

**European Railway Agency**

**Guide for the application of the INF TSI**

**According to Framework Mandate C(2010)2576 final of  
29/04/2010**

<b>Reference in ERA:</b>	ERA/GUI/07-2011/INT
<b>Version in ERA:</b>	2.00
<b>Date:</b>	16 October 2014

<b>Document elaborated by</b>	European Railway Agency Rue Marc Lefrancq, 120 BP 20392 F-59307 Valenciennes Cedex France
<b>Document Type:</b>	Guide
<b>Document Status:</b>	Public

## 0. DOCUMENT INFORMATION

### 0.1. Amendment record

*Table 1: Status of the document*

Version Date	Author(s)	Section number	Modification description
Guide Version 1.00 26 Aug 2011	ERA IU	All	First publication
Guide Version 2.00 16 Oct 2014	ERA IU	All	Second publication following the revision of the (existing) INF TSIs in force (merged and extended scope)

## 0.2. Table of contents

<b>0. DOCUMENT INFORMATION</b> .....	<b>2</b>
0.1. Amendment record .....	2
0.2. Table of contents.....	3
0.3. List of tables .....	4
<b>1. SCOPE OF THIS GUIDE</b> .....	<b>5</b>
1.1. Scope.....	5
1.2. Content of the guide .....	5
1.3. Reference documents.....	5
1.4. Definitions, abbreviations and acronyms .....	5
<b>2. CLARIFICATIONS ON THE INF TSI</b> .....	<b>7</b>
2.1. Introduction (Section 1).....	7
<i>Geographical scope (Point 1.2)</i> .....	7
<i>Content of this TSI (Point 1.3)</i> .....	8
2.2. Definition and scope of subsystem (Section 2).....	8
2.3. Essential requirements (Section 3).....	10
2.4. Description of the Infrastructure subsystem (Section 4) .....	11
<i>Introduction (Point 4.1)</i> .....	11
<i>TSI Categories of Line (Point 4.2.1)</i> .....	11
<i>Requirements for Basic Parameters (Point 4.2.2.2)</i> .....	16
<i>Structure gauge (Point 4.2.3.1)</i> .....	17
<i>Distance between track centres (Point 4.2.3.2)</i> .....	18
<i>Minimum radius of horizontal curve (Point 4.2.3.4)</i> .....	18
<i>Cant deficiency (Point 4.2.4.3)</i> .....	18
<i>Equivalent conicity (Point 4.2.4.5)</i> .....	19
<i>Rail inclination (Point 4.2.4.7)</i> .....	19
<i>Track resistance to applied loads (Point 4.2.6)</i> .....	20
<i>Allowance for dynamic effects of vertical loads (Point 4.2.7.1.2)</i> .....	21
<i>Immediate action limits on track geometry defects (Point 4.2.8)</i> .....	21
<i>Platforms (Point 4.2.9)</i> .....	22
<i>Platform height (Point 4.2.9.2)</i> .....	22
<i>Platform offset (4.2.9.3)</i> .....	23
<i>Maximum pressure variations in tunnels (Point 4.2.10.1)</i> .....	23
<i>Equivalent conicity in service (Point 4.2.11.2)</i> .....	24
<i>Fixed installation for servicing trains (Point 4.2.12)</i> .....	25
<i>Operating rules (Point 4.4)</i> .....	26
2.5. Interoperability Constituents (Section 5) .....	26
<i>The rail fastening system (Point 5.3.2)</i> .....	26
<i>Track sleepers (Point 5.3.3)</i> .....	28
2.6. Assessment of Conformity of Interoperability Constituents and EC Verification of the Subsystems (Section 6).....	30

Assessment of sleepers (Point 6.1.5.2).....	30
Assessment of structure gauge (6.2.4.1) .....	30
<i>For the assessment of the structure gauge after assembly before putting into service, it is expected that the specific assessment procedures usually defined by the applicant will be considered.....</i>	30
Assessment of distance between track centres (6.2.4.2) .....	30
<i>For the assessment of the distance between track centres after assembly before putting into service, it is expected that the specific assessment procedures usually defined by the applicant will be considered.....</i>	30
Assessment of track layout (Point 6.2.4.4).....	30
Assessment of cant deficiency for trains designed to travel with higher cant deficiency (Point 6.2.4.5) .....	31
Assessment of design values for equivalent conicity (Point 6.2.4.6).....	31
Assessment of existing structures (Point 6.2.4.10).....	31
Assessment of platform offset (Point 6.2.4.11) .....	32
Assessment of maximum pressure variations in tunnels (Point 6.2.4.12) .....	32
Assessment of track resistance for plain line (Point 6.2.5.1) .....	32
Subsystems containing Interoperability constituents not holding an EC declaration (Point 6.5) .....	34
Subsystem containing serviceable interoperability constituents that are suitable for reuse (Point 6.6) .....	34
<b>2.7. Implementation of the Infrastructure TSI (Section 7).....</b>	<b>36</b>
Application of this TSI to new railway lines (Point 7.2) .....	36
Upgrading of a line (Point 7.3.1).....	36
Substitution in the framework of maintenance (Point 7.3.3) .....	37
Existing lines that are not subject to a renewal or upgrading project (Point 7.3.4).....	37
Ascertain compatibility of infrastructure and rolling stock after authorization of rolling stock (Point 7.6).....	38
Technical characteristics of switches and crossings design (Appendix C.2).....	38
<b>2.8. Glossary (Appendix S).....</b>	<b>39</b>
<b>2.9. Safety assurance over fixed obtuse crossings (Appendix J) .....</b>	<b>40</b>
<b>3. LIST OF APPENDICES .....</b>	<b>41</b>

### 0.3. List of tables

Table 1: Status of the document .....	2
Table 2: Rail inclination for plain line and switches and crossings.....	20
Table 3: EC verification of the infrastructure subsystem containing serviceable interoperability constituents that are suitable for reuse .....	34
Table 4: CEN Standards relevant for conformity assessments.....	42
Table 5: Track configurations that fulfil the requirement of point 4.2.4.5 "Equivalent Conicity" (Assessed with S1002 & GV 1/40).....	50

## 1. SCOPE OF THIS GUIDE

### 1.1. Scope

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 'Infrastructure' subsystem adopted by Commission Regulation EU/1299/2014 of 18 November 2014 ('INF TSI').

The guide should be read and used only in conjunction with the 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

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

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

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

Guidance is given by means of further explanatory text and, where relevant, by reference to standards that demonstrate compliance with the INF TSI.

List of standards relevant to INF TSI is enclosed in Appendix 1 of this document.

Where reference is made, within this guide, to "*existing TSI(s)*", it is meant to refer to either HS INF TSI or to CR INF TSI, or to both.

The application of the relevant standards listed in Appendix 1 – Point 1.2 is not meant to be mandatory. In some cases, harmonised standards that cover the basic parameters of the TSIs provide presumption of conformity with certain clauses of the TSIs. In accordance with the spirit of the new approach to technical harmonisation and standardisation, application of these standards remains voluntary but their references are published on the Official Journal of the European Union (OJEU). These specifications are listed in the TSI application guide in order to facilitate their use by the industry. These specifications remain complementary to TSIs.

### 1.3. Reference documents

Reference documents are listed in the general part of the 'Guide for the application of TSIs'.

### 1.4. Definitions, abbreviations and acronyms

Definitions and abbreviations are given in the general part of the 'Guide for the application of TSIs'. Here below a list of acronyms used in this document:

---

CEN	European Committee for Standardization
CR INF TSI	Conventional Railway INF TSI
ERA	European Railway Agency
EU	European Union
HS INF TSI	High speed infrastructure TSI
HS RST TSI	High speed Rolling Stock TSI
HSLM	High Speed Load Model
IAL	Immediate Action Limits
IC	Interoperability Constituents
IM	Infrastructure Manager
INF TSI	Infrastructure TSI
MS	Member State
NoBo	Notified Body
PRM TSI	Person with Reduced Mobility TSI
QC	Quality Control
RU	Railway Undertaking
SRT TSI	Safety in Railway Tunnel TSI
TEN	Trans European Network
TSI	Technical Specification for Interoperability

## 2. CLARIFICATIONS ON THE INF TSI

### General remarks

For all the requirements whose mandatory scope of application are new lines, it is understood that these requirements are optional (target parameters) for upgrade or renewal of existing lines. It is expected that, while preparing the project of upgrade/renewal of the existing line, the fulfilment of the target parameters will be considered, when technically and economically possible.

### 2.1. Introduction (Section 1)

#### **Geographical scope (Point 1.2)**

*The geographical scope of this TSI is defined in Article 2(4) of this Regulation.*

Article 2(4) of the Commission Regulation 1299/2014 on the 'Infrastructure' Subsystem (INF TSI) quotes:

*The TSI shall apply to the following networks:*

- (a) the trans-European conventional rail system network as defined in Annex I, point 1.1 of Directive 2008/57/EC;*
- (b) the trans-European high-speed rail system network (TEN) as defined in Annex I, point 2.1 of Directive 2008/57/EC;*
- (c) other parts of the network of the whole rail system;*

*and excludes the cases referred to in Article 1(3) of Directive 2008/57/EC.*

The field of application of INF TSI has been extended to the whole European Union rail system, according to Article 1 point 4 of Directive 2008/57/EC, ..... *including track access to terminals and main port facilities serving or potentially serving more than one user.....*

The only railway infrastructures that are excluded from the application of INF TSI are the cases referred to in Article 1(3) of Directive 2008/57/EC, such as:

- i. metros, trams and other light rail systems;*
- ii. networks that are functionally separated from the rest of the railway system and intended only for the operation of local, urban or suburban passenger services, as well as railway undertakings operating solely on these networks;*
- iii. privately owned railway infrastructure and vehicles exclusively used on such infrastructure that exist solely for use by the owner for its own freight operations;*
- iv. infrastructure and vehicles reserved for a strictly local, historical or touristic use.*

### Content of this TSI (Point 1.3)

*(2) Requirements in this TSI are valid for all track gauge systems within the scope of this TSI, unless a paragraph refers to specific track gauge systems or to specific nominal track gauges.*

The concept of track gauge system has been entered in order to give rise to technical harmonization within rail systems with the same nominal track gauge (i.e.: 1668 mm, which is shared between Spain and Portugal; 1600 mm, shared between Ireland and United Kingdom; 1524 mm, shared among Finland, Sweden and Estonia; 1520 mm, shared among Estonia, Latvia, Lithuania, Poland and Slovakia; together with 1435 mm, which is regarded as the European standard nominal track gauge).

