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## 0. DOCUMENT INFORMATION

### 0.1. Amendment record

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## 1. SCOPE OF THIS GUIDE

### 1.1. Scope

1.1.1 This document is an annex to the 'Guide for the application of TSIs'. It provides information on the application of the Technical Specification for Interoperability for the 'Conventional Rail Locomotives and Passenger Rolling Stock' subsystem adopted by Commission Decision 2011/291/EU of 26 April 2011 ('CR LOC&PAS TSI').

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

### 1.2. Content of the guide

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

1.2.2. Guidance is not provided for in clauses where the original CR LOC&PAS TSI requires no further explanation.

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

1.2.4. Guidance is given by means of further explanatory text and, where relevant, by reference to standards that demonstrate compliance with the CR LOC&PAS TSI; relevant standards are listed in section 4 of this document, and their purpose is indicated in the column 'purpose' of the table.

### 1.3. Reference documents

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

### 1.4. Definitions and abbreviations

Definitions and abbreviations are given in sections 2.2 and 1.4 of the CR LOC&PAS TSI, and in the general part of the 'Guide for the application of TSIs'.

## 2. GUIDANCE ON THE APPLICATION OF THE CR LOC&PAS TSI

### 2.1. Foreword

The structure of this section of the application guide follows the structure of the TSI and contains the following subsections:

- scope of the TSI
- structure of the TSI
- characterisation of the rolling stock subsystem
- interoperability constituents
- assessment of conformity
- implementation
- some practical cases

### 2.2. Scope of the TSI

#### Section 1.2: Geographical scope

*'The requirements for high speed rolling stock designed to operate on the Trans European High-Speed Rail system as provided for in Annex I (2.2) of Directive 2008/57/EC, at maximum speed intended for this high-speed network, are not covered in this TSI.'*

*'The additional requirements to this TSI that may be necessary for safe operation on high-speed networks of conventional rolling stock of maximum speed lower than 190 km/h which are in the scope of this TSI (as defined in clause 2.3 below) are identified as an open point in the current version of this TSI.'*

The operation on the HS network of an RST with a maximum speed lower than 190 km/h is addressed in the Directive, Annex I, section 2.2, which mandates that it is to be covered by the conventional TSI.

The CR LOC&PAS TSI is therefore applicable, but additional requirements may be necessary, and will be investigated when the HS RST TSI is revised. In the meantime, notified national rules may cover these additional requirements.

The following aspects should be considered:

- interface to other subsystems
- operation of trains with a wide variety of performance (maximum speed, stopping distance, etc.) on the same line.

#### Section 2.1: The rolling stock subsystem as part of the conventional rail system

*'According to Directive 2008/57/EC, the rolling stock subsystem of the trans European conventional rail system includes all trains likely to travel on all or part of the conventional lines of the TEN; the maximum operational speed of these trains is not specified.'*

Where an RST has a maximum speed higher than or equal to 190 km/h and is intended to operate on CR and HS networks, it shall be assessed against both the CR LOC&PAS and the HS RST TSIs.

See also clauses 6.1.4 and 6.2.5 of the TSI.

## 2.3. Structure of the TSI

### Section 1.3 (c) and (e): Technical specification and conformity assessment

*In accordance with Article 5(3) of Directive 2008/57/EC this TSI:*

*(c) establishes the functional and technical specifications to be met by the subsystem and its interfaces vis-à-vis other subsystems (Section 4);*

*(e) 'states, in each case under consideration, which procedures are to be used in order to assess the conformity or the suitability for use of the interoperability constituents, on the one hand, or the 'EC' verification of the subsystems, on the other hand (Section 6);'*

Where it has not been possible to specify separately the technical requirement and its conformity assessment requirement, a combined requirement is specified in section 4.

Section 6 contains particular assessment procedures, where they are specified separately; section 6 should therefore be considered in conjunction with section 4.

See also clauses 6.1.1 and 6.2.1.

## 2.4. Characteristics of the rolling stock subsystem

### Clause 4.1.2: Description of the rolling stock subject to the application of this TSI

- *Single vehicle or fixed rakes of vehicles intended for general operation and when required, predefined formation(s) of several vehicles (locomotives) of the type under assessment for multiple operation.*

*Note: Multiple operation of the unit under assessment with other types of rolling stock is not in the scope of this TSI.'*

The other types of rolling stock referred to in the note may already be authorised to be placed in service. They are not subject to a conformity assessment against this TSI at the same time as the unit under assessment. Therefore, they are not considered in the EC verification related to that unit.

Multiple operation of the unit under assessment with other types of rolling stock is managed according to the CR OPE TSI, clause 4.2.2.5: *'the combination of vehicles forming a train must comply with the technical constraints of the route concerned'*.

A predefined formation of several vehicles of the type under assessment for multiple operation can be covered by the EC verification if required by the applicant.

For example, for an electric and/or diesel multiple unit, multiple operation may include several predefined formations (2 trainsets, 3 trainsets, etc.).

### Clause 4.1.3: Main categorisation of the rolling stock for application of the TSI requirements

*'A unit can fall into one or several of the categories above. Unless stated otherwise in the clauses of the section 4.2, requirements specified in this TSI apply to all technical categories of rolling stock defined above.'*

The categories have been designed with the aim of attributing requirements to each unit under assessment.

A passenger coach with a cab falls into the following categories: 'Unit designed to carry passengers' and 'Unit fitted with a cab'.

If it is equipped with a pantograph, it also falls into the category 'electric unit', because it is supplied with electric energy in accordance with the CR ENE TSI (see definition of an electric unit given in the same clause).

#### Clause 4.2.2.2.4: Rescue coupling

*'In such a case, the unit to be assessed shall be designed so that it is possible to carry the rescue coupler on board.'*

The decision whether or not to install a rescue coupler on board should be made at operational level (outside of the scope of this TSI).

If the Railway Undertaking (RU) decides to install a rescue coupler on board, the Infrastructure Manager (IM) does not need to be involved. Otherwise, the decision not to install a rescue coupler on board should be made by the RU and the IM, with consideration of the maximum time to rescue the unit which they have to agree upon.

For example, if an RU operates on a given line many trains that can rescue each other without a rescue coupler, it may be possible to ensure the rescuing in a maximum time without a rescue coupler available on board.

#### Clause 4.2.2.4: Strength of vehicle structure

*'For mobile railway infrastructure construction and maintenance equipment (OTMs), alternative requirements to those expressed in this clause for static load, category and acceleration are set out in Annex C, clause C.1.'*

The assessment of the strength of the OTM structure is set out in the TSI, clause 4.2.2.4, and in addition by an alternative arrangement set out in Annex C.1. Thus it is possible, according to the TSI, clause 4.2.2.4 to demonstrate compliance with the requirements either by calculations or by tests. It is also made possible by the TSI, clause 4.2.2.4 and Annex C.1 to classify the OTM as PI, PII, FI or FII for the load definitions to be taken into account in the demonstration.

The aerodynamic loading and joining techniques are covered in the TSI, clause 4.2.2.4, last subparagraphs, which are applicable to all RSTs.

#### Clause 4.2.2.9: Glass

*'Where glass is used in glazing (including mirrors), it shall be either laminated or toughened glass which is in accordance with a relevant national or international standard with regard to the quality and area of use, thereby minimising the risk to passenger and staff being injured by breaking glass.'*

Some of the relevant standards are listed in sections 3 and 4. Other relevant standards should be accepted as a basis for conformity assessment, provided that their relevance is proven by the applicant to the NoBo.

#### Clause 4.2.2.10: Load conditions and weighted mass

*'For OTMs, different load conditions (minimum mass, maximum mass) may be used, in order to take into account optional on-board equipment.'*



An OTM may be operated in different configurations, for example equipped with different tools for different tasks or functions. This optional onboard equipment might, for each configuration, affect the mass of the vehicle. Therefore, the different masses depending on the configuration may be considered when defining the load conditions according to the TSI.

### Clause 4.2.3.1: Gauge

*'The kinematic reference contour with its associated rules describes the outer dimensions of the unit; it shall be within one of the reference profiles GA, GB or GC (according to clause 4.2.2 of the CR INF TSI). The assumed sway (or flexibility) coefficient for the gauge calculation shall be justified by calculation or measurements as set out in EN 15273-2:2009.'*

The target reference profiles are set out in the CR INF TSI, which specifies a calculation based on the kinematic method as set out in standard EN 15273-3. Hence the method for calculating the reference profile of rolling stock is also based on the kinematic method.

*'For electric units, the pantograph gauge shall be verified by calculation according to clause A.3.12 of EN 15273-2:2009 to ensure that the pantograph envelope complies with the mechanical kinematic pantograph gauge which in itself is determined according to Annex E of CR ENE TSI, and depends on the choice made for the pantograph head geometry: the two permitted possibilities are defined in clause 4.2.8.2.9.2 of this TSI.'*

*The voltage of the power supply is considered in the infrastructure gauge in order to ensure the proper insulation distances between the pantograph and fixed installations.*

*The pantograph sway as specified in clause 4.2.14 of CR Energy TSI and used for the mechanical kinematic gauge calculation shall be justified by calculations or measurements as set out in EN 15273-2:2009.'*

The pantograph envelope has interfaces with the three TSIs, CR INF, CR ENE and CR LOC&PAS:

- It is based on the pantograph head geometry defined in clause 4.2.8.2.9.2 of the CR LOC&PAS TSI, used as a reference for the overhead line contact position.
- The mechanical kinematic pantograph gauge calculation method is described in Annex E of the CR ENE TSI.
- This is complemented by the electrical clearance, which has to be considered for the structure gauge defined in clause 4.2.4.1 of the CR INF TSI.  
The necessary electrical clearance between the pantograph and fixed installations depends on the supply voltage (i.e. 25 kV AC, 15 kV AC, 1.5 kV DC, 3 kV DC) and on local conditions for the insulation and creepage distance calculations (which are known by the IM); they are needed for defining the structure gauge.  
Note: this aspect is covered when defining the structure gauge; it does not fall within the scope of the CR LOC&PAS TSI.

For verifying the sway coefficient (or the flexibility coefficient) of the pantograph, which is considered in the mechanical part of the equation, simulations or input from past designs may be used, or finally a 'type' test may acknowledge the sway coefficient.

*‘Any gauge, with a kinematic reference profile smaller than GC, may also be recorded in the register together with the harmonised applicable gauge (GA, GB or GC), provided it is assessed using the kinematic method.’*

Not all RSTs are optimised with a gauge corresponding exactly to one of the target gauges, and other gauges may be considered for the design of the RST. In order to allow compatibility checks between the RST and existing infrastructure, it is considered useful, in addition to the target reference gauge, to also declare the actual RST gauge in the vehicle type register (ERATV).

#### Clause 4.2.3.2.1: Axle load

*‘The axle load is a performance parameter of the infrastructure specified in clause 4.2.2 of the CR INF TSI.’*

The load-carrying capacity of the infrastructure defines the limiting value that the RST axle load is required not to exceed.

