

## Recommendations for Systems for the Supervision of Enhanced Permissible Speeds and Tilt Enable

### Synopsis

This document supports [GE/RT8012](#) and [GE/RT8019](#). It recommends principles to apply to satisfy the requirements mandated by these two standards.

Signatures removed from electronic version

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# Recommendations for Systems for the Supervision of Enhanced Permissible Speeds and Tilt Enable

## Part A

### Issue Record

This document will be updated when necessary by distribution of a complete replacement.

| Issue | Date      | Comments          |
|-------|-----------|-------------------|
| One   | June 2001 | Original Document |

### Technical Content

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## Part B

### Introduction

#### B1 Purpose

The purpose of this document is to support [GE/RT8012](#) and [GE/RT8019](#). In parts B to E it recommends principles to apply to satisfy the requirements mandated by these two standards. The appendices give further guidance.

#### B2 Scope

The overall scope of Railway Group Standards is as specified in Appendix A of [GA/RT6001](#).

This document contains recommendations that are applicable to the duty holders of the following categories of Railway Safety Case:

- a) Infrastructure controller
- b) Train operator

The recommendations concern trains operating:

- a) in tilting mode over routes on which they are authorised to operate; and
- b) on sections of route on which **enhanced permissible** speeds are authorised.

This document does not address the requirements of automatic train protection.

#### B3 Definitions

##### Alert

*An audible prompt given to the driver of a train by a supervision system to indicate to him that a specified event has been detected.*

##### Automatic Train Protection

Automatic Train Protection (ATP) is an automatic system for preventing trains from exceeding the limit of their movement authorities and from exceeding the **permissible speed** (or **enhanced permissible speed**, where applicable) and any prevailing **speed** restrictions.

##### Balise

*A spot transmission device that transmits data to the trains. A balise can also be known as a 'beacon' or a 'transponder'.*

##### Cab Signalling

*Provision of in-cab movement authority and **speed** limit information to the driver of a train.*

##### Clearances

The calculated distance between moving vehicles and fixed structures or between two moving vehicles on adjacent tracks. The requirements are contained in [GE/RT8029](#).

##### Driver-Machine Interface

*The Driver-Machine Interface (DMI) is a set of devices in the cab through which the driver and systems provided to meet the requirements of [GE/RT8012](#) and [GE/RT8019](#) communicate.*

##### Enhanced permissible speed

*The authorised maximum **speed** (higher than the **permissible speed**) over a section of line which applies to a specific type of train operating at cant deficiencies in excess of those permitted at the **permissible speed**. **Enhanced permissible** speeds are detailed in the Sectional Appendix. There may be more than one **enhanced permissible speed** applicable to a given section of line.*

## Recommendations for Systems for the Supervision of Enhanced Permissible Speeds and Tilt Enable

### ETCS

*European Train Control System. The name given to the system providing cab-signalling and automatic train control functions that are specified to be applicable to the railways of the European Union.*

### GSM-R

*Global System Mobile - Railway. The European Standard specific to railway applications for the transmission by radio of voice and data between train and trackside installations.*

### Intervention

*The function that calls for the application of the train's brakes in response either to an overspeed condition or to the detection of the train tilting within a section of track where **tilt** is not authorised.*

### Permissible Speed

*The authorised maximum **speed** over a section of line, either for all trains or (where differential speeds are applied) for specific types of train as detailed in the sectional appendix, operating up to the cant deficiency limits defined in GC/RT5021.*

### Speed Supervision

*The function of measuring the **speed** of a train and comparing the value obtained against a limit. If the limit is exceeded the function prompts other functions, for example informing the driver, calling for the brakes.*

### Target Distance

*The computed distance from the location of the train to the intended point of enforcement of one or more of:*

- a) an **enhanced permissible speed**
- b) a **permissible speed**
- c) cancellation of **Tilt Enable**.

*It is derived by the system on the train from distance data received from the trackside, usually applying from the location of a specific balise. It is decreased as the train moves forward by the distance travelled beyond that balise as measured on the train.*

### Target Speed

*The value of **speed** that the train should achieve or be less than at the target distance.*

### Tilt Authority

***Tilt Authority** is an output to the **Tilt Control System** that permits the train to be tilted.*

### Tilt Enable

*The information passed from the **Tilt Enable** and Supervision System to the **Tilt Control System** that the latter requires in order to operate.*

### Tilt Control System

A train system that operates and controls the tilting of the vehicle body fitted to tilting trains.