Requirements stated in the TSI have to be applied according to the following priority order:

1. General requirements in chapter 4 will be fulfilled unless covered by a specific requirement of the track gauge system concerned (chapter 4), or a specific case of the MS concerned (point 7.7). For most of the parameters listed in the INF TSI, in general, requirements are valid for all track gauge systems.
2. Specific requirements for the relevant track gauge system (chapter 4) will be fulfilled unless covered by a specific case of the MS concerned (point 7.7).

All specific requirements referring to a specific track gauge system or a specific nominal track gauge contain the following wordings at the beginning: *"for the XXXX track gauge system..."*, *"instead of point (x), for the XXXX track gauge system"* and *"instead of point (x), for the nominal track gauge of XXX..."*.

An example for a Basic Parameter valid for all track gauge systems is "Track resistance to vertical loads" (Point 4.2.6.1): there is no paragraph within the Point referring to specific track gauge systems.

An example for a Basic Parameter that has different requirements for different track gauge systems is "Structure Gauge" (Point 4.2.3.1): paragraphs (4) and (5) of the Point replace, for the 1520 mm and 1600 track gauge system, respectively, the requirements set by paragraphs (1) to (3) of the same basic parameter.

## 2.2. Definition and scope of subsystem (Section 2)

### **2.3 Interfaces of this TSI with the Persons with Reduced Mobility TSI**

*All requirements relating to the infrastructure subsystem for the access of persons with reduced mobility to the railway system are set out in the Persons with Reduced Mobility TSI.*

### **2.4 Interfaces of this TSI with the Safety in Railway Tunnels TSI**

*All requirements relating to the infrastructure subsystem for safety in railway tunnels are set out in the Safety in Railway Tunnels TSI.*

PRM and SRT TSIs bring additional requirements to the Infrastructure subsystem in addition to those given by the INF TSI itself. Therefore, the verification of the subsystem against INF TSI does not include requirements of those TSIs.



---

The Infrastructure subsystem has to be assessed against the PRM and/or SRT TSIs when relevant.

## 2.3. Essential requirements (Section 3)

The Directive 2008/57/CE states essential requirements relating to health, safety, reliability, availability, environmental protection, technical compatibility and accessibility. Table 1 of the INF TSI lists the basic parameters of the infrastructure subsystem which are considered to correspond to these requirements.

## 2.4. Description of the Infrastructure subsystem (Section 4)

### Introduction (Point 4.1)

*(2) The limiting values set out in this 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 purpose of the INF TSI is not to be considered as a design guide.

Design and construction of a railway infrastructure should be based on standards, good practices values, etc.

These values shall be within the limits of TSI requirements.

*(5) Where reference is made to EN standards, any variations called ‘national deviations’ in the EN do not apply, unless otherwise specified in this TSI.*

It is not permitted to apply “national deviations” to an EN standard, unless it is specified in TSI. The concept of “National Deviation” means any modification of, addition to or deletion from, the content of an EN, made in a national standard within the same scope as the EN.

The concept of “National Annex” is different from that of National Deviations: A National Annex may contain only allowed choices for defined “Nationally Determined Parameters (NDP)” and information provided for easier implementation (“Non contradictory Complementary Information (NCCI)”). A National Annex shall not alter any provision of the European Standard except the allowed choices for the “Nationally Determined Parameters (NDP)”.

### TSI Categories of Line (Point 4.2.1)

*(1) Annex I to Directive 2008/57/EC recognises that the Union rail network may be subdivided into different categories for the Trans-European conventional rail network (point 1.1), the Trans-European high-speed rail network (point 2.1) and the extension of the scope (point 4.1). In order to deliver interoperability cost-effectively this TSI defines performance levels for ‘TSI categories of line’.*

The new traffic codes defined in the INF TSI are consistent with the categories of line defined in the former HS and CR INF TSI. In other words, for existing lines classified according to the former categories of line (I, II, IV-P, IV-F, IV-M, etc.), there is at least one traffic code or combination of traffic codes possible (P1, P3, P3/F2, etc.).

With the regulation 1315/2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, the development of the Trans – European transport network shall be based on a “dual layer” structure:

1. **The comprehensive network**, consisting of all existing and planned transport infrastructure of Trans – European transport network.
2. **The core network**, consisting of all those existing and planned transport infrastructure of the Comprehensive Network that are of the highest strategic importance for the development of the Trans – European transport network.

The Regulation defines some technical requirements to be met for the infrastructure of lines on the Core and Comprehensive Network (nominal track gauge, speed, axle load, train length).

If the line is part of the TEN Network, when choosing the traffic code (or combination of traffic codes) from table 2 and table 3, it is necessary to take into account the requirements set out by the Regulation 1315/2013 to make sure that the performance parameters comply with the aforesaid Regulation as well as with the requirements of the INF TSI.

The off-TEN network does not fall under Regulation 1315/2013.

*(3) The TSI category of line shall be a combination of traffic codes. For lines where only one type of traffic is carried (for example a freight only line), a single code can be used to describe the requirements; where mixed traffic runs the category will be described by one or more codes for passenger and freight. The combined traffic codes describe the envelope within which the desired mix of traffic can be accommodated.*

When building the concept of the new INF TSI categories of line, the following rules have been applied:

- no differentiation between High Speed and Conventional Railway lines;
- no distinction between lines of TEN and Off-TEN network;
- classification now includes the type of traffic and the value of performance parameter (e.g. 'P4');
- no distinction between "new" and "upgraded" lines;
- performance parameters as set out in the CR INF TSI are suitable;
- no need to consider 'density of traffic' as this is not related to interoperability.

After analysis of typical traffic modes in Europe, several types of traffic codes were selected, for Passenger traffic and for Freight traffic. Each TSI category of line can be created using multiple traffic codes given in Table 2 and 3 in any combination. This provides a flexible categorization to reflect actual traffic needs.

Example.

If a new line is intended to be operated by passenger trains with speed of 250 km/h, local commuter trains with speed of 120 km/h and heavy freight trains in the night, then the best combination of traffic codes seems to be P2, P5 and F1.

Then, the TSI category of line for this case would simply be P2-P5-F1.

The line shall then have to be designed in order to fulfil the envelope of performance parameters for this category:

- Gauge: GC (from F1)

- Axle load: 22,5 t (from F1)
- Line speed: 200 - 250 km/h (from P2)
- Usable length of platform: 200 – 400 m (from P2)
- Train length: 740 – 1050 m (from F1)

However, if any part of the subsystem is intended to be used only by trains relating to one of the traffic code, then performance parameters for this part shall relate to the specific traffic code.

*(4) For the purpose of TSI categorisation, lines are classified generically based on the type of traffic (traffic code) characterised by the following performance parameters:*

- gauge,
- axle load,
- line speed,
- train length
- usable length of platform.

*The columns for 'gauge' and 'axle load' shall be treated as minimum requirements as they directly control the trains that may run. The columns for 'line speed', 'usable length of platform' and 'train length' are indicative of the range of values that are typically applied for different traffic types and they do not directly impose restrictions on the traffic that may run over the line.*

*(7) The performance levels for types of traffic are set out in Table 2 and Table 3 here-under.*

**Table 2**

**Performance parameters for passenger traffic**

Traffic code	Gauge	Axle load [t]	Line speed [km/h]	Usable length of platform [m]
P1	GC	17(*)	250-350	400
P2	GB	20(*)	200-250	200-400
P3	DE3	22.5(**)	120-200	200-400
P4	GB	22.5(**)	120-200	200-400
P5	GA	20(**)	80-120	50-200
P6	G1	12(**)	n.a.	n.a.
P1520	S	22.5(**)	80-160	35-400
P1600	IRL1	22.5(**)	80-160	75-240

(\*) Axle load is based on design mass in working order for power heads (and for P2 locomotives) and operational mass under normal payload for vehicles capable of carrying a payload of passengers or luggage as defined in section 2.1 of EN 15663:2009+AC:2010. The corresponding \*\* axle load values for vehicles capable of carrying a payload for passengers or luggage are 21,5t for P1 and 22,5t for P2 as defined in Annex K to this TSI.

(\*\*) Axle load is based on design mass in working order for power heads and locomotives as defined in section 2.1 of EN 15663:2009+AC:2010 and design mass under exceptional payload for other vehicles as defined in Annex K to this TSI.

**Table 3**

**Performance parameters for freight traffic**

Traffic code	Gauge	Axle load [t]	Line speed [km/h]	Train length [m]
F1	GC	22.5(*)	100-120	740-1050
F2	GB	22.5(*)	100-120	600-1050
F3	GA	20(*)	60-100	500-1050
F4	G1	18(*)	n.a.	n.a.
F1520	S	25(*)	50-120	1050
F1600	IRL1	22.5(*)	50-100	150-450

(\*) Axle load is based on design mass in working order for power heads and locomotives as defined in section 2.1 of EN 15663:2009+AC:2010 and design mass under exceptional payload for other vehicles as defined in Annex K to this TSI.