*‘Use of this information at operational level for compatibility check between rolling stock and infrastructure (outside the scope of this TSI):*

*The axle load of each individual axle of the unit to be used as interface parameter to the infrastructure has to be defined by the Railway Undertaking as required in clause 4.2.2.5 of the CR OPE TSI.’*

The axle load of a rolling stock is one of the parameters used for the technical compatibility of the rolling stock to the infrastructure. The TSI does not set out the maximum axle load which has to be taken into account for this technical compatibility assessment as this approach would be too restrictive. Instead, reference is made to clause 4.2.2.5 of the OPE TSI which states that the RU is responsible for the train composition and is required to ensure that *‘the weight of the train must be within the maximum permissible for the section of route. Axle load limitations must be respected’*. In this way, the RU should control the payload of its rolling stock by operating rules in order for it to be compatible with the route.

#### Clause 4.2.3.3.1: Rolling stock characteristics for the compatibility with train detection systems

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

The set of parameters in order to be compatible with train detection systems, such as track circuits, axle counters and loop systems, have been identified in the TSI with references to the CCS TSI for each parameter and type of train detection system.

The TSI requirement for rolling stock regarding compatibility with the CCS TSI is that the train detection system(s) with which the rolling stock has been assessed as being compatible is (are) declared (recorded in the ERATV).



The RST is allowed to be non-compatible with any TSI specification relating to this clause, but this has to be recorded in the register.

At present, there are several open points declared in the relevant TSIs (e.g. electromagnetic compatibility).

These open points, as well as compatibility with the existing train detection systems, are to be checked at MS level according to the notified national rules by a designated body appointed by the MS. This verification does not fall within the scope of the TSIs, but is part of the authorisation for placing in service; its result will be indicated in the ERATV by means of reference to these national rules.

### Clause 4.2.3.3.2: Axle bearing condition monitoring

*‘The range of working temperature of the axle bearing is an open point.  
Note: see also clause 4.2.3.5.2.1 regarding axle boxes.’*

The range of working temperatures of the axle bearing is an open point in the TSI. It should be noted, however, that it is required in clause 4.2.3.5.2.1 of the TSI that *‘temperature limits reached in service shall be defined and recorded in the technical documentation’*. With this information, the RU and the IM providing the service of line-side detectors can check the adequacy of the temperature alarm levels of line-side detectors for that particular rolling stock (limit of the outside temperature of the axle box to be extrapolated from the axle bearing temperature working range, considering also that, in the case of failure, there is a rapid increase of temperature far above the nominal temperature working range).

Clause 4.2.3.5.2.1 also applies to units fitted with onboard detection equipment (information to be used for the definition of onboard alarm levels).



## Clause 4.2.3.4.2: Running dynamic behaviour (and subclauses)

### b) Requirements

*'In order to verify the running dynamic characteristics of a unit (running safety and track loading), the process sets out in EN 14363:2005 clause 5 and in addition for tilting trains in EN 15686:2010 shall be followed, with the amendments expressed below (in this clause and its sub clauses). The parameters described in clauses 4.2.3.4.2.1 and 4.2.3.4.2.2 shall be assessed using criteria defined in EN 14363:2005.'*

The TSI mandates that rolling stock is tested for its running dynamic behaviour according to the procedures set out in standard EN 14363.

In accordance with standard EN 14363, different procedures for testing may apply:

- for new types of rolling stock, which have not yet been subject to testing, a complete on-track test must be carried out;
- for rolling stock similar to a type previously subject to testing as described above, a partial test might be sufficient;
- furthermore, if certain criteria as set out in standard EN 14363 are met, a dispensation from testing is permitted. In that case, open points regarding test track are not applicable; this applies in those MSs in which the 'initial acceptance' (as defined in standard EN 14363) has been used.

There are two methodologies for performing complete or partial on-track tests; normal and simplified measuring methods:

- the normal method requires measurement of all track forces;
- the simplified method requires measurement of lateral axle box forces, or measurement of acceleration only, the choice of the parameters to be measured depending on fulfilment of certain criteria as set out in standard EN 14363.

The test conditions are set out in the clause of standard EN 14363 dealing with track geometry and track quality.

The requirements for track geometry define the straight and curved track sections on which the rolling stock has to be tested, including required combinations of test speed and curve radii.

It is recognised that it is difficult to meet all the requirements and conditions set out in standard EN 14363 for the running dynamic testing of rolling stock; therefore:

- open points are declared in the TSI for the test conditions and the test track quality;
- amendments concerning the requirement to test on two different rail inclinations, and some of the assessment criteria, are also introduced in the TSI. Thus, testing of rolling stock on only one rail inclination is allowed if the testing procedure partly includes tests with equivalent conicities as specified in the TSI, and the instability criterion is met;
- the TSI allows for the assessment criteria Y/Q to be evaluated by an alternative statistical method.
- the Yqst criteria has been defined differently in the TSI, with consideration of the radii.

## b) Requirements

*In addition to the requirements concerning the test report given in clause 5.6 of EN 14363:2005, the test report shall include information on:*

- *The track quality on which the unit was tested on, recorded by the monitoring of a consistent set of some of the parameters set out in EN 13848-1:2003 / A1:2008, the selected set of parameters depending on available measurement means.'*

The quality of the track on which the rolling stock was tested is subject to the requirements set out in standard EN 14363; it has to be recorded in the test report.

This TSI requirement specifies the format of the track quality data: the test report should include available data regarding the track geometric quality as described in standard EN 13848-1, together with the method used to collect this data.

### Clause 4.2.3.4.2.2: Track loading limit value

*The limit value for unrestricted operation of the rolling stock on the TEN network (as defined in TSIs) shall be:  $(Y_{qst})_{lim} = (30 + 10500/R_m)$  kN.*

*Where:  $R_m$  = mean radius of the track sections retained for the evaluation (in metres).*

*When this limit value is exceeded due to high friction conditions, it is permitted to recalculate the estimated value of  $Y_{qst}$  on the zone after replacing the individual  $(Y_{qst})_i$  values on the track sections 'i' where  $(Y/Q)_{ir}$  (mean value of Y/Q ratio on the inner rail over the section) exceeds 0,40 by:  $(Y_{qst})_i - 50[(Y/Q)_{ir} - 0,4]$ . The values of the  $Y_{qst}$ ,  $Q_{qst}$  and mean curve radius (before and after recalculation) shall be recorded in the test report.*

*In case the  $Y_{qst}$  value exceeds the limit value expressed above, the operational performance of the rolling stock (e.g. maximum speed) may be limited by the infrastructure, considering track characteristics (e.g. curve radius, cant, rail height).'*

The parameter  $Y_{qst}$  is an interface parameter between rolling stock and infrastructure that should not be considered as a pass/fail criterion, but rather as a cause of the wear of the rail caused by the rolling stock in curves. Therefore the notion of this particular criterion is downplayed in the TSI to a reference value. A value exceeding the limiting value is not seen as non-compliance of the rolling stock with the TSI, but is rather a boundary for the technical compatibility with particular characteristics of the track that may lead to speed limitation in curves.

See also clause 7.5.1.2 of the TSI (subject to be examined when revising the TSI).

### Clause 4.2.3.4.3.2: In-service values of equivalent conicity

*The 'in-service values of the track conicity' is an open point in the CR infrastructure TSI; therefore, the 'in-service values of wheelset conicity' is an open point in this TSI.*

*This clause is excluded from the assessment made by a notified body.*

*When a unit is operated on a given line, the equivalent conicity in-service values shall be maintained considering the specified limits for the unit (see clause 4.2.3.4.3) and local conditions*

*of the network?*

In-service values cannot be checked by a notified body when assessing a new RST. There is, however, concern among experts that the equivalent conicity should be controlled and limited for running safety reasons. Therefore, maintenance limits of wheels and wheelsets are addressed in this clause of the TSI, but are declared as an open point due to the absence of harmonised maintenance limits relating to the track.

During operation, these limits are to be kept within the limit values considering the local conditions of the infrastructure on which the rolling stock is operated.

The following elements regarding maintenance limits of wheels and wheelsets, and how local conditions of the network may be considered, are given for the attention of RUs (Railway Undertakings) and ECMs (Entities in Charge of Maintenance):

The maintenance plan should set out the RU's (or ECM's) procedures for maintaining wheelsets and wheel profiles. The procedures should take account of the conicity ranges for which the vehicle is designed (see clause 4.2.3.4.3 of the TSI).

Wheelsets should be maintained to ensure (directly or indirectly) that the wheelset conicity remains within the approved limits for the vehicle when the wheelset is modelled passing over those of the representative samples of track test conditions (simulated by calculation) specified in Table 3 of the TSI which are relevant considering local conditions of the network.

For a novel bogie / vehicle design, or for operation of a known vehicle on a route with relevant different characteristics, the development of wear of a wheel profile, and therefore the change in wheelset conicity, is usually not known. In this case, a provisional maintenance plan should be proposed. The validity of the plan should be confirmed following monitoring of the wheel profile and equivalent conicity in service. The monitoring should consider a representative number of wheelsets, and should take into account the variation between wheelsets in different positions in the vehicle and between different vehicle types in the trainset.

If the running dynamic test required in clause 4.2.3.4.2 of the TSI has been performed with a representative wheel profile (naturally worn in service or theoretically worn) on test track sections as defined in UIC 518:2009, clause 6.2.3, then the maintenance plan may be based on the monitoring of the geometrical dimensions of the wheels, with a wheel profile limit extrapolated from the test conditions (and compliant to clause 4.2.3.5.2.2 of the TSI). The in-service value of equivalent conicity is then indirectly controlled, with the assumption that the test track sections are representative of the actual network on which the RST is operated.

In all cases, if ride instability is reported, the RU should model the measured wheel profiles and distances between active faces of the wheels over the representative sample of track test conditions specified in Tables 2 and 3 of the TSI to check for compliance with the maximum equivalent conicity at which the vehicle is designed and certified to be stable.

If the wheelsets comply with the maximum equivalent conicity at which the vehicle is designed and certified to be stable, the CR INF TSI requires the IM to check the track for compliance with the requirements set out in the CR INF TSI.

If both vehicle and track comply with the requirements of the relevant TSIs, a joint investigation by the RU and the IM shall be undertaken to determine the reason for the instability.

### Clause 4.2.3.5.2.1: Mechanical and geometric characteristics of wheelsets

*Mechanical behaviour of axles:*

*In addition to the requirement on the assembly above, the demonstration of compliance for mechanical resistance and fatigue characteristics of the axle...'*

The assessment of the axle potentially comprises two stages.

The first stage of the process is to perform a mechanical strength calculation and to evaluate the calculated stress against stress limit values.

The second stage, a bench test, should only be performed when the validity of the stress limit value used in the first stage have to be checked. EN 13260 and EN 13261 sets out the verification procedure to be followed for this verification.