### Tilt Enable and Supervision System

A system that enables and supervises the operation of the **Tilt Control System**.

### Tilt Prohibited Section

A section of route where, to maintain clearances, operation of a tilting train in tilting mode is prohibited.

**Tilting Train**

A train which tilts the train body on curves to reduce the lateral acceleration experienced by passengers, allowing the train to operate at higher speeds through curves than non-tilting trains.

**Train Protection and Warning System**

*Train Protection and Warning System (TPWS) is a system mitigating against Signals Passed At Danger and non-respect of **permissible** speeds.*

**Warning**

*Information, usually audible and visual, given to the driver of a train by a supervision system to indicate to him that Intervention is imminent, and the driver should take preventative action.*

**B4 Introduction****B4.1**

*Similarities between the implementation of a **speed** supervision system (required by **GE/RT8012** to support **enhanced permissible** speeds) and the implementation of a **tilt enable** and supervision system (required by **GE/RT8019** to ensure that **tilt** is only enabled where clearances can be achieved) suggest that the functionality of these systems can be contained in a common system. Such similarities include the means of data transmission, the measurement of distance, determining the need for intervention and the Driver-Machine Interface.*

*These two systems are comprised of equipment at the trackside and equipment on the train.*

*Using information from the trackside, the equipment on board the train will establish warning and intervention criteria applicable to the locations of lengths of track where **tilt** is prohibited and/or an **enhanced permissible speed** is in force. The braking performance of the train will affect the warning and intervention criteria. The model of the braking system used to determine the intervention criteria should be based on the principles described in Appendix A.*

**B4.2**

*Part C recommends the practice that should be adopted for the **speed** supervision requirements. Part D recommends the practice that should be adopted for the **tilt enable** and supervision requirements. Part E makes system and operating recommendations common to both **speed** supervision and **tilt enable**.*

*This document quotes the requirements of the respective Railway Group Standards.*

**B4.3**

*The systems transmitting data meeting the requirements of **GE/RT8012** and **GE/RT8019** could be applied to the control of other risks, for example, those relating to **speed** and to the train's route availability. The principle of As Low As Reasonably Practicable (ALARP) should be applied to assess the safety implications and benefits of these systems to control other risks.*

## Recommendations for Systems for the Supervision of Enhanced Permissible Speeds and Tilt Enable

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## Part C

### Recommendations Specific to **GE/RT8012**: **Speed Supervision**

#### C1 General Requirements for Operation at **Enhanced Permissible** Speeds

##### C1.1

###### **GE/RT8012** section 5.1

###### **Provision of **speed** limit information and **speed** supervision and control**

Tilting Trains shall be permitted to operate at **Enhanced Permissible** Speeds through curves only if **speed** limit information and **speed** supervision and control is provided by one of the following means:

- use of lineside signs, with a **speed** supervision and control system, or
- use of Cab Signalling with an Automatic Train Protection system.

The specific requirements for these arrangements are set out in sections 6, 7 and 8.

*This RACOP addresses the requirements for lineside signs complemented by a **speed** supervision system. The value of the signed **enhanced permissible speed** and its derivation when several types of train are authorised to operate at **enhanced permissible** speeds through the section are described in paragraph C2.5.*

##### C1.2

###### **GE/RT8012** section 5.2

###### **Use of Cab Signalling**

Cab Signalling with an Automatic Train Protection system shall be used to control the **speed** of Tilting Trains on curves if:

- the Tilting Trains are operating at speeds greater than 125mph on the approach to curves, or
- a Cab Signalling system is in use for controlling the movement of trains, instead of lineside signalling.

*Cab signalling requirements, including ATP requirements, are contained in **GE/RT8026**. The implementation of the requirements of **GE/RT8012** within an ATP system should be based upon the data formats referred to in section E5.*

##### C1.3

###### **GE/RT8012** section 5.3

###### **Temporary and Emergency **speed** restrictions**

Where lineside signs are provided, Tilting Trains shall travel over Temporary and Emergency **Speed** restrictions at the same speeds as conventional trains, and the provision of signs and AWS magnets for such **speed** restrictions in accordance with **GK/RT0038** shall reflect this requirement.