The performance parameters “gauge” and “axle load” are considered as “Hard” parameters; it means that it is mandatory to provide at least their precise value. This is the reason why in Table 2 and 3 they are specified as single values.

The performance parameters “line speed”, “usable length of platform” and “train length” are considered as “Soft” parameters; that means that values of these parameters for specific line may be selected from the range/value given in Table 2 and 3. This selection should be made at the beginning of the project.

Some considerations on note “\*” of Table 2:

Trains with axle loads according to the definition under \* and complying to the validity limits of HSLM in Annex E of EN 1991-2:2003/AC:2010 are covered by HSLM defined in 4.2.7.1.2 (2), which is used for dynamic checks of new bridges. The mass definition "operational mass under normal payload" covers the former mass definition for “Class 1” trains, according to the HS RST TSI (Decision 2008/232/CE) in this case.

With this, the dynamic effects of trains:

- being within the limits of validity of HSLM (Annex E of EN 1991-2:2003/AC:2010) and
- in which no standing passengers are tolerated or allowed

are covered in the design of new bridges.

If trains

- have a maximum axle load higher than the \* value of table 2 or
- are outside the limits of validity of HSLM (Annex E of EN 1991-2:2003/AC:2010)

these “Real Trains” or appropriate dynamic load models have to be used for dynamic calculations according to 4.2.7.1.2 (3) and 7.6 to ensure dynamic compatibility of the train and the bridge. In this case the mass definition “design mass under normal payload” according to Appendix K INF TSI shall be used.

Some considerations on note “\*\*” of Table 2 (and note “\*” of Table 3) :

The axle loads according to the definition under \*\* of Table 2 (and \* of Table 3) indicate the maximum axle load considering full loading due to standing passengers. As this is the highest possible axle load it has to be used for the categorisation of a train into a Line Category as set out in chapter 6 of EN 15528:2008+A1:2012, which in turn is used for assessing the static effects of trains on bridges to ensure their structural safety.

The axle load values for wagons in Table 3 represent the values according to design mass under normal payload according to Table 5 of EN 15663:2009+AC:2010, which is the maximum payload for freight.

Codes P1 to P5 and F1 to F2 are generally intended to be applied to TEN lines. P6 and F4 are intended to be the minimum requirements for Off TEN lines: it does not exclude the possibility to apply any other traffic code for Off TEN Lines.

P1520 and F1520 are specifically for on 1520 mm track gauge system.

P1600 and F1600 are specifically for on 1600 mm track gauge system.

Performance parameter ‘train length’ applies to freight traffic because the train length determines the minimum length of a siding to be provided.

Performance parameter ‘usable length of platform’ applies to passenger traffic because this is the main interface between passenger rolling stock and infrastructure (e.g. platform): the real train length might be longer or shorter than platform length, the parameter describes only the length to be provided for access of passengers from the platform to the train.

*(5) The performance parameters listed in Table 2 and Table 3 are not intended to be used to directly ascertain the compatibility between rolling stock and infrastructure.*

Point 7.6 of INF TSI gives guidance on how to ascertain compatibility between rolling stock and infrastructure.

The interfaces with the Rolling stock subsystem are defined in Point 4.3.1.

*(9) Passenger hubs, freight hubs and connecting lines are included in the above traffic codes, as*

*appropriate.*

The requirements of a selected Traffic Code for a line are also valid for the running tracks passing through passenger hubs, freight hubs and connecting lines. Running tracks are those tracks used for trains' operation.

*(11) Without prejudice to Section 7.6 and point 4.2.7.1.2(3), when categorising a new line as P1, it shall be ensured that 'Class I' trains, according to the HS RST TSI (Commission Decision 2008/232/EC (1)), for a speed greater than 250 km/h, can run on that line up to the maximum speed.*

Paragraph (11) of point 4.2.1 has been included in order to preserve backward compatibility among the existing Class I high speed Rolling Stock, the existing TSI category of line I and the new line categorized with P1 traffic code.

However, in order to ensure that "Class I" trains can run on a new line as P1 up to the maximum speed, if necessary, point 4.2.7.1.2(3) is to be taken into account, because "Class I" trains are not automatically compatible to the limits of validity of HSLM (Annex E of EN 1991-2:2003/AC:2010).

*(12) It is permissible for specific locations on the line to be designed for any or all of the performance parameters line speed, usable length of platform and train length less than those set out in Table 2 and Table 3, where duly justified to meet geographical, urban or environmental constraints.*

The design speed for a line also affects the alignment of main tracks through a station. Any other station track does not need to meet this requirement. If main tracks through a station need to be designed for lower speeds, then this is normally justified by geographical or urban constraints.

Reduced speed in tunnels, aside platforms or bridges are not due to design speed but due to specific operational conditions and does not necessarily concern all trains in all cases. For example, speed on bridges depends on the EN line category of the vehicles and thus may be different.

The track in main direction of a turnout is normally designed for line speed; the diverging track of switches does not need to comply with this speed. Side modifiers, gauge changeover facilities and other installations of this type may require reduced speed. It should be regarded as a local permanent speed restriction rather than a lower design speed.

#### **Requirements for Basic Parameters (Point 4.2.2.2)**

*(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 three-rail system is a particular case of a multi-rail track, where one rail is common for two track gauges.

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



This would allow for example in a three-rail system one pair of rails to be assessed as one track with the option to assess the track formed using the third rail at some time in the future (or not subject it to assessment at all).

*(6) A short section of track with devices to allow transition between different nominal track gauges is allowed.*

Devices mentioned in this Point include equipment for:

- Gauge changeover facilities
- Equipment for exchange of wheelsets
- Equipment for exchange of bogies
- Any other systems allowing transition

### **Structure gauge (Point 4.2.3.1)**

*(1) The upper part of the structure gauge shall be set on the basis of the gauges selected according to point 4.2.1. Those gauges are defined in Annex C and in Annex D, point D.4.8 of EN 15273-3:2013.*

Gauges other than “Structure Gauge” (e.g. pantograph gauge, etc.) are defined in the relevant TSIs, EN15273-3:2013 and others.

The interfaces of the INF TSI with other TSIs are listed in Point 4.3.

*(3) Calculations of the structure gauge shall be done using the kinematic method in accordance with the requirements of sections 5, 7, 10 and the Annex C and Annex D, point D.4.8 of EN 15273-3:2013.*

The target is to use the Installation Nominal Gauge in new lines, upgrading and in general, wherever it is possible.

For design and construction of a new line, if the local situation is such that the installation nominal gauge cannot be cleared (for example because of geographical, urban or environmental constraints), an installation limit gauge may be defined and cleared. In this case it is necessary to justify the use of the Installation Limit Gauge.

For the rest of cases: existing lines, renewals, local improvements, new elements, etc. it is possible either to use the Installation Nominal or the Limit Gauge, though it is advisable to use the Installation Nominal Gauge.

The use of a uniform gauge may permit efficient design and maintenance by IM and also EC verification by the NoBo, thus avoiding a very time-consuming calculation for any location and any potential obstacle.

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 15273-3:2013. 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.

### Distance between track centres (Point 4.2.3.2)

(3) The distance between track centres shall at least satisfy the requirements for the limit installation distance between track centres, defined according section 9 of EN 15273-3:2013.

There are exceptional cases for which the limit installation distance between track centres, calculated according to chapter 9 of EN 15272-3:2013, is greater than the minimum nominal distance between track centres defined in Table 4 and 6.

Therefore, when deciding the distance between track centres in a double - track railway line, the minimum requirements of Table 4 and 6 shall be fulfilled, as well as the requirements for the limit installation distance between track centres defined in paragraph (3).

For example, in the case of two tracks with a radius of 1900 m, speed equal to 200 km/h and cants of 180 mm and 90 mm, the value of the limit installation distance between track centres obtained for GB structure gauge is 3825 mm, which is higher than the distance between track centres of 3800 mm defined in table 4.

### Minimum radius of horizontal curve (Point 4.2.3.4)

(2) Reverse curves (other those in marshalling yards where wagons are shunted individually) with radii in the range from 150 m up to 300 m for new lines shall be designed to prevent buffer locking. For straight intermediate track elements between the curves, Table 43 and Table 44 of Appendix I shall apply. For non-straight intermediate track elements, a detailed calculation shall be made in order to check the magnitude of the end throw differences.

In case a non – straight intermediate element is used between two curves with opposite curvature, the geometry and length of this element should be defined in such a way that the magnitude of the end – throw difference still prevents buffer locking.

### Cant deficiency (Point 4.2.4.3)

(1) The maximum values for cant deficiency are set out in Table 8.

**Table 8**  
**Maximum cant deficiency [mm]**

Design speed [km/h]	$v \leq 160$	$160 < v \leq 300$	$v > 300$
For Operation of rolling stock conforming to the Locomotives and Passenger TSI		153	100
For operation of rolling stock conforming to the Freight Wagons TSI	130	-	-

In the INF TSI, only maximum values of cant deficiency are given. So, for the verification of stability of vehicles on the track using the parameter of uncompensated acceleration, recalculations have to be done in order to be able to compare applied values of uncompensated acceleration with the cant deficiency limits expressed in mm.

The maximum values of cant deficiency set in Table 8 (and in Table 9 for the 1668 mm track gauge system) must be respected in the design/construction of a railway infrastructure line, taking as reference which TSI compliant Rolling Stock is intended to be operated on that specific line.

Rules and requirements for compliance of rolling stocks against TSIs are described in the relevant TSI (LOC&PAS and/or Freight).

*2) It is permissible for trains specifically designed to travel with higher cant deficiency (for example multiple units with axle loads lower than set out in table 2; vehicles with special equipment for the negotiation of curves) to run with higher cant deficiency values, subject to a demonstration that this can be achieved safely.*

Rules for the demonstration of safe running of vehicles, relating to running dynamics, are described in the LOC&PAS TSI.