A full-scale fatigue testing, which is mandated by the TSI, is required for the validation of the axle and wheelset assembly fatigue characteristics, but is only required when major changes are introduced in the manufacturer's fabrication process for axle or wheelset, including those introduced by the material manufacturer or when the axle manufacturer changes the supplier of the material.

*Verification of manufactured axles:*

*A verification procedure shall exist to ensure at the production phase that no defects may decrease the mechanical characteristics of the axles'*

The axle is considered a safety-relevant component which needs to be checked and controlled, not only for the design criteria, but also for ensuring end-quality of the product. Standard EN 13261 sets out the verification procedure to be followed for the parameters stated in the TSI: the number of samples to be checked in production, the procedures to be followed for any changes in the design of the axle or changes of manufacturer of the material of the axle, etc.

*Geometrical dimensions of wheelsets:*

*The dimensions  $A_R$  and  $S_R$  shall be complied with in laden and tare conditions. Smaller tolerances within the above limits may be specified by the manufacturer in the maintenance documentation for in-service values'*

For the type test, the wheelset dimensions are to be checked, not only on a wheelset at component level, but also when the wheelset is subject to loading (corresponding to the load conditions defined in clause 4.2.3.5.2).

For the routine test required in Annex H, these dimensions may be checked for only one load case (design mass in working order).

The values set out in the TSI for the dimensions are the extreme values (limits); the maintenance limits are to be set not to exceed these extreme values.

### Clause 4.2.3.5.2.2: Mechanical and geometric characteristics of wheels

*Mechanical behaviour:*

*The mechanical characteristics of the wheel shall be proven by mechanical strength calculations,..., as specified in EN 13979-1:2003 clauses 7.2.1 and 7.2.2.'*

The assessment of the interoperability constituent 'wheel' potentially comprises several stages, which are explained below.

The process is to perform a mechanical strength calculation and to evaluate the calculated stress against the permissible stress limit values.

*'...where the calculation show values beyond the decision criteria, a bench test according EN 13979-1:2003/A1:2009 clause 7.3 is required to be performed to demonstrate compliance. For forged and rolled wheels, the fatigue characteristics (considering also the surface roughness) shall be verified by a fatigue type test of 10 million load cycles with a fatigue stress in the web of less than 450 MPa (for machined webs) and 315 MPa (for unmachined webs), with a probability of 99.7%. The fatigue stress criteria are applicable to steel grades ER6, ER7, ER8 and ER9; for other steel grades the decision criteria shall be extrapolated from the known criteria of the other materials.'*

The following stage is only required in the case where the stress determined by the mechanical strength calculation (according to stage above) exceeds the permissible stress limit values defined in standard EN 13979-1.

This stage comprises a fatigue bench test to validate the wheel fatigue design.

*Thermo-mechanical behaviour:*

*If the wheel is used to brake a unit with blocks acting on the wheel running surface, the wheel shall be thermo mechanically proven by taking into account the maximum braking energy foreseen. A type test, as described in EN 13979-1:2003/A1:2009 clause 6.2 shall be performed in order to check that the lateral displacement of the rim during braking and the residual stress are within tolerance limits specified.'*

This additional stage is only required in the case where the wheel is intended to be used with brake blocks applied on the tread for braking purpose.

This stage is intended to check the thermo-mechanical aspect induced by brake blocks.

*Verification of manufactured wheels:*

*A verification procedure shall exist to ensure at the production phase that no defects may decrease the mechanical characteristics of the wheels'*

The wheel is considered a safety-relevant component which needs to be checked and controlled, not only for the design criteria, but also for ensuring end-quality of the product. Standard EN 13262 sets out the verification procedure to be followed for the parameters stated in the TSI; it includes the product characteristics to be verified, the number of samples to be checked in production, the procedures to be followed for any changes in the design of the wheel or changes of manufacturer of the material of the wheel, etc.

Full-scale fatigue testing according to standard EN 13262 is required for the validation of the wheel material, but is only otherwise required when major changes are introduced in the



manufacturer's process or when the wheel manufacturer changes the supplier of the material.

### Clause 4.2.3.5.2.3: Variable gauge wheelsets

*'The changeover mechanism of the wheelset shall ensure the safe locking in the correct intended axial position of the wheel'*

The objective of including this type of wheelset in the TSI is to achieve a general acceptance of RSTs equipped with such variable gauge wheelsets in all MS. The requirement is limited to the safe locking into place of the wheels after a changeover has been effectuated; its assessment is an open point.

For a dual-gauge RST, the TSI requirement above applies to the positions (track gauges) identified in the TSI. More generally, the TSI requirements apply in the following way:

1. If there is no specific case applicable

The dual-gauge RST is intended to be operated only on the part of the CR TEN network with a track gauge of 1435 mm; it has to be assessed against the TSI with its axles in the position '1435 mm track gauge'.

The EC declaration of verification is limited to the '1435 mm track gauge' position.

The dual-gauge RST may be verified according to national rules with its axles in another position for operation on the off-TEN network.

2. If there is a general specific case applicable to the RST (clause 7.3.2.1 of the TSI) or a specific case applicable to wheelsets (clauses 4.2.3.5.2 and 7.3.2.8 of the TSI)

There are 2 possibilities:

a) The dual-gauge RST is intended to be operated only on the part of the CR TEN network with a track gauge corresponding to the specific case; it has to be assessed against the TSI (and national rules corresponding to the specific case) with its axles in that position.

The EC declaration of verification is limited to that 'track gauge' position.

It may be verified according to national rules with its axles in another position for operation on the off-TEN network.

b) The dual-gauge RST is intended to be operated on the part of the CR TEN network with a track gauge corresponding to the specific case and on the part of the CR TEN network with a track gauge of 1435 mm.

It has to be assessed against the TSI with its axles in the two different positions; the conformity assessment procedure (including tests) has to be duplicated for the TSI requirements for which the axial position of wheels has an impact.

The EC declaration of verification has to clearly indicate that both positions have been assessed.

The installations and procedures to change the wheelset gauge and compatibility with the existing changeover installation are not covered; they should be addressed at national level, where relevant (border between different track gauges).

### Clause 4.2.4.1: Braking – General

*'This interface between Infrastructure and Rolling stock is covered by the clause 4.2.2.6.2 of the CR OPE TSI.'*

See the part of the application guide covering the OPE TSI, in particular Annex T 'Braking performance'.

#### Clause 4.2.4.2.1: Functional requirements

*'The temperature reached around the brake components shall also be considered in the design of the rolling stock.'*

The components in the vicinity of brake components have to be designed with consideration of the temperature reached around these components, and should maintain their functionality at that temperature.

This applies in particular to wheels with built-in brake discs; the wheel and the attachment of the disc have to take into account the effective temperature reached and the heat transfer when brakes are used. Taking the heat transfer into account is advisable in order to prevent thermo-mechanical problems (thermal fatigue) in the wheel web.

*'A brake application command, whatever its control mode, shall take control of the brake system, even in case of active brake release command; this requirement is permitted not to apply when intentional suppression of the brake application command is given by the driver (e.g. passenger alarm override, uncoupling...).'*

Intentional suppression (combined with other functions) of the brake application by the driver is allowed in those specific situations described in the documentation for operation.

#### Clause 4.2.4.4.1: Emergency braking command

*'Unless the command is cancelled, the emergency brake activation shall lead permanently, automatically and in less than 0.25 seconds to the following actions:*

- transmission of an emergency brake command along the train by the brake control line at a defined transmission speed, which shall be higher than 250 metres/second.*
- cut-off of all tractive effort in less than 2 second; this cut-off shall not be able to be reset until the traction command is cancelled by the driver.*
- a inhibition of all 'release brake' commands or actions.'*

The emergency brake activation leads to the described actions; these actions may only be suspended following a cancellation of the emergency braking command; if the signal which has led to the emergency braking activation disappears for a reason other than cancellation (e.g. in the case of command failure), this is not considered as a cancellation, and the described actions continue to be applied.

The time specified (0.25 s) is the time within which actions have to be initiated.

The time within which the action is to be completed is specified for each action, where relevant.

The transmission speed of the emergency brake command is specified as a reference for brake systems with pneumatic brake pipe; for all types of brake system, the response time specified in

clause 4.2.4.5.2 must also be fulfilled.

#### Clause 4.2.4.4.2: Service braking command

*The service brake function shall allow the driver to adjust (by application or release) the brake force between a minimum and a maximum value in a range of at least 7 steps (including brake release and maximum brake force), in order to control the speed of the train.'*

It is not required to have mechanical notches on the brake lever corresponding to the steps; the brake lever may be of any type (continuous, with pulses, time dependant, etc.); the objective is to have a sufficient precision of the service brake command.

#### Clause 4.2.4.4.5: Parking braking command

*'The parking braking command shall lead to the application of a defined brake force for an unlimited period of time, during which a lack of any energy on board may occur.'*

The 'unlimited period of time' means that the parking brake force shall not rely on stored energy on board; this may be validated by a design review. A test can only be performed during a limited period of time.

#### Clause 4.2.4.5.1: Braking performance – General

*'The friction coefficients used by friction brake equipments and considered in the calculation shall be justified (see standard EN14531-1:2005 clause 5.3.1.4).'*

The friction coefficients considered in the calculation have to be chosen from data (abacus) provided by the supplier, taking into account their environmental conditions as described in standard EN 14531-1 (which depend on general environmental conditions specified in clause 4.2.6.1 of the TSI, and on effects internal to the rolling stock due to the braking system). They should correspond to the value met during tests (possible correction after tests).

#### Clause 4.2.4.5.2: Emergency braking performance

*'Degraded conditions shall consider possible single failures; to that end, the emergency braking performance shall be determined for the case of single point failures leading to an increase of the brake distance of more than 5%, and the associated single failure shall be clearly identified (component involved and failure mode, failure rate if available).'*

The TSI mandates the identification of single point failures and the evaluation of their impact on the braking performance; for those extending the stopping distance by more than 5%, a calculation of the emergency braking performance with that failure shall be provided, together with the description of the corresponding failure, and failure rate if available.

#### Clause 4.2.4.5.3: Service braking performance

*'Maximum service braking performance:*

*When the service braking has higher design performance capability than the emergency braking, it shall be possible to limit the maximum service braking performance (by design of the braking control system, or as a maintenance activity) at a level lower than the emergency braking performance.*

Note:

*Member States may ask the emergency braking performance to be at a higher level than the maximum service braking performance for safety reasons, but in any case they cannot prevent the access to a railway undertaking using a higher maximum service braking performance, unless that Member State is able to demonstrate that the national safety level is endangered.'*

The TSI allows the design of an RST with the service braking having a higher performance capability than the emergency braking.

The limitation of the service braking performance (when required, as stated above) may be obtained by an intervention at a maintenance workshop (e.g. change of software or change of settings of the braking system components).

The NSA is allowed to limit the maximum service braking performance, but where an RU does not agree and has adequate operating rules the NSA must demonstrate that such a limitation is necessary to maintain the national level of safety.

