossings	EN 13232-9:2006, Railway applications – Track – Switches and crossings – Part 9: Layouts	
		EN13232-6:2005, Railway applications – Track – Switches and crossings – Part 6: Fixed common and obtuse crossings	
		EN 13232-8: 2007, Railway applications – Track – Switches and crossings – Part 8: Expansion devices	
14	4.2.7.1 Track resistance to vertical loads	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
15	4.2.7.2 Longitudinal track resistance	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
16	4.2.7.3 Lateral track resistance	prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track alignment design parameters –	With Amendment A1:2009

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		Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	
		EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
17	4.2.8.4 Resistance of existing bridges and earthworks to traffic loads	EN 14363: 2005 – Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests	
18	4.2.11.1 Maximum pressure variations in tunnels	EN14067-4:2005, Railway applications – Aerodynamics – Part 4: Requirements and test procedures for aerodynamics on open track	With Amendment A1:2009
		EN14067-5:2006, Railway applications – Aerodynamics – Part 5: Requirements and test procedures for aerodynamics in tunnel	
19	4.2.11.5 Effect of crosswinds	EN 14067-6: 2010, Railway applications – Aerodynamics – Part 6: Requirements and test procedures for cross wind assessment	Effect of crosswinds is open point
20	4.4.3 Protection of workers against aerodynamic effects	EN14067-4:2005, Railway applications – Aerodynamics – Part 4: Requirements and test procedures for aerodynamics on open track	
21	4.5 Maintenance plan	EN 13848-1:2003, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry	
		EN 13232-9:2006, Railway applications – Track – Switches and crossings – Part 9: Layouts	

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		prEN 13803-1:June 2007, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line	
		EN 13803-2:2006, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 2: Switches and crossings and comparable alignment design situations with abrupt changes of curvature.	With Amendment A1:2009
22	5.3.1 The rail	EN 13674-1:2003, Railway applications –Track– Rail – Part 1 : Vignole railway rails 46 kg/m and above	With Amendment A1:2007
		EN 13674-2: 2006, Railway applications – Track– Rail – Part 2 : Switch and crossing rail used in conjunction with Vignole railway rails 46 kg/m and above	
23	5.3.2 The rail fastening system	EN 13481-2:2002, Railway applications – Track – Performance requirements for fastening systems – Part 2: Fastening systems for concrete sleeper	With Amendment A1:2006
		EN 13481-3: 2002, Railway applications – Track – Performance requirements for fastening systems – Part 3: Fastening for wood sleeper	With Amendment A1:2006
		EN 13481-8:2006, Railway applications – Track – Performance requirements for fastening systems – Part 8: Fastening systems for track with heavy axle load	
		EN 13146-1:2002, Railway applications – Track – Test methods for fastening systems – Part 1: Determination of longitudinal rail restraint	

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		EN 13146-4:2002, Railway applications – Track – Test methods for fastening systems – Part 4: Effect of repeated loads	With Amendment A1:2006
		EN 13146-7:2002, Railway applications – Track – Test methods for fastening systems – Part 7: Determination of clamping force	
		EN 13146-8:2002, Railway applications – Track – Test methods for fastening systems – Part 8: In service tests	With Amendment A1:2006
		EN 13146-9:2009, Railway applications – Track – Test methods for fastening systems – Part 9: Determination of stiffness	
24	5.3.3 Track sleepers	EN 13230-1:2009, Railway applications – Track – Concrete sleepers and bearers – Part 1: General requirements	
		EN 13230-2:2009, Railway applications – Track – Concrete sleepers and bearers – Part 2; Prestressed monobloc sleepers	
		EN 13230-3:2009, Railway applications – Track – Concrete sleepers and bearers – Part 3: Twin-block reinforced sleepers	
		EN 13145: 2001, Railway applications – Track – Wood sleepers and bearers	

ANNEX 2

Track element configurations which fit requirements for the track design against equivalent conicity

Table 6 shows rail profiles in configuration with track gauges and rail inclinations that fulfil the requirements of the CR INF TSI against design equivalent conicity. These track configurations are those mostly applied in Europe.

The assumptions and some other details for the calculations are included. Calculations were made for equivalent conicity at y = 3 mm.

To assess whether the results of calculations were within the permitted limit, the following limit values were assumed: **0.25** for calculations with S1002 and with GV1/40; **0.30** for calculations with EPS.

Table 3: Track configurations verified against equivalent conicity

Rail head profiles in configuration with track gauges and rail inclinations that fulfil requirements of the CR INF TSI against design equivalent conicity		
Rail	Track gauge [mm]	Relevant rail inclinations
(1)	(2)	(3)
46 E1	1435	1:20
46 E3	1435	1:20, 1:30, 1:40
49 E1	1435	1:20, 1:30, 1:40
49 E5	1435	1:20, 1:30, 1:40
50 E3	1435	1:20, 1:30, 1:40
50 E6	1435	1:20
54 E1	1435	1:20, 1:30, 1:40
	1524	1:20, 1:30, 1:40
	1668	1:20, 1:30, 1:40
54 E2	1435	1:20, 1:30, 1:40
54 E3	1435	1:20, 1:30, 1:40
54 E4	1435	1:20, 1:30, 1:40
56 E1	1435	1:20, 1:30, 1:40
60 E1	1435	1:20, 1:30, 1:40
	1524	1:20, 1:30, 1:40
	1668	1:20, 1:30, 1:40
60 E2	1435	1:20, 1:30, 1:40

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