Other verifications may be needed in order to guarantee that the operation of the referred types of rolling stock at speeds above the design speed is safe, such as those regarding structure gauge, distance between track centres, maximum pressure variations in tunnels, crosswinds, ballast pick up, immediate action limits on track geometry defects due to the higher speed attained, etc.

#### **Equivalent conicity (Point 4.2.4.5)**

*(3) Design values of track gauge, rail head profile and rail inclination for plain line shall be selected to ensure that the equivalent conicity limits set out in Table 10 are not exceeded.*

The design values of track gauge to be taken into account when assessing the requirement of "Equivalent Conicity" are the values of "design track gauge" as defined in Appendix S "Glossary" of INF TSI.

#### **Rail inclination (Point 4.2.4.7)**

*4.2.4.7.1 (3) For sections of not more than 100 m between switches and crossings without inclination where the running speed is no more than 200 km/h, the laying of rails without inclination is allowed.*

##### **4.2.4.7.2 Requirements for switches and crossings**

*(1) The rail shall be designed to be either vertical or inclined.*

*(2) If the rail is inclined, the designed inclination shall be selected from the range 1/20 to 1/40.*

- (3) *The inclination can be given by the shape of the active part of the rail head profile*
- (4) *Within switches and crossings where the running speed is more than 200 km/h and no more than 250 km/h, the laying of rails without inclination is allowed provided that it is limited to sections not exceeding 50 m.*
- (5) *For speeds of more than 250 km/h the rails shall be inclined.*

The inclination of the rail, either in plain line or in Switches & Crossings, can be chosen within the range from 1/20 to 1/40.

The table below summarizes the different situations for **rail inclination** as set out in points 4.2.4.7.1 and 4.2.4.7.2.

**Table 2: Rail inclination for plain line and switches and crossings**

	Plain line	Switches and Crossings
<b><math>v \leq 200</math> km/h</b>	<i>Inclined*</i> * For sections of not more than 100 m between switches and crossings without inclination where the running speed is no more than 200 km/h, the laying of rails without inclination is allowed.	<i>Vertical or Inclined</i>
<b><math>200 &lt; v \leq 250</math></b>	<i>Inclined</i>	<i>Inclined*</i> * Within switches and crossings where the running speed is more than 200 km/h and no more than 250 km/h, the laying of rails without inclination is allowed provided that it is limited to sections not exceeding 50 m.
<b><math>v &gt; 250</math></b>	<i>Inclined</i>	<i>Inclined</i>

**Track resistance to applied loads (Point 4.2.6)**

- 4.2.6.1. *Track resistance to vertical loads*
- The track design, including switches and crossings, shall take into account at least the following forces:*
- (a) *the axle load selected according to point 4.2.1;*
  - (b) *maximum vertical wheel forces. Maximum wheel forces for defined test conditions are defined in EN 14363:2005 point 5.3.2.3.*
  - (c) *vertical quasi-static wheel forces. Maximum quasi-static wheel forces for defined test conditions are defined in EN 14363:2005 points 5.3.2.3.*

#### 4.2.6.2. Longitudinal track resistance

##### 4.2.6.2.1 Design forces

The track, including switches and crossings, shall be designed to withstand longitudinal forces equivalent to the force arising from braking of 2.5 m/s<sup>2</sup> for the performance parameters chosen in accordance with point 4.2.1.

##### 4.2.6.2.2 Compatibility with braking systems

- (1) The track, including switches and crossings, shall be designed to be compatible with the use of magnetic braking systems for emergency braking.
- (2) The requirements for the design of track, including switches and crossings, which are compatible with the use of eddy current braking systems are an open point.
- (3) For the 1600 mm track gauge system it shall be allowed not to apply point (1).

##### 4.2.6.3. Lateral track resistance

The track design, including switches and crossings, shall take into account at least the following forces:

- (a) lateral forces; Maximum lateral forces exerted by a wheel set on the track for defined test conditions are defined in EN 14363:2005 point 5.3.2.2.
- (b) quasi-static guiding forces; Maximum quasi-static guiding forces  $Y_{qst}$  for defined radii and test conditions are defined in EN 14363:2005 point 5.3.2.3.

Point 4.2.6 gives guidance to Infrastructure Managers of the loads that the track must be able to withstand. The load values used for calculation of track components and/or track assemblies shall be consistent with point 4.2.6. The reference “at least” in the TSI reflects the fact that the maximum loads to be taken into account while designing the track may depend on planned operation and general strategy of each IM (running of special trains, running of maintenance vehicles, etc.).

#### **Allowance for dynamic effects of vertical loads (Point 4.2.7.1.2)**

- (3) It is permissible to design new bridges such that they will also accommodate an individual passenger train with higher axle loads than covered by HSLM. The dynamic analysis shall be undertaken using the characteristic value of the loading from the individual train taken as the design mass under normal payload in accordance with Appendix K with an allowance for passengers in standing areas in accordance with Note 1 of Appendix K.

In addition to what is stated in point 4.2.7.1.2(3), it is permissible to design new bridges that will accommodate an individual passenger train not conforming with limits of validity (e.g. higher individual axle loads, different spacing axles within a bogie, etc.) of HSLM in Annex E of EN 1991-2:2003/AC:2010. See also point 4.2.1 (11).

#### **Immediate action limits on track geometry defects (Point 4.2.8)**

##### 4.2.8.1. The immediate action limit for alignment

- (1) The immediate action limits for isolated defects in alignment are set out in point 8.5 of EN 13848-5:2008+A1:2010. Isolated defects shall not exceed the limits of wavelength range

- D1 as set out in table 6.*
- (2) *The immediate action limits for isolated defects in alignment for speeds of more than 300 km/h are an open point.*
- 4.2.8.2. *The immediate action limit for longitudinal level*
- (1) *The immediate action limits for isolated defects in longitudinal level are set out in point 8.3 of EN 13848-5:2008+A1:2010. Isolated defects shall not exceed the limits of wavelength range D1 as set out in table 5.*
- (2) *The immediate action limits for isolated defects in longitudinal level for speeds of more than 300 km/h are an open point.*

For alignment and for longitudinal level these points refer to the IAL limits of EN 13848-5:2008+A1:2010.

The maintenance regimes of several European countries already use IAL for alignment and longitudinal level stricter than the ones in the EN 13848-5:2008+A1:2010: this means that the compliance with what is required by the INF TSI is guaranteed.

Decision of IMs of a possible “relaxation” (but still within the limits of the INF TSI) of the IALs for their network should never come from the application of the INF TSI itself: the Safety Management System of each Infrastructure Manager has to justify that the “new” IAL defined in their respective network can still guarantee the safe running of trains.

#### **Platforms (Point 4.2.9)**

- (2) *For the requirements of this point it is permissible to design platforms required for the current service requirement provided provision is made for the reasonably foreseeable future service requirements. When specifying the interfaces with trains intended to stop at the platform, consideration shall be given to both the current service requirements and the reasonably foreseeable service requirements at least 10 years following the bringing into service of the platform.*

The current service requirements should be established by taking into account what is needed to give support to operation at the moment when the platform is being designed, plus a provision as defined in the Glossary of the TSI (Passive provision).

Foreseeable service requirements should be based on the information that is available at the moment when the platform is being designed.

Paragraph (2) allows new platforms to be designed to satisfy current service needs (e.g. non-TSI compliant trains stop) provided that provision is included in the design to enable “reasonably foreseeable” future service requirements to be accommodated (e.g. compliant TSI trains will stop at the station).

#### **Platform height (Point 4.2.9.2)**

- (1) *The nominal platform height shall be 550 mm or 760 mm above the running surface for radii of 300 m or more.*

For the assessment of the platform height in the “after assembly - before putting into service” phase, it is expected that the tolerances and specific assessment procedures usually defined by the applicant will be considered.

#### **Platform offset (4.2.9.3)**

(1) *The distance between the track centre and the platform edge parallel to the running plane ( $b_q$ ), as defined in chapter 13 of EN 15273-3:2013, shall be set on the basis of the installation limit gauge ( $b_{qlim}$ ). The installation limit gauge shall be calculated on the basis of the gauge G1.*

For structure gauges with equal width of reference profiles and associated rules at the height of the platform edge, the same value will be obtained for the installation limit gauge ( $b_{qlim}$ ). Therefore, the calculations made for any of them will be valid for the rest.

For example, the calculations made on the basis of a gauge other than G1 (i.e., GA, GB, GC or DE3) will fulfil the requirements of this point.

#### **Maximum pressure variations in tunnels (Point 4.2.10.1)**

(1) *Any tunnel or underground structure intended to be operated at speeds greater than or equal to 200 km/h has to provide that maximum pressure variation, caused by the passage of a train running at the maximum allowed speed in the tunnel, do not exceed 10 kPa during the time taken for the train to pass through the tunnel.*

The design of the cross section of a tunnel involves several other requirements, in addition to that of “Maximum pressure variation”, in order to give room to, for example:

- The verification of the structure gauge
- The installation of the energy and signalling systems
- Walkways for the evacuation passengers in case of emergency

Additionally, it is recommended to take into account the effects on energy consumption of the aerodynamic resistance to motion of trains, which depends on the clearance between trains and tunnels.

“The maximum allowed speed in the tunnel” to be considered is the maximum speed which is attainable when the most restrictive conditions for all the relevant subsystems are taken into account.

This speed will be used for the verification of the requirement at design review.

According to preliminary conclusions of the workgroup in charge of the revision of EN 14067-5, which is the main reference in the INF TSI for aerodynamics when operating in tunnels, it would only be necessary to apply this criterion on tunnels of 200 m or longer.