#### Clause 4.2.4.6.1: Limit of wheel rail adhesion profile

*'The braking system of a unit shall be designed so that the service brake performance without dynamic brake and the emergency brake performance do not assume a calculated wheel/rail adhesion in the speed range > 30 km/h higher than the following values:*

- 0.15 for locomotives, for units designed to carry passengers assessed for general operation, and for units assessed in fixed or pre-defined formation(s) having more than 7 and less than 16 axles.*
- 0.13 for units assessed in fixed or pre-defined formation(s) having 7 axles or less.*
- 0.17 for units assessed in fixed or pre-defined formation(s) having 20 axles or more. This minimum number of axles may be reduced to 16 axles if the test required in section 4.2.4.6.2 related to the efficiency of the WSP system provides positive results; otherwise 0.15 shall be used as limited value of the wheel rail adhesion between 16 and 20 axles.'*

The wheel rail adhesion limits specified are considered as realistic values on the basis that the wheel rail contact should not rely on higher adhesion coefficients.

These limits do not prevent the unit from being subject to the test to verify the efficiency of the WSP system (test required in clause 4.2.4.6.2).

0.15 is the usual limit for units operated in general operation (train formation not known at design stage); for these units, the WSP test is performed with a representative train configuration (as the future train formations are not known).

For short trainsets, a lower limit is specified because it is known that they are more sensitive to degraded adhesion conditions; the opposite applies for long trainsets. For all trainsets, the check of the efficiency of the WSP is performed with the real train configuration, therefore validating the real behaviour of the train in degraded adhesion conditions.

#### Clause 4.2.4.6.2: Wheel slide protection system

*'when reference is made to the clause 6.2 of EN 15595:2009 'overview of required test*

*programmes’, only the clause 6.2.3 applies, and it applies to all types of units.’*

Section 6.2.1 of the standard is specific to coaches, but cannot be referred to in the TSI for two reasons: this clause assumes a certain stopping distance performance which is not specified in the TSI, and the definition of a coach is not given in this TSI.

Clause 6.2.3 is more general, and can apply to all types of RST.

Where a coach has a stopping distance consistent with clause 6.2.1, the applicant may comply on a voluntary basis with clause 6.2.1 in addition to clause 6.2.3.

#### **Clause 4.2.4.7: Dynamic brake – Braking system linked to traction system**

*‘Subject to a safety analysis covering the hazard ‘after activation of an emergency command, complete loss of the brake force’.*

*Note: for electric units, this analysis shall cover failures leading to absence on-board the unit of the voltage delivered by the external power supply.’*

Where the dynamic brake is included in the emergency braking performance, the TSI mandates evaluation of the global reliability of this dynamic brake. If relevant, the onboard parts of the power supply also have to be considered (pantograph, inverter, etc.), and a hypothesis has to be taken regarding the availability of the external power supply.

#### **Clause 4.2.4.8.2: Magnetic track brake**

*‘A magnetic track brake is allowed to be used as an emergency brake, as mentioned in the CR INF TSI, clause 4.2.7.2.’*

This clause addresses the emergency brake only.

It does not prohibit the use of braking systems independent of wheel-rail adhesion for the service brake; this use may be subject to restrictions, which are described in the Infrastructure register.

Clause 4.2.7.2 of the CR INF TSI states:

*‘(1) Track shall be designed to be compatible with the use of magnetic track brakes for emergency braking.*

*(2) The compatibility (or otherwise) of the design of track adopted with the use of braking systems independent of wheel-rail adhesion conditions for service braking and for emergency braking shall be published in the Register of Infrastructure.*

*Braking systems independent of wheel-rail adhesion conditions include magnetic track brakes and eddy current track brakes.*

*(3) Where the track is compatible with the use of braking systems independent of adhesion conditions, the Register of Infrastructure shall state any limitation on the use of the braking systems on which compatibility depends, taking into account local climatic conditions and the expected number of repeated brake applications at a given location.’*

Electro-magnetic compatibility aspects for interface to axle counters are covered in clause 4.2.3.3.1.2; there is an open point to be verified according to national rules by the Designated Body (DeBo) for magnetic brakes, whatever their use (emergency or service brake).

#### Clause 4.2.4.9: Brake state and fault indication

*'To that end, it shall be possible at certain phases during operation for the train staff to identify the status (applied or released or isolated) of the main (emergency and service) and parking brake systems, and the status of each part (including one or several actuators) of these systems that can be controlled and/or isolated independently.*

*If the parking brake always depends directly on the state of main brake system, it is not required to have an additional and specific indication for the parking brake system.'*

Control of the status of the braking system directly depends on the design of the system; the choice of the parts to be controlled independently is made by the applicant. It has a direct impact on degraded operating conditions, which have to be described in the documentation required by clause 4.2.12.4.

#### **Applicability to units intended for general operation:**

*'Only functionalities that are relevant to the design characteristics of the unit (e.g. presence of a cab,...) shall be considered.*

*The signals transmission required (if any) between the unit and the other coupled unit(s) in a train for the information regarding the brake system to be available at train level shall be documented, taking into account functional aspects.'*

For example, in the case of assessment of a passenger carriage for general operation with no cab, it is not possible to check the information the driver receives in the cab; it is only possible to check local indications (e.g. external brake indicators) and electric or numeric information that is to be transmitted to a cab when the carriage is integrated in a train.

## Clause 4.2.5: Passenger-related items

*‘For information purposes only, the following non exhaustive list gives an overview of the basic parameters covered by the PRM TSI, which are applicable to conventional units which are intended to carry passengers:’*

The PRM TSI is in force and applies independently of the CR LOC&PAS TSI to the RST that is designed to carry passengers and that falls within the scope of the CR LOC&PAS TSI.

### Clause 4.2.5.3: Passenger alarm: functional requirements

*‘The passenger alarm shall comply either:*

- a) with the HS RST TSI 2008 clause 4.2.5.3.*
- b) or alternatively, with the provisions described below, which then replace the provisions of the HS RST TSI 2008 for application to units in the scope of this CR LOC&PAS TSI.’*

The TSI allows the options of either applying the requirements described in the HS RST TSI:2008 (referred to for CR RST in clause 4.2.5.8 of the SRT TSI:2008) for the passenger alarm and brake override, or to apply an alternative passenger alarm which does not initiate braking but establishes a communication link between the driver and the place in which the alarm was initiated.

**Note:** to allow the alternative, clause 4.2.5.8 of the SRT TSI:2008 is repealed (see Article 8 of Commission Decision on the CR LOC&PAS TSI).

*‘A device in the cab shall allow the driver to acknowledge his awareness of the alarm. The driver’s acknowledgement shall be perceivable at the place where the passenger alarm was triggered and shall stop the acoustic signal in the cab.’*

When a passenger alarm is initiated, this results in visual and acoustic indications in the cab. In the case of no acknowledgement of the alarm by the driver, a brake will be initiated after 10 seconds, which will be perceived by passengers as a confirmation of the alarm; this is consistent with clause 4.2.5.3 of the HS RST TSI (*‘transmit an acknowledgement, recognisable by the person who triggered the signal (acoustic signal in the vehicle, braking application, etc.)’*).

If the passenger alarm is acknowledged by the driver, the clause above applies. There will be no automatic application of the brake, but passengers should be informed that the driver is aware of the alarm; the means to inform passengers is not specified in the TSI, but is required as being a direct consequence of the acknowledgment by the driver; it is not mandatory to have this information given simultaneously to the driver’s acknowledgment of the alarm, but it should be given within 10 seconds of the passenger alarm being initiated.

For example, the means to inform passengers could be an acoustic signal in the unit (as mentioned in the HS RST TSI; e.g. automatic announcement triggered by the driver’s acknowledgment), or it could be a visual sign (light in the place where the alarm was initiated).

*‘Criteria for a train departing from a platform:*

*A train is deemed to be departing from a platform during the period of time elapsing between the moment when door status is changed from 'released' to 'closed and locked' and the moment when the last vehicle has left the platform.  
This moment shall be detected by an on-board device.'*

This text defines the functional requirement.

*'If the platform is not physically detected, the train is deemed to have left the platform when:*

- *The speed of the train reaches 15 (+/- 5) km/h, or:*
- *The distance covered is 100 (+/- 20) m*

*Whichever occurs the first.'*

This text allows for a simplified technical solution in the case where there is no onboard device that detects the end of the platform.

The applicant may implement a similar technical solution using a distance higher than 100 m, providing that it demonstrates the criterion will occur before the last vehicle has left the platform (in accordance with the definition of 'train be departing from the platform' given in the functional requirement set out above).

**'Safety requirements:**

*The passenger alarm is considered to be a safety related function, for which the required safety level is deemed to be satisfied by the following requirements:*

- *A control system shall permanently monitor the ability of the passenger alarm system to convey the signal.  
As alternative, a passenger alarm system with no control system (as described in this bullet point) shall be accepted if it is demonstrated to be compliant with the required safety level; the value of the required safety level is an open point.'*

The safety level is by default safeguarded by the control system described (permanent monitoring that the signal can be conveyed).

However, alternative design of the passenger alarm system is equally permitted, relying on a safety level for its ability to convey the signal from the passenger alarm to the cab.

Other functionalities of the passenger alarm system than those described in this subclause are not considered to be safety-related.

**Applicability to units intended for general operation:**

*'Only functionalities that are relevant to the design characteristics of the unit (e.g. presence of a cab, of a crew interface system,..) shall be considered.*

*The signals transmission required between the unit and the other coupled unit(s) in a train for the communication system to be available at train level shall be implemented and documented, taking into account functional aspects.'*



When the unit under assessment has to be coupled to other units to be operated as a train, and the train composition is not defined, it is not usually possible to verify all functionalities; only information available on the unit under assessment needs to be verified.

Note: this also applies to clauses 4.2.5.5 and 4.2.5.6.

#### Clause 4.2.5.6: Exterior doors: passenger access to and egress from Rolling Stock

*‘The control of external passenger access doors is a safety related function; the functional requirements expressed in this clause are necessary to ensure the safety level required; the safety level required for the control system described in points D and E below is an open point.’*

The remote control of doors by the driver or the crew must be designed taking into account any hazards relating to the safety of passengers (unintentional opening of doors, reliability of the information given by the ‘doors-closed proving system’, etc.).

#### Clause 4.2.5.9: Internal air quality

*‘In case of interruption of the ventilation, due to an interruption of the main power supply or to a breakdown of the system, an emergency provision shall ensure the supply of outside air into all passenger and staff areas.  
If this emergency provision is ensured through battery supplied forced ventilation, measurements shall be performed in order to define the duration ...’*

If the emergency provision is ensured through battery-supplied forced ventilation, this functionality is limited in time due to the autonomy of the battery; therefore, the expected duration during which the functionality will be met must be evaluated.