*For Temporary **Speed** Restrictions (TSRs), the arrangements for the suspension of any authorisation displayed to the driver to operate up to the applicable **enhanced permissible speed** should be incorporated into the arrangements for the implementation of the TSR.*

*For Emergency **Speed** Restrictions (ESRs), until the arrangements to suspend any authorisation to operate at **enhanced permissible speed** are implemented, the arrangements described in **GO/RT3000** Section U for informing the driver of an ESR apply and the driver is required to act on this information.*

*The infrastructure controller should publish and implement procedures for **enhanced permissible speed** suspension and reinstatement.*

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The information given to driver in the cab should be consistent with the information given at the lineside.

## C1.4

### GE/RT8012 section 5.4

#### Review of arrangements for compliance

Prior to the implementation of any change to the **Permissible Speed** or **Enhanced Permissible Speed** at a given location, the arrangements for compliance with this document shall be reviewed and amended where necessary.

**GK/RT0007** contains the overall process for planning changes to **permissible speeds** and **enhanced permissible speeds**. See also Part E, section E3.1.

## C2 Provision of Lineside Signs

### C2.1 Enhanced Permissible Speed Indicators

#### GE/RT8012 section 6.1.1

Lineside **speed** indicators shall be provided at every change in **Permissible Speed** and **Enhanced Permissible Speed** on routes on which Tilting Trains operate.

An **enhanced permissible speed** indicator should be provided for each length of line where authorised by the Sectional Appendix. The value to be displayed on the indicator should be derived in accordance with section C2.5. The position of a **speed** indicator should take into account the tolerances of the train-borne distance measurement and **speed** measurement functions so that, when driving in accordance with the sign and with the design of the **speed** supervision system meeting the requirements of section 7.1 of **GE/RT8012**, it is possible to drive without unjustified interventions.

Appendix A describes the process that the train operator should undertake to apply supervision of **enhanced permissible speeds**. The process provides the information for ensuring compatibility of the **enhanced permissible speed** indicator positions with the operation of the supervision system. As described in appendix A, the train operator and the infrastructure controller have the responsibility to ensure that the position of the **speed** indicator allows the train to be driven according to the signed speeds and the **speed** displayed in the cab on the speed odometer, without unnecessary interventions being invoked nor the real **speed** becoming unsafe without intervention.

### C2.2 Permissible Speed Indicator

#### GE/RT8012 section 6.1.2

Where the same **speed** applies to both conventional and Tilting Trains, a **Permissible Speed** indicator shall be provided without an **Enhanced Permissible Speed** indicator. Where a different **speed** applies, an **Enhanced Permissible Speed** indicator shall be provided in addition to the **speed** indicator(s) for conventional trains. An **Enhanced Permissible Speed** indicator shall not be provided in isolation.

A **permissible speed** (PS) value is required with each **enhanced permissible speed** value so that the driver is aware of the appropriate **permissible speed** to apply should it not be possible to operate at **enhanced permissible speed**.

### C2.3 The Form of Enhanced Permissible Speed Indicators

#### GE/RT8012 section 6.1.3

The **Enhanced Permissible Speed** indicators shall use a unique and distinctive form so drivers can distinguish them easily from conventional **speed** indicators.

The form of the indicators is mandated in **GK/RT0033** and is different in both shape and colour from conventional **speed** indicators.

There are no specific recommendations relating to **GE/RT8012** section 6.1.3.

**C2.4 Height of the Enhanced Permissible Speed Indicator Relative to the Permissible Speed Indicator****GE/RT8012 section 6.1.4**

An **Enhanced Permissible Speed** indicator, where provided, shall always be positioned immediately below a **Permissible Speed** indicator.