**Equivalent conicity in service (Point 4.2.11.2)**

- (1) *If ride instability is reported, the railway undertaking and the infrastructure manager shall localise the section of the line in a joint investigation according paragraphs (2) and (3) hereafter.*

*Note: This joint investigation is also specified in point 4.2.3.4.3.2 of TSI LOC & PAS for action on rolling stock.*

- (2) *The infrastructure manager shall measure the track gauge and the railhead profiles at the site in question at a distance of approximate 10 m. The mean equivalent conicity over 100 m shall be calculated by modelling with the wheelsets (a) – (d) mentioned in paragraph 4.2.4.5(4) of this TSI in order to check for compliance, for the purpose of the joint investigation, with the limit equivalent conicity for the track specified in Table 14.*

Table 14

**Equivalent conicity in service limit values for the track, (for the purpose of joint investigation)**

<i>Speed range [km/h]</i>	<i>Maximum value of mean equivalent conicity over 100 m</i>
$v \leq 60$	<i>assessment not required</i>
$60 < v \leq 120$	0,40
$120 < v \leq 160$	0,35
$160 < v \leq 230$	0,30
$v > 230$	0,25

- (3) *If the mean equivalent conicity over 100 m complies with the limit values in Table 14, a joint investigation by the railway undertaking and the infrastructure manager shall be undertaken to specify the reason for the instability.*

Ride instability is influenced by several factors, one of which being the in service equivalent conicity mentioned in the TSI. It is advisable that when ride instability problems are encountered all these factors are taken into consideration, while conducting the joint investigation.

Defects in running gear or other issues from the vehicle may create unstable running. On track side, some geometric defects may also result in unstable running even when respecting the equivalent conicity values. These defects may even result from unstable running of other previous trains passed on the line.

During the investigation, it is recommended to start with an inspection of the train and track, according to the usual maintenance procedures of RU and IM, respectively. This



may include reviewing wheels, jaw dampers, suspension components, etc. for the RU and track geometric defects, etc. for the IM.

For evaluating the in-service value of equivalent conicity, in the process of the joint investigation by the Infrastructure Manager (IM) and the Railway Undertaking (RU) the first step is to identify the location where ride instability is being experienced (4.2.11.2(1) of INF TSI).

The IM then calculates the track mean equivalent conicity over 100m following the process described in 4.2.11.2 (2) and compares the values against those given in Table 14.

At the same time, the RU calculates the wheelset equivalent conicity following the process described in point 4.2.3.4.3.2 (3) of the TSI LOC&PAS and compares the values against the maximum equivalent conicity the vehicle was designed and tested for.

There are several outcomes following these calculations:

- Both the results obtained from the calculations by the IM and RU fulfil the requirements set in their respective TSIs so no prescribed actions have to be undertaken.  
In this situation, the IM and RU shall continue their joint investigation in order to find out the reason of the instability.
- The results obtained from the IM's calculation exceed the limiting values. Actions shall be taken on the infrastructure to return the mean equivalent conicity to acceptable levels.
- The results obtained from the RU's calculation exceed the limiting values. Actions shall be taken to return the wheel sets to the correct profile.
- Both the results obtained from the calculations by the IM and RU exceed the requirements set in their respective TSIs. Actions shall be put in place on both the infrastructure and the wheel sets in order to restore the limiting values.

In order to return the track into the limits of equivalent conicity, different actions may be taken, depending on the cause. Rail grinding may be practical in case of wear problems or even narrow track gauge. In case of narrow gauge this may be resolved by changing or adapting the fastenings or replacing sleepers. Sometimes even specific tamping operations can have an impact on the track gauge.

After corrective actions have been taken, the joint investigation should continue in order to effectively verify whether the problem on instability has been resolved.

The joint investigation above described should be conducted regardless TSI compliance of rolling stock.

### ***Fixed installation for servicing trains (Point 4.2.12)***

#### ***4.2.12.1. GENERAL***

*This point 4.2.12 sets out the infrastructure elements of the maintenance subsystem required for servicing trains.*

Provision of fixed installations for servicing trains is optional. The Member State decides which elements belong to the interoperable network according to point 6.2.4.14.

Requirements in the TSI apply when installations are included in the content of the line which is the subject of the EC verification procedure.

#### **Operating rules (Point 4.4)**

*(2) In certain situations involving pre-planned works, it may be necessary to temporarily suspend the specifications of the infrastructure subsystem and its interoperability constituents defined in sections 4 and 5 of this TSI.*

Temporary suspension of the requirements of the TSI is permitted for pre-planned works.

An example would be at the site of a new underpass where provisional arrangements, non-compliant with the TSI, will be in place during the construction period.

## **2.5. Interoperability Constituents (Section 5)**

Paragraphs (1) and (2) of Point 5.1 and paragraphs (1) and (3) of Point 5.2 define precisely which elements of the track are understood as Interoperability Constituents of the Infrastructure subsystem.

According to Points 5.1 and 5.2 the following goods, other than those mentioned in 5.2(3), are not considered to be Interoperability Constituents:

- a) steel sleepers (or made of 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 element 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 this TSI for one or more of the following reasons:

- there are no harmonized specifications for these elements;
- the elements are not commonly used or are only used in specific locations and conditions;
- the small volume of production does not bring benefits to the opening market;
- several technical solutions exist for these types of elements.

Components which function like ICs, but which are excluded from the 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 Point 6.6. of the TSI.

#### **The rail fastening system (Point 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 and for speeds of more than 250 km/h shall be at least 9kN,*
- (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:*
- the maximum axle load the rail fastening system is designed to accommodate,*
  - the combination of rail, rail inclination, rail pad and type of sleepers with which the fastening system may be used.'*

### Tests on rail fastenings

When a module CH (see point 6.1.2) is selected for assessing the conformity of the IC "Rail fastening system", quality control tests to confirm the performance of rail fastenings must be appropriate for the rail fastening design.

It is the responsibility of the organization signing the declaration of conformity to be able to demonstrate that quality control procedures are in place to ensure that fastenings supplied have a performance consistent with the requirements set out in Point 5.3.2. These are requirements that, by their nature, can only be demonstrated directly in type approval tests.

It must be possible to demonstrate that these QC checks ensure that the rail fastenings supplied are the same as the fastening subjected to the type approval test.

In this respects, QC checks, performed during manufacturing, should include regular measurements of:

- geometric features defining 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);
- the critical shapes and dimensions;
- the key mechanical and material properties;

of every component of the rail fastening system.

This may also include subjecting samples of some components, such as spring steel clips, to routine fatigue testing, but it is recognized that repeated load testing of complete rail fastening assemblies can only be carried out at the type approval stage.

### Longitudinal restraint (5.3.2(2)(a))

For the purposes of using the TSI and in associated ENs, the longitudinal rail restraint is defined as the minimum axial force, applied to a rail secured to a sleeper by a fastening assembly, causing non-elastic slip of the rail through the fastening system.

For general applications in plain line, this value shall be at least:

- 7 kN, for speed equal or lower than 250km/h;

- 9 kN, for speed higher than 250 kmh.

A method for determining if the fastening system meets these requirements at the type approval testing stage is given in EN 13146-1.

Some alternative methods exist, which are based on the force required to cause gross slip (instead of beginning of slip) of the rail. This force may be substantially higher than the force defined in these European Standards but fastening systems compliant with methods based on gross slip may not be compliant with the method based on beginning of slip. (for example, 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: 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 special fastening systems are covered by paragraph 5.2(3) and are not considered ICs as they do not fulfil the requirements for longitudinal rail restraint.

#### Resistance to cyclic loads. (5.3.2(2)(b))

The resistance to cyclic loads is demonstrated in a type approval test in which a complete rail fastening assembly is subjected to a combination of cyclic loads applied through a piece of rail, appropriate to its intended use. An acceptable test method is set out in EN 13146-4. This method is consistent with the requirement for 20% permitted change in clamping force and longitudinal restraint, and 25% change in vertical static stiffness (up to a vertical static stiffness of 300 MN/m).

### **Track sleepers (Point 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 point 4.2.4.1 for 'Nominal track gauge', point 4.2.4.7 for 'Rail inclination' and point 4.2.6 for 'Track resistance to applied loads'.*

According to Point 6.1.4.4, the EC declaration of conformity for track sleepers must include, among others, the statement setting out the combinations of rail, rail inclination and type of rail fastening system with which the sleeper may be used. No separate EC declarations of conformity are needed for sleepers that may be used with more than one combination.

The applicant has to show, and the NoBo has to verify, that the construction and geometry of the sleeper allow the declared elements to be used in those combinations.

Additionally, the sleeper has to fulfil the requirements referred to in Point 5.3.3:

- a) in reference to Point 4.2.4.1 – that the sleeper is designed for the nominal track gauge;
- b) in reference to Point 4.2.4.7 – that the sleeper construction allows for keeping the rail inclination within the permitted range.

The conformity assessment in relation to the requirements of Point 4.2.6 '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 design bending moment assumed in the sleeper – as the result of the maximum vertical axle load 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) For the nominal track gauge system of 1 435 mm, the design track gauge for track sleepers shall be 1 437 mm.*

From the nominal track gauge of the project, a design value of the track gauge shall be used to design the track.

The track design starts with the choice of rail profiles to be used and the rail inclination to be applied. The further design concerns basically the design of the sleepers together with its fastening system to be used with the sleeper.

For drawing the assembly of components within the sleepers, the following steps are common practise:

- the rails are put at the 'design track gauge';
- fastening systems are added on the drawing of the sleeper, where it is verified that the different components fit together.

This is done at the nominal dimensions of all components.

Some lateral gaps will be foreseen between rail foot and the fastening systems in order to allow tolerances of the different components. The full verification of the compatibility of all tolerances with the design is out of the scope of the TSI.