Alternatively, the requirement can be met by provision of passive facilities such as openable windows or flaps (providing external air into the train). Since the airflow through such passive devices will vary with the ambient conditions, and therefore cannot be directly assessed, operational rules (outside the scope of the CR LOC&PAS TSI) are needed for the effective use of such facilities.

*‘Train staff shall have the possibility of preventing passengers being exposed to environmental fumes that may be present, especially in tunnels. This requirement shall be satisfied by compliance to clause 4.2.7.11.1 of the HS RST TSI.’*

The means to be used by the train staff (manual closing or closing by remote control) are not specified, and therefore not mandated.

### Clause 4.2.6.1: Environmental conditions

*'The design of rolling stock, as well as its constituents shall take into account the environmental conditions to which this rolling stock will be subjected to.'...*

*'For the functions identified in the clauses below, design and/or testing provisions taken to ensure that the rolling stock is meeting the TSI requirements in this range shall be described in the technical documentation.'....*

*'Depending on the ranges selected, and on provisions taken (described in the technical documentation), relevant operating rules could be necessary to ensure the technical compatibility between the rolling stock and environmental conditions that can be met on parts of the TEN network.*

*In particular, operating rules are necessary when rolling stock designed for the nominal range is operated on a particular line of the TEN network where the nominal range is exceeded at certain periods of the year.'*

Environmental conditions specified in the TSI are limited to physical, chemical or biological conditions external to the rolling stock to which they will apply at a certain time. The TSI mandates that these conditions are taken into account in the design of the rolling stock, and the TSI defines a nominal range for these conditions covering most parts of Europe.

However, a few MSs have concerns because they have more severe conditions during some periods of the year. To cover this, severe ranges are specified for the temperature parameters (both low and high temperatures) and snow, ice and hail. The severe ranges of temperature, T2 (-40°C to +35°C) and T3 (-25°C to +45°C), reflect the different climates found throughout Europe.

The design and assessment of rolling stock can take into consideration one of the severe conditions or a combination of several severe conditions. If this choice is made by the applicant, the TSI mandates that all requirements are met for that severe condition; in that case, provisions in design and/or in testing are to be identified and demonstrated by the applicant. In addition, these provisions should be reported in the technical documentation of the rolling stock. These provisions may be considered for establishing operating rules (mitigation in the case of conditions not covered by the aforesaid provisions).

It should be noted that the assessment is to establish that the functionality of the rolling stock mandated by the TSI is maintained, either by design provisions (actual testing of the components, protection of the components from environmental extremes, etc.) which are covered by the 'EC' declaration of verification, or by operational limitations on the use of the equipment defined at operational level (see also the CR OPE TSI, clause 4.2.1.2.4), on the basis of the technical documentation which is part of the technical file attached to the 'EC' declaration of verification.

### Clause 4.2.6.1.7: Resistance to pollution

*'Note: reference to standards in this clause is relevant only for the definitions of substances having a polluting effect.*

*The polluting effect as described above has to be evaluated at the design stage.'*

The clause in the TSI on resistance to pollution is applied at the design phase of the rolling stock. The applicant has to prove in the design phase that consideration has been given to

the substances as set out in the TSI. The reference to certain clauses of standards is limited to the definition of the substances, without quantifying them. The assessment of the requirement is thus to verify that consideration of the effects of the substances has been taken in the design of the rolling stock.

#### Clauses 4.2.6.2.1 & 4.2.6.2.2: Slipstream effects

*'The train formation to be used for ~~verified by a test~~ is specified below for different types of rolling stock:*

- Unit assessed in fixed or predefined formation*

*The full length of the fixed formation or the maximum length of the pre-defined formation (i.e. the maximum number of ~~multiple~~ units permitted to be coupled together ~~shall be tested~~)'*

For units assessed in predefined formation, only one train formation is required to be used for the test: that which has the maximum length.

Conformity of the unit to the TSI in this tested train formation gives presumption of conformity for any other predefined formation.

An assessment of the TSI requirement for each possible predefined formation is not required.

### Clause 4.2.7.1.1: Head lights

*‘Two white headlamps shall be provided at the front end of the train in order to give visibility for the train driver.’*

The TSI specifies minimum requirements regarding headlights that are sufficient for operation on the CR TEN network.

The use by RUs of additional means for headlights is not prohibited by the TSI; the use of these additional headlights may be subject to restrictions on certain networks; however, their presence cannot be a condition of access to a network.

### Clause 4.2.7.1.4: Lamp controls

*‘It shall be possible for the driver to control the head, marker and tail lamps of the unit from the normal driving position; this control may use independent command or combination of commands.’*

*Note: it is not required to control the lights in a particular combination to display an emergency warning signal in case of emergency situation.’*

The TSI specifies the lamp controls at the level of the unit; there is no specification at the level of the train.

The use by RUs of lights to display an emergency situation is not prohibited by the TSI; it may be subject to restrictions on certain networks; however, this functionality cannot be a condition of access to a network.

#### Clause 4.2.8.2.2: Operation within range of voltages and frequencies

*'Electric units shall be able to operate within the range of at least one of the systems 'voltage and frequency' defined in the CR Energy TSI, clause 4.2.3.'*

The design of an RST for other additional 'voltage and frequency' systems not described in the CR ENE TSI is not prohibited by the TSI.

If such an additional system is the subject of a specific case in the CR ENE TSI, it is consequently the subject of a specific case in the CR LOC&PAS TSI (listed in section 7.3, with applicable rules described or to be notified).

If it only applies to the CR off-TEN network, it does not fall within the scope of the current TSIs, and is covered by national rules.

#### Clause 4.2.8.2.7: System energy disturbances for AC systems

*'A compatibility assessment shall be done in accordance with the methodology defined in the clause 10.3 of EN 50388:2005. the steps and hypothesis described in table 6 of EN50388:2005 have to be defined by the applicant (column 3 not applicable), taking into consideration input data given in Annex D of the same standard; the acceptance criteria shall be as defined in clause 10.4 of EN 50388:2005.*

*All hypothesis and data considered for this compatibility study shall be recorded in the technical documentation (see clause 4.2.12.2).'*

See the part of the application guide covering the CR ENE TSI, in particular clause 4.2.9.

#### Clause 4.2.8.2.9.2: Pantograph head geometry (IC level)

*'At least one of the pantograph(s) to be installed on an Electric unit shall have a head geometry type compliant with one of the two specifications given in the clauses below.'*

The installation of other additional pantographs of different head geometry is not prohibited by the TSI.

If such an additional pantograph is the subject of a specific case applicable to the OCL geometry in the CR ENE TSI, or is necessary for operation on existing OCLs of the CR TEN network, it is (in both cases) consequently the subject of a specific case in the CR LOC&PAS TSI (listed in section 7.3, with applicable rules described or to be notified).

If it only applies to the CR off-TEN network, it does not fall within the scope of the current TSIs, and is covered by national rules.

#### Clause 4.2.8.2.9.4: Contact strips

*'Contact strip material*

*Material used for the contact strips shall be mechanically and electrically compatible with the contact wire material (as specified in clause 4.2.18 of the CR Energy TSI), in order to avoid excessive abrasion of the surface of the contact wires, thereby minimising wear of both contact wires and contact strips.'*



See also clause 5.3.8.1 of the TSI defining the area of use of the IC contact strips.  
See also clause 6.1.2.2.7 specifying the conformity assessment procedure to be used.

The following EN standards, currently under revision, cover this subject:

- EN 50367: this standard deals with the interaction between contact line and pantograph, including material for contact strips.
- EN 50405: this standard deals with the assessment of contact strips made of carbon.

The aim of the revision of EN 50405 is to have a comprehensive assessment procedure for the IC contact strips. Aspects defining their area of use (clause 5.3.8.1 of the TSI) should be considered in the assessment procedure.

Contact strips covered by an EC declaration of conformity should be allowed for applications corresponding to their area of use, without any additional test.

Regarding the pantograph contact force and dynamic behaviour, the weight of the pantograph head may have an impact on the test results; therefore, if different contact strips than those initially validated are used, it should be checked that the weight variation is not significant; the manufacturer of the pantograph should cover this aspect in the technical documents provided with the pantograph's EC declaration of conformity.

#### Clause 4.2.8.2.9.6: Pantograph contact force and dynamic behaviour

*'The verification at interoperability constituent level shall validate the dynamic behaviour of the pantograph itself, and its capability to collect current from a TSI compliant overhead contact line (see clause 6.1.2.2.6).*

*'The verification at rolling stock subsystem level shall allow to adjust the contact force, taking into account aerodynamic effects due to the rolling stock and the position of the pantograph in the unit or train fixed or predefined formation(s) (see clause 6.2.2.2.15).'*

The pantograph is the component that ensures the current collection from the overhead contact line (OCL). The quality of the current collection depends on characteristics of the OCL, the pantograph and the rolling stock; these three elements have a certain dynamic behaviour that has an impact on the final performance.

When a pantograph is designed, a set of characteristics regarding the OCL are taken into account, including the maximum operating speed of the rolling stock (which depends on the OCL and on the rolling stock); in addition, the design allows for the adjustment of the contact forces (static and dynamic), by different means (pressure, springs, deflector, etc.).

A pantograph is not designed for a particular rolling stock, but for a type of OCL and a maximum speed; the definition of the pantograph as an interoperability constituent (IC) is in line with this principle.

Tests performed for the assessment of the pantograph as an IC aim at validating characteristics of the pantograph itself, for OCLs compliant to the CR ENE TSI, and for a certain maximum speed (area of use of the IC defined in clause 5.3.8 of the CR LOC&PAS TSI). The concept of IC allows the designer or manufacturer of the pantograph to issue an EC declaration of conformity independently of a particular use of the pantograph.

When this pantograph is integrated into a particular rolling stock, the applicant for this rolling stock has to make the necessary adjustments in order to get a mean contact force in the range specified in the TSI.



See also the part of the application guide covering the CR ENE TSI, in particular the clause on 'Assessment of Dynamic behaviour and quality of current collection'.

#### Clause 4.2.8.2.9.7: Arrangement of pantographs (RST level)

*'Where the spacing of 2 consecutive pantographs in fixed or pre-defined formations of the assessed unit is less than the spacing shown in clause 4.2.17 of the CR Energy TSI for the selected OCL design distance type, or where more than 2 pantographs are simultaneously in contact with the overhead contact line equipment, it shall demonstrated by testing that the current collection quality as defined in clause 4.2.8.2.9.6 above is met for the poorest performing pantograph.*

*The OCL design distance type (A, B or C as defined in the clause 4.2.17 of the CR Energy TSI) selected (and therefore used for the test) shall be recorded in the technical documentation (see clause 4.2.12.2).'*

See the part of the application guide covering the CR ENE TSI, in particular clause 4.2.17.

#### Clause 4.2.8.2.9.8: Running through phase or system separation sections (RST level)

*'The infrastructure register gives information on the permitted pantographs position: lowered or raised (with permitted pantograph arrangements) when running through systems or phase separation sections.'*

See the part of the application guide covering the CR ENE TSI, in particular clauses 4.2.19 and 4.2.20.