If different rail profiles are used, separate drawings shall be produced for different rail profiles.

The actual values for gauge in track will depend on the chosen design values for all components, the production tolerances and the assembly in track, eventually influenced by train loads and maintenance operations. The choice of the gaps between rail foot and fastening may be considered to influence the actual values in track, gaps that are not necessarily to be put equally distributed between left and right from the rail foot.

For the turnouts a similar approach is applied. As changing the track gauge has an impact in the theoretical diagram of the turnout, it is good practice to choose the design value for the turnout equal to the nominal track gauge. The position of the gaps between rail foot can be chosen in such way to have an actual and mean track gauge in track somewhat wider than if gaps were distributed evenly left and right of rail.

## 2.6. Assessment of Conformity of Interoperability Constituents and EC Verification of the Subsystems (Section 6)

### **Assessment of sleepers (Point 6.1.5.2)**

*(2) For polyvalent gauge and multiple gauge track sleepers it is allowed not to assess the design track gauge for the nominal track gauge of 1 435 mm.*

Polyvalent gauge track sleeper: Track sleeper designed to fit the rail in more than one position in order to allow for a different track gauge on each.

Multiple gauge track sleeper: Track sleeper designed to include more than one track gauge within the respective pairs of rails.

### **Assessment of structure gauge (6.2.4.1)**

*(3) After assembly before putting into service clearances shall be verified at locations where the designed installation limit gauge is approached by less than 100 mm or the installation nominal gauge or uniform gauge is approached by less than 50 mm.*

For the assessment of the structure gauge after assembly before putting into service, it is expected that the specific assessment procedures usually defined by the applicant will be considered.

### **Assessment of distance between track centres (6.2.4.2)**

*(2) After assembly before putting into service, distance between track centres shall be verified at critical locations where the limit installation distance between track centres as defined according chapter 9 of EN 15273-3:2013 is approached by less than 50 mm.*

For the assessment of the distance between track centres after assembly before putting into service, it is expected that the specific assessment procedures usually defined by the applicant will be considered.

### **Assessment of track layout (Point 6.2.4.4)**

*(1) At design review the curvature, cant, cant deficiency and abrupt change of cant deficiency shall be assessed against the local design speed.*

When assessing the values of “cant” and “minimum radius of horizontal curve” in the “Assembly before putting into service” phase (as required in Table 37), tolerances and specific assessment procedures, usually defined by IMs in their rules for acceptance of works, should be taken into account.

### **Assessment of cant deficiency for trains designed to travel with higher cant deficiency (Point 6.2.4.5)**

*Point 4.2.4.3(2) states that 'It is permissible for trains specifically designed to travel with higher cant deficiency (for example multiple units with lower axle loads; vehicles with special equipment for the negotiation of curves) to run with higher cant deficiency values, subject to a demonstration that this can be achieved safely'. This demonstration is outside the scope of this TSI and thus not subject to a notified body verification of the infrastructure subsystem. The demonstration shall be undertaken by the RU, if necessary in cooperation with the IM.*

For trains running at higher cant deficiency, demonstration of safe running has to be performed according to EN14363:2005 and/or EN15686:2010.

For gauging, verification has to be performed according to section 14 of EN 15273-3:2013

Operation at speeds above design speed may also have an impact on other requirements to be accomplished such as those regarding distance between track centres, maximum pressure variations in tunnels, crosswinds, ballast pick up, immediate action limits on track geometry defects due to the higher speed attained.

### **Assessment of design values for equivalent conicity (Point 6.2.4.6)**

*Assessment of design values for equivalent conicity shall be done using the results of calculations made by the infrastructure manager or the contracting entity on the basis of EN 15302:2008+A1:2010.*

When assessing the design value of the parameter "Equivalent Conicity", calculations have to be performed according to the procedure defined in Point 4.2.4.5 of INF TSI, having chosen the following elements of the track configuration:

- design track gauge;
- rail head profile;
- rail inclination.

Appendix 2 to this Guide provides several track configurations that are deemed to fulfil the requirement of design equivalent conicity.

For projects in which serviceable rails are used, for the assessment of design value of equivalent conicity, the theoretical railhead profile may be taken into account.

### **Assessment of existing structures (Point 6.2.4.10)**

*(1) Assessment of existing structures against the requirements of point 4.2.7.4(3) (b) and (c) shall be done by one of the following methods:*

- (a) check that the values of EN line categories, in combination with the allowed speed published or intended to be published for the lines containing the structures, is in line with the requirements of Appendix E of this TSI,*
- (b) check that the values of EN line categories, in combination with the allowed speed*

*specified for the structures or for the design, is in line with the requirements of Appendix E of this TSI,*

- (c) *check the traffic loads specified for the structures or for the design against the minimum requirements of points 4.2.7.1.1 and 4.2.7.1.2. When reviewing the value of factor alpha according to point 4.2.7.1.1 it is only necessary to check that the value of factor alpha is in line with the value of factor alpha mentioned in Table 11.*

The checks considered in Point (a) would be enough when the EN Line Category as published by the IM is compatible with the intended Traffic Codes. For example, if the published EN Line Category is D4-100 and the required capacity is only D2-100, compatibility may be regarded as demonstrated with no further assessment.

Point (b) covers also cases when the speed specified for the structure(s) may be different from the speed of the line.

Point (c) is intended to cover those situations in which EN line categorization is not fully used.

#### **Assessment of platform offset (Point 6.2.4.11)**

*(1) Assessment of the distance between the track centre and the platform edge as a design review shall be done using the results of calculations made by the Infrastructure Manager or the contracting entity on the basis of chapter 13 of EN 15273-3:2013.*

Methodology to calculate  $b_{q_{lim}}$  is set in chapter 13 of EN 15273-3:2013.

Definition of  $b_{q_{lim}}$  can be found in section H.2.1 of EN15273-1:2013

#### **Assessment of maximum pressure variations in tunnels (Point 6.2.4.12)**

*(2) The input parameters to be used are to be such that the reference characteristic pressure signature of the trains set out in the locomotives and passenger rolling stock TSI is fulfilled.*

In operation phase the demonstration can be carried out by the Infrastructure Manager considering real trains, with signatures lower than the reference interoperable train signature as is defined in the locomotives and passenger rolling stock TSI in order to allow higher speeds.

#### **Assessment of track resistance for plain line (Point 6.2.5.1)**

*(1) The demonstration of conformity of the track to the requirements of point 4.2.6 may be done by reference to an existing track design which meets the operating conditions intended for the subsystem concerned.*

*(2) A track design shall be defined by the technical characteristics as set out in Appendix C.1 to this TSI and by its operating conditions as set out in Appendix D.1 to this TSI.*

*(3) A track design is considered to be existing, if both of the following conditions are met:*



- (a) *the track design has been in normal operation for at least one year and*
- (b) *the total tonnage over the track was at least 20 million gross tons for the period of normal operation.*
- (4) *The operating conditions for an existing track design refer to conditions which have been applied in normal operation*
- (5) *The assessment to confirm an existing track design shall be performed by checking that the technical characteristics as set out in Appendix C.1 to this TSI and conditions of use as set out in Appendix D.1 to this TSI are specified and that the reference to the previous use of the track design is available.*
- (6) *When a previously assessed existing track design is used in a project, the notified body shall only assess that the conditions of use are respected.*
- (7) *For new track designs that are based on existing track designs, a new assessment can be performed by verifying the differences and evaluating their impact on the track resistance. This assessment may be supported for example by computer simulation or by laboratory or in situ testing.*
- (8) *A track design is considered to be new, if at least one of the technical characteristics set out in Appendix C to this TSI or one of conditions of use set out in Appendix D to this TSI is changed*

“Track resistance to applied load” (4.2.6.) is a basic parameter for which presumption of conformity at design stage may be used. Point 6.2.5.1 for plain line (and point 6.2.5.2 for switches&crossings) details how the assessment can be performed by referring to an existing track design meeting the operating condition intended for the subsystem concerned.

In that respect, Appendix C and Appendix D are intended to establish respectively the technical characteristics and the conditions of use that define a track design.

Paragraph (3) sets out the conditions under which a track design is considered “existing”.

The track design of the subsystem concerned is presumed to be compliant with the requirements of point 4.2.6 when it is possible to demonstrate that its technical characteristics (as defined in Appendix C) and its conditions of use (as defined in appendix D) are identical to those of an existing track design (that, of course, meets the operating conditions of the subsystem concerned).

The assessment of track resistance to applied loads has to be made by considering the whole set working together. Likewise, the consistency of the properties of each track component with the requirements on track resistance for the whole track design as set out in 4.2.6 has to be evaluated by assessing the whole set containing the referred component. For this reason, Appendix C takes into account the relevant features of every component. Within some track designs, several components of similar characteristics can be used in the same place in order to allow the use of products from different manufacturers or for other reasons. This circumstance is usually covered by internal classifications of track components as established in the technical specifications of the IM. The definition of the technical characteristics of a track design may be done by

referring to these internal categories of track components provided that compatibility with the intended conditions of use as set out in Appendix D is respected.

It is understood as 'normal operation' when trains run along the line for their own purposes without any exceptional provision to mitigate their impact on infrastructure.

**Subsystems containing Interoperability constituents not holding an EC declaration (Point 6.5)**

and

**Subsystem containing serviceable interoperability constituents that are suitable for reuse (Point 6.6)**

When assessing subsystems that contain IC not holding an EC declaration or that are reused, the following guide can be used to help identify the procedure to follow:

**Table 3: EC verification of the infrastructure subsystem containing serviceable interoperability constituents that are suitable for reuse**

Ref.	Features of the subsystem	Reference to INF TSI	Comments
A	General case. Subsystems containing NEW Interoperability constituents holding an EC declaration	6.2.	The EC verification of the <u>infrastructure subsystem is carried out according to chapter 6.2 to 6.4</u>
B	Subsystems containing NEW Interoperability constituents not holding an EC declaration  (procedure valid until 31 May 2021)	6.5.	If the applicant is developing a new project and intends to use new interoperability constituents already manufactured but are not yet covered by an EC declaration, the NoBos are permitted to issue an EC certificate of verification for the subsystem if the following requirements are fulfilled:  (a) the conformity of the subsystem has been checked against the requirements of chapter 4 and sections 6.2 to 7 (excluding 7.7) of the TSI,( conformity of ICs to chapter 5 and section 6.1 is not required) and  (b) the same type of interoperability constituents, have been used in a subsystem already approved and put in service in at least one of the Member State before the entry in force of the TSI.

C	Subsystem containing REUSED serviceable interoperability constituents that are suitable for reuse (procedure with no time limit)	6.6.	<p>If the applicant is developing a new project and intends to reuse serviceable interoperability constituents, the NoBos are permitted to issue an EC certificate of verification for the subsystem if the following two requirements are fulfilled:</p> <p>(a) the conformity at the subsystem level has been checked against the requirements of sections 4 and sections 6.2 to 7 (excluding 7.7) the TSI , [conformity to section 6.1 is not required]</p> <p>and</p> <p>(b) The interoperability constituents are not covered by the relevant EC declaration of conformity and/or suitability for use.</p> <p>Usually the applicant shall ensure that the proposed serviceable constituents are suitable for reuse.</p>
---	--	------	--

## 2.7. Implementation of the Infrastructure TSI (Section 7)

### *Application of this TSI to new railway lines (Point 7.2)*

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

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

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

*(b) the creation of a bypass,*

*(c) 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 taking this decision.

### *Upgrading of a line (Point 7.3.1)*

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

*(2) The infrastructure subsystem of a line is considered to be upgraded in the context of this TSI when at least the performance parameters axle load or gauge, as defined in point 4.2.1, are changed in order to meet the requirements of another traffic code.*

*(3) For other TSI performance parameters, according to Article 20(1) of the Directive 2008/57/EC, Member States decide to what extent the TSI needs to be applied to the project.*

Paragraph (1) gives the general definition of “upgrading” set out in the Directive 2008/57/CE. The meaning of upgrading, for the purpose of the INF TSI, is given in Paragraph (2): it is more specific, but still inside the definition given in the Directive 2008/57/CE.

If a project includes the improvement of performance parameters axle load or gauge (or both) to meet the requirements of another traffic code according to the TSI Categories of Line, it shall be considered as an upgrade. In this event, section 7 of the TSI sets out certain requirements to be considered by the Member State when applying Article 20.1 and 20.2 of the Directive 2008/57/EC.

The TSI needs to be applied at least for all basic parameters relating to the “Hard” performance parameters concerned in the event of an upgrade including a modification to improve axle load or gauge (or both) in order to meet the requirements of another traffic code according to the TSI Categories of Line.

Paragraph (3) refers to the requirements relating to the other “soft” performance parameters (‘line speed’, ‘train length’ and ‘usable length of platform’ – see Point 4.2.1(4)-) in the event of an upgrade. In this case, the Member State will decide to which extent the TSI needs to be applied to the project.

### **Substitution in the framework of maintenance (Point 7.3.3)**

*(1) Where the parts of a subsystem on a line are maintained, the formal verification and authorisation for placing into service is not required in accordance with this TSI. However, maintenance replacements should be, as far as it is reasonably practicable, undertaken in accordance with the requirements of this TSI.*

*(2) The objective should be that maintenance replacements progressively contribute the development of an interoperable line.*

*(3) In order to bring progressively an important part of the infrastructure subsystem in a process towards interoperability, the following group of basic parameters should be adapted together:*

- (a) Line layout,*
- (b) Track parameters,*
- (c) Switches and crossings,*
- (d) Track resistance to applied loads,*
- (e) Structures resistance to traffic loads,*
- (f) Platforms.*

*(4) In such cases, it is noted that each of the above elements taken separately cannot ensure compliance of the whole subsystem. The conformity of a subsystem can only be stated when all the elements are compliant with the TSI.*

It is up to the Member States to decide what to include in the National Implementation plan: normally, substitutions in the framework of maintenance may not be included in the plan as the implementation of the TSI is not mandatory for these projects.

The aforementioned plans should be based on those upgrade and renewal projects that have been decided to be carried out at the moment when the plan is being drafted.

### **Existing lines that are not subject to a renewal or upgrading project (Point 7.3.4)**

*The demonstration of the level of compliance of existing lines with the basic parameters of the TSI is voluntary. The procedure for this demonstration shall be in accordance with Commission Recommendation 2014/881/EU of 18 November 2014 <sup>(1)</sup>.*

The Directive 2008/57/CE does not require EC verification of an existing line unless it is subject to renewal or upgrading.

Demonstration of the level of compliance to the TSI is voluntary.

If this demonstration is to be undertaken, the procedure described in the Commission recommendation 2014/881/EU may be used.

The information related to performance parameters and values of relevant basic parameters of an existing line is included in the Register of Infrastructure.

**Ascertain compatibility of infrastructure and rolling stock after authorization of rolling stock (Point 7.6)**

*(2) The design of the TSI categories of line as defined in section 4 is generally compatible with the operation of vehicles categorised in accordance with EN 15528:2008+A1:2012 at up to the maximum speed as shown in Appendix 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 harmonized 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 Appendix 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 allow the maximum operational load of the rolling stock to be restricted to lower level 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 Point, 'vehicle' is understood in terms of the Directive 2008/57/CE.

**Technical characteristics of switches and crossings design (Appendix C.2)**

*Switches and crossings design shall be at least defined by the technical characteristics as follows:*

- (a) Rail*
  - Profile(s) & grades (switch rail, stock rail)*
  - Continuous welded rail or length of rails (for jointed track sections)*
- (b) Fastening system*
  - Type*
  - Pad stiffness*
  - Clamping force*
  - Longitudinal restraint*
- (c) Sleeper*
  - Type*

- *Resistance to vertical loads:*
  - *Concrete: design bending moments*
  - *Wood: compliance to EN 13145:2001*
  - *Steel: moment of inertia of cross section*
- *Resistance to longitudinal and lateral loads: geometry and weight*
- *Nominal and design track gauge*
- (d) *Rail inclination*
- (e) *Ballast cross sections (ballast shoulder – ballast thickness)*
- (f) *Ballast type (grading = granulometrie)*
- (g) *Type of crossing (fixed or movable point)*
- (h) *Type of locking (switch pannel, movable point of crossing)*
- (i) *Special devices: for example sleeper anchors, third/ fourth rail, ...*
- (j) *Generic switches and crossings drawing indicating*
- *Geometrical diagram (triangle) describing the length of the turnout and the tangents at the end of the turnout*
- *Main geometrical characteristics like the main radii in switch, closure and crossing panel, crossing angle*
- *Sleeper spacing*

In the context of Switches & Crossings, the elements that support the S&C are commonly known as “bearers”; in that respect, when in Appendix C.2 reference is made to technical characteristic of ‘sleeper’, it has to be intended that the technical characteristics shall refer also to the bearers.

When filling in the data corresponding to the “bearers” nominal and design track gauge, it could be enough to include the nominal track gauge in the list and refer to the drawings of the layout of the Switches & Crossings for the design track gauge of each “bearer”.

“Movable point of crossing” has the same meaning as swing nose crossing.

## 2.8. Glossary (Appendix S)

<i>Design track gauge / Konstruktionsspurweite / Ecartement de conception de la voie</i>	5.3.3	<i>A single value which is obtained when all the components of the track conform precisely to their design dimensions or their median design dimension when there is a range.</i>
--	-------	---

When designing a sleeper, one of the most important goals is to make sure that the track gauge in operation will deviate from its design value as less as possible.

The track gauge, though, is not only affected by the design of the sleeper, but it is also influenced by the dimensions, tolerances and position (within the sleeper) of:

- rails;

- each component of the rail fastening system, with which the sleeper is equipped.

Therefore, when defining the design track gauge of a sleeper, all track components (rails, clips, insulators, etc.) that play a role in the track gauge should be considered with their nominal design dimensions (or median design dimension, when there is a range.) and their nominal design position within the sleeper.

In addition to the EC declaration of conformity, the value of the 'design track gauge' should be explicitly stated on all relevant documents (drawings, technical note, etc.) of the sleepers.

The concept of 'design track gauge' is related to the design of the sleepers only. The only basic parameter of the INF TSI that is affected by the 'design track gauge' is the 'equivalent conicity' at design stage. All remaining parameters refer to the nominal value of track gauge.

<i>EN Line Category / EN Streckenklasse / EN Catégorie de ligne</i>	<i>4.2.7.4, Appendix E</i>	<i>The result of the classification process set out in EN 15528:2008+A1:2012 Annex A and referred to in that standard as 'Line Category'. It represents the ability of the infrastructure to withstand the vertical loads imposed by vehicles on the line or section of line for regular service.</i>
---	------------------------------------	---

For the purpose of the INF TSI, "regular service" is equivalent to "normal service".

<i>Swing nose</i>	<i>4.2.5.2</i>	
-------------------	----------------	--

According to EN13232-7, within the domain of "common crossing with movable point", the term "swing nose" identifies the part of the crossing which forms the vee and that it is moved to form a continuous running edge for either the main or the branch line.