#### Clause 4.2.8.2.9.10: Pantograph lowering (RST level)

*'Mandatory requirement for electric units designed for a maximum speed higher or equal to 100 km/h to be equipped with an ADD is an open point.'*

The automatic dropping device (ADD) functionality is specified in the TSI. The specified ADD should be accepted on all networks.

For an RST with a maximum speed lower than 100 km/h, the applicant is free whether or not to equip the RST with the ADD functionality.

For an RST with a higher maximum speed, the ADD functionality may be mandated; this open point will be covered by a national rule (as required by the Directive for all open points), and not by a requirement from an IM.

### Clause 4.2.9.1.1: Driver's cab – General

*'The driver's cabs shall be designed to permit operation by a single driver.'*

The TSI requires that the design permits operation by a single driver; however, the TSI does not prohibit operation by two drivers.

### Clause 4.2.9.1.3.1: Front visibility

*'For locomotives with central cab and for OTMs, in order to ensure the visibility of low signals, it is permitted that the driver moves to several different positions in the cab in order to meet the above requirement; it is not required to meet the requirement from the seated driving position.'*

For locomotives with a central cab and OTMs, due to the nose structure in front of the cab, the visibility of low signals on the opposite side of the normal working place is not always possible from the seated driving position.

### Clause 4.2.9.1.7: Climate control and air quality

*'At the seated driving position (as defined in the clause 4.2.9.1.3) of the driver's head and shoulders, there shall be no air flows caused by the ventilation system having an air velocity exceeding the limit value recognised to ensure a proper working environment.'*

An acceptable limit value for the air velocity is set out in standard EN14813-1:2006, clause 9.5; the measurement procedure for air velocity is specified in standard EN14813-2:2006, clause 6.2.

The driver may be provided with the means to adjust the air velocity and/or to direct the air flow for his own comfort; in this case, the acceptable limit should be reached for at least one position of the adjustment system.

### Clause 4.2.9.3.1: Driver's activity control function

*'The system shall allow for the adjustment (at workshop, as a maintenance activity) of the time X within the range of 5 seconds to 60 seconds.'*

*'Note: it is allowed to have the function described in this clause fulfilled by the CCS Subsystem. It is also allowed to install a system of a fix time X (no adjustment possible) provided that the time X is within the range of 5 seconds to 60 seconds. A Member State may ask for a maximum fix time for safety reasons, but in any case it cannot prevent the access to a railway undertaking that using a higher time Z (within the range specified), unless that Member State is able to demonstrate that the national safety level is endangered.'*

There is no unique response time specified, because this function has interfaces with operating rules and human factors; therefore, the RU may have its own specification.

For newly designed systems (usually software-based), the requirement mandating the functionality of adjustment of the response time is part of the TSI specification; this does not represent any difficulty, and allows the use of the same system by different RUs.

As these newly designed systems are not yet available, a note allowing the use of systems of existing design without the functionality of adjustment of the response time (which continue to satisfy the operational need in the current situation) has been inserted in the TSI.

In the case of a train running in different MSs having a requirement of the maximum value of





the time X for safety reasons, the RU has to select a value accepted by the different NSAs (for example, the minimum one, which will be accepted because the NSA can only ask for a maximum value); if the MS(s) have no particular requirement, the RU may use a time X within the range specified in the TSI according to its own operating rules.

It has to be noted that the 'roll-away protection' falls within the scope of the CCS TSI, and is not covered by the CR LOC&PAS TSI (even though the 'driver's activity control' function is used for that purpose in existing applications).



### Clause 4.2.10.1.1: Fire safety – Requirements applicable to all units, except freight locomotives and OTMs

*‘Category A rolling stock is the minimum category for rolling stock operated on the TEN infrastructures.’*

Requirements specified in the SRT TSI for category A rolling stock represent the minimum requirements for ensuring fire safety, and therefore even trains not intended to run in tunnels are required to comply with the requirements for category A.

### Clause 4.2.10.2: Fire safety – Material requirements

*‘In addition to the provisions in SRT TSI (referring back to the HS RST TSI) and pending the publication of EN45545-2, the requirements relating to the fire behaviour properties of materials and the selection of components is also permitted to be satisfied by the verification of conformity in accordance with TS 45545-2:2009, using the appropriate operation category as specified in TS 45545-1:2009.’*

The HS RST TSI makes reference to certain national standards that are mutually recognised; the TS 45545-2:2009 has the same status as these national standards, and is mutually recognised.

The applicant can choose to apply one of the standards among those identified.

### Clause 4.2.10.4: Passenger evacuation

*‘Once opened, each emergency exit shall have an opening which is sufficient in size to allow the release of persons. This requirement is deemed to be met when the opened emergency exit includes a rectangular open and free area of at least 700mm x 550mm.’*

Certain flexibility with regard to the dimensions required for meeting this requirement is allowed. A rectangular opening with dimensions of 700mm x 550mm is considered to represent the minimum area for both evacuation and rescue from the passenger areas. If, for reasons of the structural design of the unit, the rectangular shape with dimensions of 700mm x 550mm cannot be entirely met, it may be acceptable to deviate from the rectangular shape and specified dimensions as long as the total opening is at least functionally equivalent. This could for example be the case for a non-rectangular opening. Practical representative tests may be suitable for proving this functional equivalence.

### Clause 4.2.10.5: Fire barriers

*‘In addition to the provisions in the SRT TSI, for Category B fire safety rolling stock, the requirement for full ‘cross section partitions within passenger/staff areas’ is permitted to be met by Fire Spreading Prevention Measures (FSPM):  
If FSPM are used instead of full cross section partitions, it shall be demonstrated that:*

- *They ensure that fire and smoke will not extend in dangerous concentrations over a length of more than 28m within the passenger/staff areas inside a unit, for at least 15 minutes after the start of a fire,*
- *They are installed in each vehicle of the unit, which is intended to carry passengers and/or staff,*

- *They provide at least the same level of safety to persons on board as full cross section partitions, with an integrity of 15 minutes, which are tested in accordance with the requirements of EN 1363-1:1999 partition test and assuming the fire can start from either side of the partition.'*

The protection goals for fire barriers can also be met by other means, e.g. high-pressure water mist systems with a combination of early fire detection and suppression systems. The aim is to prove that an equal or better level of safety is provided to persons inside a train with a fire on board.

Since there is no safety level for fire protection defined in the SRT TSI, '15 minutes test time fire barriers' are taken as a reference case (consistent with the SRT TSI) to which other solutions should be compared.

'15 minutes test time fire barriers' may still be used to satisfy this requirement.

## Clause 4.2.12: Documentation for Operation and Maintenance

The TSI does not specify the format (paper, electronic file, etc.) of the documentation to be provided.

## Clause 4.2.12.3: Documentation related to Maintenance

*‘The following information necessary to undertake maintenance activities on rolling stock shall be provided:*

- *The maintenance design justification file: explains how maintenance activities are defined and designed in order to ensure that the rolling stock characteristics will be kept within acceptable limits of use during its lifetime. The file shall give input data in order to determine the criteria for inspection and the periodicity of maintenance activities.*
- *The maintenance description file: explains how maintenance activities shall be performed.’*

The documentation to be provided by the applicant for the EC declaration of verification should contain the technical elements that are listed in clause 4.2.12.3 of the TSI.

The applicant is responsible for gathering this documentation in the technical file (including that which may be defined and provided by its subcontractors).

Note: this documentation is assessed by the NoBo according to clause 6.2.4 of the TSI: compilation; technical content not assessed.

This documentation is in principle not related to a particular use of the rolling stock (the common use of the RST being defined by its category according to clause 4.1.3 of the TSI, and by its technical characteristics), but it may include hypothesis regarding its use.

This documentation is not required to be the final documentation to be used by the Entity in Charge of Maintenance (ECM), which has to take into account real operating and maintenance conditions in order to issue maintenance procedures or manuals that are directly applied by workers in charge of maintenance.

If the ECM deviates from the technical elements provided, this shall be under its own responsibility.

## 2.5. Interoperability Constituent

### Clause 5.3.3: WSP (wheel slide protection system)

*'Note: the WSP is not considered as an IC for other types of brake system such as hydraulic, dynamic and mixed braking systems, and this clause does not apply in that case.'*

The concept of Interoperability Constituent (IC) for the WSP system is limited to WSP functions to be used only with a pneumatic brake system, and using dump valves to control the amount of air within the brake cylinder (definition given in standard EN15595). In other cases (WSP system controlling different braking systems), this concept has not been retained due to the complexity of the functional interfaces between the RST and the WSP system.

### Clause 5.3.7: Horns

*'A horn shall comply with the requirements concerning the soundings of signals defined in clause 4.2.7.2.1. These requirements shall be assessed at IC level.'*

The sounding of signals (frequencies) does not depend on the integration of the horn on the rolling stock; the soundings of signals are checked only at the level of the IC; the assessment procedure is specified in clause 6.1.2.2.5 of the TSI, and includes the verification of both parameters simultaneously (frequencies and sound pressure level) by reference to clause 5 of standard EN 15153-2.

The sound pressure level defined in clause 4.2.7.2.2 must also be checked at rolling stock level for each application of the IC, because the integration of the horn may lead to attenuations; however, they should be covered by the allowed range (8 dB).

### Clause 5.3.8: Pantograph

*'The maximum current at standstill per contact wire of the overhead contact line for DC systems. Note: the maximum current at standstill, as defined in clause 4.2.8.2.5, shall be in accordance with the value above (current at standstill per contact wire) weighted to take into account the characteristics of the overhead contact line (1 or 2 contact wires).'*

The assessment of the maximum current at standstill at the level of the pantograph (considered as an IC) is carried out with one contact wire.

The note explains that when the pantograph is integrated into an RST, due to the required current at standstill, the pantograph may limit the area of use of the RST in terms of characteristics of the OCL; for example, the current needed at standstill by the RST may be compatible only with OCLs made of two wires in case the pantograph has a 'maximum current at standstill per contact wire' lower than the maximum current at standstill drawn from the OCL by the RST, but higher when weighted with a factor (between 1 and 2) applied for compatibility with an OCL made of two wires.

#### Clause 5.3.8.1: Contact strips

*'In addition, for contact strips made of carbon or of impregnated carbon, a conformity assessment as specified in clause 6.1.2.2.7 shall be carried out.'*



According to clause 6.1.2.2.7, the conformity assessment is to be performed according to standard EN 50405. The scope of this standard is limited to carbon contact strips. This standard is under revision, and its scope may be extended.

See also clause 4.2.8.2.9.4 above.



## 2.6. Assessment of conformity

### Clauses 6.1.2.3 and 6.2.2.3: Project phases where assessment is required

#### Annex H

*'It is detailed in Annex H of this TSI in which phases of the project an assessment shall be done for the requirements applicable:*

- Design and development phase:
  - Design review and/or design examination.
  - Type test: test to verify the design, if and as defined in the section 4.2.
- Production phase: routine test to verify the conformity of production.

*The entity in charge of the assessment of the routine tests is determined according to the assessment module chosen.'*

The table given in Annex H gives an overview of the assessment to be performed in the different phases of development and production. This table is not to be used as a stand-alone document; it is intended to be used with consideration of the requirements expressed in sections 4.2 and 6 of the TSI, which sometimes specify different requirements for different types of RST.

For example, the following is not repeated in Annex H, but is applicable:

- the requirements of clause 4.2.8.2 'Power supply' apply only to electric units,
- the requirements of clause 4.2.9 'Driver's cab' do not apply if the RST is not fitted with a driver's cab.
- section 4.2 allows for exemption of tests in particular cases (for 'strength of vehicle structure', 'rolling stock dynamic behaviour', etc.).
- certain types of RST are exempted from some of the requirements (for example OTMs are exempted from 'passive safety' requirements).

Regarding the routine tests, their detailed content is not defined in the TSI; Annex H mentions only the clauses where a routine test is to be performed, without prejudice to the conformity assessment procedures (modules) chosen by the applicant; for modules based on the quality management system relating to the production process, the applicant is responsible for the definition of routine tests.

#### Clause 6.1.5: Assessment of suitability for use

*'Prior to commencing in service tests, a suitable module (CB or CH1) shall be used to certify the design of the constituent*

In cases where, according to clause 6.1.2.1, a conformity assessment has been carried out using modules CA1, CA2 or CH, an assessment of suitability for use is not required.

## Clause 6.2.5: Units requiring EC certificates against the HS RST TSI and against this TSI

*‘ The parameters which are covered in both TSIs, and are equally specified, are listed in the table below; these parameters do not need to be re-assessed by the Notified Body appointed to perform the assessment according to this TSI; the assessment performed against the HS RST TSI is deemed to be recognized as valid for both TSIs. ’*

The clauses of the HS RST TSI which are identical or deemed equivalent to the corresponding clauses of the CR LOC&PAS TSI are identified in the table in clause 6.2.5. Consequently, the assessment of an interoperability constituent or a rolling stock unit already assessed against the HS RST TSI will be limited to those parts and clauses not identified in that table.

Other parts and clauses are assessed by reference to the assessment performed against the HS RST TSI; regarding ICs, those concerned are explicitly identified in clause 6.1.4.

### Clause 6.2.2.2.4: Braking – Safety requirements (Clause 4.2.4.2.2)

1. *Application of a harmonized criterion expressed in a tolerable hazard rate of  $10^{-9}$  per hour.*

*This criterion is in accordance with the Commission Regulation (EC) N° 352/2009 (hereafter called 'CSM on RA') Annex I, clauses 2.5.4.*

*The applicant shall demonstrate compliance with the harmonized criterion by applying Annex I-3 of the CSM on RA; the following principles may be used in the demonstration: similarity with reference system(s); application of code of practice; application of the probabilistic approach.*

*The applicant shall designate the assessment body supporting the demonstration he will provide: notified body selected for the RST sub-system or assessment body as defined in the CSM on RA.*

*The assessment shall be documented in the EC certificate issued by the notified body, or in the EC declaration of verification issued by the applicant.*

*The EC declaration of verification shall mention the compliance to this criterion, and shall be recognized in all Member States.*

*In the case of additional authorisations for placing in service of vehicles, the Article 23(1) of Directive 2008/57/EC applies.’*

Standard EN 50126 provides a methodology for safety studies.

Based on the return of experience available among manufacturers of braking systems and RSTs, and among RUs and NSAs, some elements of the braking system which have been widely used may be considered as the 'reference system', and some standards as the 'code of practice' within the limit of their scope.

The national rules used before the entry into application of this TSI may also be considered as the code of practice (provided that they satisfy the requirements of the common safety method (CSM)).

Reliability data relating to components used in the braking system may also be determined from this return of experience.



The methodology to be used in order to demonstrate compliance with the safety requirements specified in the TSI may include:

- performance of a safety analysis at the highest level of the system, with the use of adequate tools such as fault tree analysis, failure mode effects and criticality analysis, in order to identify critical parts or components of the system;
- identification of the parts or components of the system for which the notion of 'reference system' or 'code of practice' is adequate to justify their reliability and safety performance;
- demonstration for other parts or components of the system (if any) that their reliability and safety performance allow fulfilment of the TSI requirement: these parts or components do not constitute 'weak points' in the system.

In the case of rolling stock fitted with braking systems based on UIC technology, the integration of these brake systems may require some changes in the way in which they are controlled and commanded; this aspect has to be evaluated carefully so as not to jeopardise the safety performance of the complete brake system.

## 2.7. Implementation

### Clause 7.1.1.2.1: Transition period – Introduction

*'During the transition period, if the applicant chooses not to apply this TSI, the vehicle may be authorised to be placed in service in accordance with Articles 24 (first authorisation) or 25 (additional authorisation) of Directive 2008/57/EC, instead of Articles 22 or 23.*

*Any rolling stock placed in service after the end date of the transition period described in this clause shall fully comply with this TSI without prejudice to Article 9 of Directive 2008/57/EC which allows Member States to request derogations under the conditions set out in that Article.'*

Articles 24 or 25 of the Directive apply for the authorisation for placing in service of vehicles where the CR LOC&PAS TSI is not available or not applicable; these articles refer to national rules for the conformity with essential requirements of the Directive not covered by the TSIs.

### Clause 7.1.1.2.4: Rolling Stock of an existing design

*'In case of design modifications strictly limited to those necessary to ensure the technical compatibility of the rolling stock with fixed installations (corresponding to interfaces with infrastructure, energy, or control-command and signalling subsystems), the application of this TSI is not mandatory; the vehicle produced according to the 'modified' design may be authorised in accordance with Article 24 or 25 of Directive 2008/57/EC.*

*In case of other design modifications, the present clause related to 'existing design' does not apply; therefore, as the design is considered as a new one, the application of this TSI is required*

This clause is intended to allow for modifications within a type family that represent improvements which increase interoperability, e.g. to make a locomotive of an existing design compatible with an additional power supply system, or with an additional signalling system.

#### Clause 7.1.1.4: Interface with implementation of other TSIs

*‘As reminded in Section 2.1, other TSIs apply to the rolling stock sub-system; these other TSIs specify the implementation rules relevant for the requirements they cover.’*

Each TSI is applicable autonomously in accordance with the implementation provisions as set out in each respective TSI.

If the CR LOC&PAS TSI specifies a requirement by a mandatory reference to a clause of another TSI, the implementation strategy of the LOC&PAS TSI shall apply, since in this case the requirement is part of the LOC&PAS TSI.

#### Clause 7.1.2.3 Upgrade of existing rolling stock

• *‘When during the upgrade it is not economically feasible to fulfil the TSI requirement, the upgrade could be accepted if it is evident that a basic parameter is improved in the direction of the TSI defined performance.’*

It may be not justified for economic or compatibility reasons to require that all basic parameters/functions be integrated into rolling stock of an existing design when a unit is being upgraded. The following list gives guidance on which parameters/functions may be omitted, and Member States are advised not to impose full TSI compliance with these parameters during upgrade works:

- door/traction interlock systems,
- door system construction,
- fire alarm systems (see the SRT TSI, clause 7.2.3.3),
- passenger alarm 2-way communication,
- sanitary systems (release of effluents),
- passive Safety (crash worthiness).

Regarding other parameters/functions (not listed above), there is no guidance given; depending on particular conditions of the upgrade, Member States may decide whether or not to impose compliance with the TSI.

• *‘Guidance to the Member State for those modifications that are deemed to be upgrades is given in the Application Guide.’*

Any change to the design of an existing type which influences the performance of the type with respect to at least one of the parameters as described in the TSI is considered as an upgrade. Even if the performance of a certain parameter is negatively impacted, it is considered as an upgrade, because:

- it is not an indication that the overall performance of the rolling stock is not improved;
- *‘the overall safety level of the subsystem concerned may be adversely affected’* (Directive,

Article 20).

For example, a change aiming at modifying the maximum speed may have an impact on braking performance or axle loads that may be positive or negative; in any case, it is necessary to examine whether a new authorisation for placing in service would be necessary.

### Clause 7.1.3.1: Rules related to certificates – RST

***‘Modifications to a type or design already bearing an EC certificate of verification***

- *In order to establish the certificate of EC verification, the Notified Body is permitted to refer to:  
- The original type or design examination certificate for parts of the design that are unchanged, as far as it is still valid (during 7 years phase B period).’*

In the case of modifications to a type, it is likely that certain parameters are unchanged. For these parameters, reassessment by a notified body is not required as long as phase B has not yet ended.

## 2.8. Some practical cases

*[to be completed after return of experience]*

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### 3. APPLICABLE SPECIFICATIONS AND STANDARDS

3.1. Explanation of the use of the specifications and standards

Standards of voluntary use which have been identified during the drafting process of the TSI are listed in Annex 1, column 'Voluntary ref. to clause(s) of standard No'; as far as possible, the clause of the standard which is relevant for the conformity assessment of the TSI requirement should be identified. In addition, the column 'Voluntary ref – Purpose' should include a written explanation regarding the purpose of the reference to the standard.

Where relevant, an additional explanation is given in section 2 above.

Annex 1 is to be completed after a review with Standardisation Bodies, and on a regular basis, in order to take into account new or revised harmonised standards.

For consistency, Annex 1 should be read with consideration of Annex J of the TSI, entitled 'Standards or normative documents referred to in this TSI', which lists 'Mandatory ref to section(s) of Standard'; both annexes have the same structure. Standards listed in Annex J of the TSI are not always repeated in Annex 1 of this application guide, even though additional clauses to those identified as mandatory may be used on a voluntary basis.