<i>Braking systems independent of wheel-rail adhesion conditions"</i>	<i>4.2.6.2.2</i>	
---	------------------	--

"Braking systems independent of wheel – rail adhesion conditions" refers to all brake systems of the rolling stock capable to develop a brake force applied to the rails independently of the wheel – rail adhesion conditions (e.g. magnetic braking systems and eddy current braking systems)

<i>Plain line / Freie Strecke / Voie courante</i>	<i>4.2.4.5 4.2.4.6 4.2.4.7</i>	<i>Section of track without switches and crossings.</i>
---	--	---

In the context of the TSI, the concept of plain line applies both for tracks inside and outside stations.

## 2.9. Safety assurance over fixed obtuse crossings (Appendix J)

Definitions of "running edge" and "check face (guiding edge)" can be found in EN 13232-1:2003 and EN13232-6:2005 +A1:2011.



### **3. LIST OF APPENDICES**

#### **1. Applicable standards and other documents**

1.1. Standards referred to in the TSI

1.2. Application of Standards

#### **2. Track configurations which fulfil the requirement for the track design against equivalent conicity**

## APPENDIX 1

### Applicable standards

#### 1.1. Standards referred to in the TSI

All standards referred to in the text of INF TSI are listed in Table 49 'List of referenced standards', which is attached as Appendix T to the INF TSI.

The application of the sections referred to in the INF TSI text of the above mentioned standards is, therefore, mandatory.

#### 1.2. Application of standards

Table 4 contains a set of European standards relevant for conformity assessment of basic parameters against the respective TSI requirements.

Some standards listed in Table 4 are the same as the ones referred to in the INF TSI: the application of the sections of these standards quoted in the INF TSI is mandatory. The application of the remaining sections, as well as the application of other standards not referred to in INF TSI, remains voluntary.

In some cases, harmonised standards that cover the basic parameters of the TSIs provide presumption of conformity with certain clauses of the TSIs. In accordance with the spirit of the new approach to technical harmonisation and standardisation, application of these standards remains voluntary but their references are published on the Official Journal of the European Union (OJEU). These specifications are listed in the TSI application guide in order to facilitate their use by the industry. These specifications remain complementary to TSIs.

**Table 4: CEN Standards relevant for conformity assessments**

No	Point of INF TSI	CEN Standards
1	4.2.3.1 Structure gauge	EN 15273–1:2013, Railway applications – Gauges –Part 1: General – Common rules for infrastructure and rolling stock
		EN 15273–3:2013, Railway applications – Gauges – Part 3: Structure gauges
2	4.2.3.2 Distance between track centres	EN 15273–3:2013, Railway applications – Gauges – Part 3: Structure gauges

3	4.2.3.4 Minimum radius of horizontal curve	EN 13803-1:2010, Railway applications - Track - Track alignment design parameters - Track gauges 1435 mm and wider - Part 1: Plain line
		EN 13803-2:2006+A1:2009, 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.
4	4.2.3.5 Minimum radius of vertical curves	EN 13803-1:2010, Railway applications – Track - Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line
		EN 13803-2:2006+A1:2009, 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.
5	4.2.4.1 Nominal track gauge	EN 13848-1:2003+A1:2008, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry
6	4.2.4.2 Cant	EN 13803-1:2010, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line
		EN 13803-2:2006+A1:2009, 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.
		EN 14363:2005 Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests

7	4.2.4.3 Cant deficiency	EN 13803-1:2010, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line
		EN 13803-2:2006+A1:2009 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.
		EN15686:2010 Railway applications - Testing for the acceptance of running characteristics of railway vehicles with cant deficiency compensation system and/or vehicles intended to operate with higher cant deficiency than stated in EN 14363:2005, Annex G
		EN 14363:2005 Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests
8	4.2.4.4 Abrupt change of cant deficiency	EN 14363:2005 Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests
		EN 13803-1:2010, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line
9	4.2.8 Immediate action limits on track geometry defects	EN 13848-1:2003+A1:2008, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry

		EN 13848-5:2008+A1:2010 Railway applications - Track - Track geometry quality - Part 5: Geometric quality levels - Plain line
10	4.2.5.1 Design of geometry of switches and crossings	EN 13232-2:2003+A1:2011, Railway applications – Track – Switches and crossings – Part 2: Requirements for geometric design
		EN 13232-5:2005+A1:2011 Railway applications – Track – Switches and crossings – Part 5: Switches
		EN 13232-3:2003+A1:2011 Railway applications - Track - Switches and crossings - Part 3: Requirements for wheel/rail interaction
		EN 13232-7:2006+A1:2011 Railway applications - Track - Switches and crossings - Part 7: Crossings with moveable parts
		EN 13232-9:2006+A1:2011 Railway applications – Track – Switches and crossings – Part 9: Layouts
		EN 15273–3:2013, Railway applications – Gauges – Part 3: Structure gauges
11	4.2.5.3 Maximum unguided length of fixed obtuse crossings	EN 13232-9:2006+A1:2011 Railway applications – Track – Switches and crossings – Part 9: Layouts
		EN13232-6:2005+A1:2011, Railway applications – Track – Switches and crossings – Part 6: Fixed common and obtuse crossings

12	4.2.6.1 Track resistance to vertical loads	EN 13803-1:2010, 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
13	4.2.7.2 Longitudinal track resistance	EN 13803-1:2010, 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
14	4.2.7.3 Lateral track resistance	EN 13803-1:2010, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line
		EN 13803-2:2006+A1:2009, 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.
		EN 14363:2005 Railway applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests

15	4.2.7.4 Resistance of existing bridges and earthworks to traffic loads	EN 15528:2008+A1:2012  Railway applications – Line categories for managing the interface between load limits of vehicles and infrastructure.
16	4.2.10.1 Maximum pressure variations in tunnels	EN14067-4:2013, Railway applications – Aerodynamics – Part 4: Requirements and test procedures for aerodynamics on open track  EN14067-5:2006+A1:2010 Railway applications – Aerodynamics – Part 5: Requirements and test procedures for aerodynamics in tunnel
17	4.2.10.2 Effect of crosswinds	EN 14067-6: 2010, Railway applications – Aerodynamics – Part 6: Requirements and test procedures for cross wind assessment
18	4.5 Maintenance rules	EN 13848-1:2003+A1:2008, Railway applications – Track – Track geometry quality – Part 1: Characterisation of track geometry  EN 13232-9:2006+A1:2011, Railway applications – Track – Switches and crossings – Part 9: Layouts  EN 13803-1:2010, Railway applications – Track – Track alignment design parameters – Track gauges 1435 mm and wider – Part 1: Plain line  EN 13803-2:2006+A1:2009 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.
19	5.3.1 The rail	EN 13674-1:2011,  Railway applications –Track– Rail – Part 1 : Vignole railway rails 46 kg/m and above  EN 13674-2:2006+A1:2010,Railway applications – Track– Rail – Part 2 : Switch and crossing rail used in conjunction with Vignole railway rails 46 kg/m and above

		EN 13674-4:2006+A1:2009 Railway applications - Track - Rail - Part 4: Vignole railway rails from 27 kg/m to, but excluding 46 kg/m
20	5.3.2 The rail fastening system	EN 13481-1:2012 Railway applications - Track - Performance requirements for fastening systems - Part 1: Definitions
		EN 13481-2:2012/AC2014  Railway applications – Track – Performance requirements for fastening systems – Part 2: Fastening systems for concrete sleeper
		EN 13481-3:2012,  Railway applications – Track – Performance requirements for fastening systems – Part 3: Fastening for wood sleeper
		EN 13146-1:2012,  Railway applications – Track – Test methods for fastening systems – Part 1: Determination of longitudinal rail restraint
		EN 13146-4:2012,  Railway applications – Track – Test methods for fastening systems – Part 4: Effect of repeated loads
		EN 13146-7:2012,  Railway applications – Track – Test methods for fastening systems – Part 7: Determination of clamping force
		EN 13146-8:2012,  Railway applications – Track – Test methods for fastening systems – Part 8: In service tests
		EN 13146-9:2009+A1:2011, Railway applications – Track – Test methods for fastening systems – Part 9: Determination of stiffness



21	5.3.3 sleepers	Track	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+A1:2011 Railway applications – Track – Wood sleepers and bearers

## APPENDIX 2

### Track configurations which fulfil the requirement for the track design against equivalent conicity

Table 5 shows rail profiles in configuration with design track gauges and rail inclinations that fulfil the requirements of the INF TSI against design equivalent conicity. These track configurations are those mostly applied in the EU.

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 equivalent conicity limit values listed in Table 10 of the INF TSI were taken.

The fact that a given track configuration fulfils the requirement of design equivalent conicity does not necessarily mean that the same track configuration is valid for any speed and/or axle load: other requirements (e.g. "Track resistance to applied loads", etc.) must be verified in order to determine whether a track configuration can be used on a given line.

**Table 5: Track configurations that fulfil the requirement of point 4.2.4.5 "Equivalent Conicity" (Assessed with S1002 & GV 1/40)**

Rail head profile	Design Track gauge [mm]	Rail inclinations for 60km/h <V ≤ 200 km/h	Rail inclinations for 200km/h <V ≤ 280 km/h	Rail inclinations for V>280 km/h
46 E1	1435	1:20	1:20	
	1437	1:20	1:20, 1:30, 1:40	1:20
46 E3	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20, 1:30
49 E1	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
49 E3	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
50 E3	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
50 E4	1435	1:20, 1:30, 1:40	1:20	1:20

	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
54 E1	1435	1:20, 1:30, 1:40	1:20	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1668	1:20	1:20	1:20
54 E2	1435	1:20, 1:30, 1:40	1:20, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:40	1:20
54 E3	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
56 E1	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20, 1:30
60 E1	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20, 1:30
	1668	1:20	1:20	1:20
60 E2	1435	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20, 1:30, 1:40
	1437	1:20, 1:30, 1:40	1:20, 1:30, 1:40	1:20, 1:30, 1:40