3.2. A list of applicable standards is set out in Annex 1.

## 4. LIST OF ANNEXES

1. Applicable standards and other documents
2. Other annexes

## Annex 1: List of standards

TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Element of the Rolling Stock sub-system	Section			
<b>Structure and mechanical parts</b>	<b>4.2.2</b>			
Inner coupling	4.2.2.2.2	EN 15566:2009+A1:2010 EN 15551:2009+A1:2010	Product definition and verification.	
End coupling	4.2.2.2.3			
Rescue coupling	4.2.2.2.4	EN 15020:2006 UIC 648	Only compatibility with 'Scharfenberg' coupler.	
Staff access for coupling and uncoupling	4.2.2.2.5		Requirement for standard to CEN 'Headstock disposal' covering Annex A of the TSI.	RFS 034
Gangways	4.2.2.3	UIC 561		RFS 009
Strength of vehicle structure	4.2.2.4	EN 15085-5:2007	For verification of metallic joints.	
Passive safety	4.2.2.5			
Lifting and jacking	4.2.2.6		Requirement for standard to CEN covering Annex B of the TSI.	RFS 010
Fixing of devices to carbody structure	4.2.2.7			
Staff and freight access doors	4.2.2.8			
Mechanical characteristics of glass	4.2.2.9	E-ECE 324 Regulation 43		
Loading conditions and weighted mass	4.2.2.10			
<b>Track interaction and gauging</b>	<b>4.2.3</b>			
Gauging	4.2.3.1	EN 15273-2:2009	For definition of 'intermediate gauges'	
Axle load parameter	4.2.3.2.1	EN 15528:2009	For categorisation of RST according to line category.	RFS 033



TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Wheel load	4.2.3.2.2			
Rolling Stock characteristics for the compatibility with train detection systems	4.2.3.3.1			
Axle bearing condition monitoring	4.2.3.3.2	EN 15437-1:2009 prEN 15437-2	Trackside system Onboard system (open point)	
Safety against derailment running on twisted track	4.2.3.4.1	UIC 518:2009	Additional guidance to EN 14363	
Running dynamic behaviour	4.2.3.4.2	UIC 518:2009	Additional guidance to EN 14363	
Equivalent conicity	4.2.3.4.3			
Design values for new wheel profiles	4.2.3.4.3.1			
In-service values of wheelset equivalent conicity	4.2.3.4.3.2			
Structural design of bogie frame	4.2.3.5.1			
Mechanical and geometrical characteristics of wheelsets - axles  - assembly	4.2.3.5.2.1	EN 13260:2009+A1 :2010 EN 13261:2009+A1 :2010  EN 12080:2007 EN 12081:2007 EN 12082:2007 prEN15313:2009	Fatigue characteristic verification and Product verification  In service wheelset parameters	
Mechanical and geometrical characteristics of wheels	4.2.3.5.2.2	EN 13262:2004 /A1:2008+A2:2010	Product verification	
Variable gauge wheelset	4.2.3.5.2.3		Assessment (open point)	RFS029
Minimum curve radius	4.2.3.6			
Life guards	4.2.3.7			
<b>Braking</b>	<b>4.2.4</b>			







TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Functional requirements	4.2.4.2.1			
Safety requirements	4.2.4.2.2	EN 50126:1999	Demonstration of safety requirements	
Type of brake system	4.2.4.3	EN 14198:2004 EN 15179:2007 prEN 16185-1&2	Design principle of brake system.	
		EN 15355:2008+ A1:2010 EN15611:2008+ A1:2010 EN 15612:2008+ A1:2010 EN 15625:2008+ A1:2010	Definition and verification of brake component of UIC brake system.	
Emergency braking	4.2.4.4.1			
Service braking	4.2.4.4.2			
Direct braking command	4.2.4.4.3			
Dynamic braking command	4.2.4.4.4			
Parking braking command	4.2.4.4.5			
Braking performance	4.2.4.5.1			
Calculation		UIC 544-01:Oct 2004	Additional guidance to EN 14531-1 & 6	
Braking test		UIC 544-01:Oct 2004	Test methodology	RFS 002
Emergency braking	4.2.4.5.2			
Service braking	4.2.4.5.3			
Calculations related to thermal capacity	4.2.4.5.4			
Parking brake	4.2.4.5.5			
Limit of wheel rail adhesion profile	4.2.4.6.1			
Wheel slide protection system	4.2.4.6.2	EN 15595:2009	Specific clause applicable to coaches.	





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Dynamic brake – Braking systems linked to traction system	4.2.4.7			
Braking system independent of adhesion conditions	4.2.4.8.1			
Magnetic track brake	4.2.4.8.2.			
Eddy current track brake	4.2.4.8.3			
Brake state and fault indication	4.2.4.9	EN 15220-1:2008	Product verification for brake indicators.	
Brake requirements for rescue purposes	4.2.4.10	EN 15807:2011	Half coupling definition and verification.	
<b>Passenger related items</b>	<b>4.2.5</b>			
Sanitary systems	4.2.5.1			
Public address system: audible communication system	4.2.5.2			
Passenger alarm: functional requirements	4.2.5.3	UIC 541-6	Requirement for standard to CEN covering latest developments, and interface with braking/braking override.	RFS 013
Safety instructions to passengers – Signs	4.2.5.4			
Communication devices for passengers	4.2.5.5			
Exterior doors: access to and egress from Rolling Stock	4.2.5.6	EN 14752:2005	Design of doors	
Exterior door system construction	4.2.5.7	EN 14752:2005	Design of doors	
Inter-unit doors	4.2.5.8			RFS 009
Internal air quality	4.2.5.9	EN 13129-1, clause 9.5 EN 13129-2, clauses 5.1.2 and 9.5	Fresh air volume to give presumption of conformity to TSI.	





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Body side windows	4.2.5.10			
<b>Environmental conditions and aerodynamic effects</b>	<b>4.2.6</b>			
Environmental conditions	4.2.6.1	EN 50125-1:1999	Range for environmental parameters. Design and test of RST for severe conditions	RFS 021 RFS 007
Altitude	4.2.6.1.1	EN 50125-1:1999	Range for environmental parameters.	RFS 021
Resistance to pollution	4.2.6.1.7	EN 60721-3-5:1997		
Aerodynamic effects	4.2.6.2			
Slipstream effects on passengers on platform	4.2.6.2.1			
Slipstream effects on workers at the track side	4.2.6.2.2			
Head pressure pulse	4.2.6.2.3			
Maximum pressure variations in tunnels	4.2.6.2.4			
Cross wind	4.2.6.2.5	EN 14067-6:2009	RST Cross wind characteristic definition	
<b>External lights &amp; visible and audible warning devices</b>	<b>4.2.7</b>			
External lights	4.2.7.1			RFS 004
Horn	4.2.7.2			RFS 005
<b>Traction and electrical equipment</b>	<b>4.2.8</b>			
Traction performance	4.2.8.1			
General	4.2.8.1.1			
Requirements on performance	4.2.8.1.2			
Power supply	4.2.8.2			





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
General	4.2.8.2.1			
Operation within range of voltages and frequencies	4.2.8.2.2			
Regenerative brake with energy to the overhead contact line	4.2.8.2.3			
Maximum power and current from the overhead contact line	4.2.8.2.4			
Maximum current at standstill for DC systems	4.2.8.2.5			
Power factor	4.2.8.2.6			
System energy disturbances	4.2.8.2.7			
Energy consumption measuring function	4.2.8.2.8	prEN 50463	Requirement for standard to CEN covering Annex B of the TSI.	RFS 026
Requirements linked to pantograph	4.2.8.2.9			
Working range in height of pantograph	4.2.8.2.9.1			
Height of interaction with contact wires	4.2.8.2.9.1.1			
Working range in height of pantograph	4.2.8.2.9.1.2			
Pantograph head geometry	4.2.8.2.9.2			
Pantograph head geometry type 1600 mm	4.2.8.2.9.2.1			
Pantograph head geometry type 1950 mm	4.2.8.2.9.2.2			
Pantograph current capacity	4.2.8.2.9.3			
Contact strip material	4.2.8.2.9.4	EN 50367:2006	For material of contact strips	RFS 016 RFS 024





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Pantograph static contact force	4.2.8.2.9.5			
Pantograph contact force and dynamic behaviour	4.2.8.2.9.6			
Arrangement of pantographs	4.2.8.2.9.7			
Running-through phase or system separation sections	4.2.8.2.9.8			
Insulation of pantograph from the vehicle	4.2.8.2.9.9	EN 50163:2004 EN 50124-1:2001+ A1:2003 and A2:2005	Design rules	
Pantograph lowering	4.2.8.2.9.10			
Electrical protection of the train	4.2.8.2.10			
Diesel and other thermal traction system	4.2.8.3			
Protection against electrical hazards	4.2.8.4			
<b>Cab and operation</b>	<b>4.2.9</b>			
Driver's Cab	4.2.9.1			
General	4.2.9.1.1			
Access and egress in operating conditions	4.2.9.1.2.1	UIC 651	Requirement for standard to CEN covering antropometric data and forward visibility.	RFS 006
Driver's cab emergency exit	4.2.9.1.2.2	EN 15227:2008	TSI requirement verification	
Front visibility	4.2.9.1.3.1	UIC 651		RFS 006
Rear and side view	4.2.9.1.3.2			
Interior layout	4.2.9.1.4	UIC 651	Assessment	RFS 006
Driver's seat	4.2.9.1.5			





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Driver's desk – Ergonomics	4.2.9.1.6			
Climate control and air quality	4.2.9.1.7	EN 14813-1:2006+A1:2010, clause 9.5 EN 14813-2:2006+A1:2010, clause 6.2 UIC 651, clause 2.9.3	Air velocity (around head of driver) and CO <sub>2</sub> content	
Internal lighting	4.2.9.1.8	EN 13272, clause 6	Measurement of luminosity	
Windscreen – Mechanical characteristics	4.2.9.2.1			RFS 003
Windscreen – Optical characteristics	4.2.9.2.2			RFS 003
Equipment	4.2.9.2.3			
Driver machine interface	4.2.9.3			
Driver's activity control function	4.2.9.3.1			
Speed indication	4.2.9.3.2			
Driver display unit and screens	4.2.9.3.3	UIC 612	Relevant sections for design rules.	RFS 023 RFS 022
Controls and indicators	4.2.9.3.4	UIC 612	Relevant sections for design rules.	RFS 022
Labelling	4.2.9.3.5			
Remote control function	4.2.9.3.6	EN 50239:1999	Design and assessment, including safety aspects.	
Onboard tools and portable equipment	4.2.9.4			
Storage facility for staff personal effects	4.2.9.5			
Recording device	4.2.9.6			
<b>Fire safety and evacuation</b>	<b>4.2.10</b>			





TSI		Standard		
Characteristics to be assessed		Voluntary ref. to section(s) of standard No	Purpose of the voluntary ref.	To be drafted
Material requirements	4.2.10.2			
Specific measures for flammable liquids	4.2.10.3	CEN/TS 45545-7		
Passenger evacuation	4.2.10.4	CEN/TS 45545-4		
Fire barriers	4.2.10.5	EN 1363-1:1999 CEN/TS45545-3		
<b>Servicing</b>	<b>4.2.11</b>			
Cleaning of driver's cab windscreen	4.2.11.2.1			
Exterior cleaning through a washing plant	4.2.11.2.2			
Toilet discharge system	4.2.11.3			
Water refilling equipment	4.2.11.4			RFS 014
Interface for water refilling	4.2.11.5			RFS 014
Special requirements for stabling of trains	4.2.11.6			
Refuelling equipment	4.2.11.7			RFS 011
<b>Documentation for operation and maintenance</b>	<b>4.2.12</b>			
General	4.2.12.1			
General documentation	4.2.12.2			
Documentation related to maintenance	4.2.12.3			
Operating documentation	4.2.12.4			
Lifting diagram and instructions	4.2.12.5			
Rescue related descriptions	4.2.12.6			