*There are no specific recommendations relating to GE/RT8012 section 6.1.4.*

**C2.5 The Enhanced Permissible Speed Value to be Displayed****GE/RT8012 section 6.1.5**

Where more than one **Enhanced Permissible Speed** applies through a given curve, as shown in the Sectional Appendix, only one **speed** value shall be shown on the **Enhanced Permissible Speed** indicator. The value shown shall be the highest **Enhanced Permissible Speed** at which all Tilting Trains authorised to operate on the route can safely traverse the curve without an unacceptable risk of overturning.

Requirements for calculating the **Enhanced Permissible** Speeds are given in **GC/RT5021**.

*The infrastructure controller should determine the value to be shown on the **enhanced permissible speed** indicator applicable to a curve in accordance with the recommendations contained in **GC/RC5521**.*

*The train operator should advise the infrastructure controller of the probabilities of the **speed** control system allowing speeds above the value of a given target **speed** as discussed in Appendix A of this document.*

*The **enhanced permissible speed** value represents the **speed** limit for safety. Drivers of trains who, for the purpose of passenger comfort, are required to follow an **enhanced permissible speed** profile below that indicated by the lineside indicators, should be provided with a route **speed** profile which is taken from the Sectional Appendix and which is clear and fit for use in the cab at the speeds concerned. In general, there will not be a simple rule for the drivers of such trains to apply to relate the value on the **enhanced permissible speed** indicator to the value specified in the Sectional Appendix for the train being driven. It should be arranged that the locations at which changes occur in unsigned **enhanced permissible speed** profiles coincide with those of the signed profile.*

*The infrastructure controller should ensure that Table A of the Sectional Appendix documents the **enhanced permissible speed** of each type of train that is authorised for operation along the route.*

*The signed **enhanced permissible speed** values should be reviewed on each occasion that:*

- a) a new type of tilting train is introduced
- b) infrastructure changes are made that could affect **speed**.

*(Configuration and change control are addressed in Part E, section E3.1)*

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### C2.6 Limit to the Quantity of Speed Values to be Displayed at a Location

#### GE/RT8012 section 6.1.6

A total of no more than three speed values shall be shown on the lineside indicators at any one speed change location.

GK/RT0038 states to which type of trains the two values available for trains operating at permissible speeds may apply.

### C2.7 Enhanced Permissible Speed Warning Indicators

#### GE/RT8012 section 6.2.1

Railway Group Standard GK/RT0038 sets out the requirements for providing warning indicators and associated AWS magnets for Enhanced Permissible Speeds. It includes the additional requirements relevant to continuous route signing.

GK/RT0038 sets out the requirements for the installation of permissible speed warning indicators and the Automatic Warning System (AWS) for permissible speeds.

#### Warning Indicators

The reference to continuous route signing in this context means that additional warning indicators for enhanced permissible speeds should be provided when:

- they do not cause confusion to drivers
- there is a benefit to the overall efficiency and safety of operations
- the degraded mode analysis recommended in section E4.3 indicates that the driver requires advanced warning of the permissible speed applicable for the case when the expected following enhanced permissible speed authority is not displayed in the cab.

A warning indicator is recommended for each location where there is a reduction in enhanced permissible speed, both in the signed and the unsigned speed profiles. A warning board for the corresponding permissible speed value(s) should also be provided where there is a change at the location concerned. Where the permissible speed value(s) in force does not change, the use of a miniature sign to repeat this value with the warning indicator may be considered.

A warning indicator for a reduction in the permissible speed should always be accompanied by enhanced permissible speed information, unless the end of an enhanced permissible speed zone is to be indicated. Where the enhanced permissible speed value in force does not change, the use of a miniature sign to repeat this value with the warning indicator may be considered.

#### Automatic Warning System

Because of the requirement for a speed supervision system, the installation of the Automatic Warning System (AWS) at reductions of enhanced permissible speed is not required. The installation of the AWS is required at the warning indicator of a section where operation at enhanced permissible speed is not authorised, and the speed reduction from the applicable enhanced permissible speed to the permissible speed meets the criteria of GK/RT0038, unless the appropriate speed supervision data is provided at that location.

The AWS magnets installed for warning of reductions in permissible speed should be assessed by the train operator for their influence upon drivers operating to enhanced permissible speeds. Measures should be taken to ensure that the significance of AWS to these drivers is maintained.

**C2.8 The Form of Enhanced Permissible Speed Warning Indicators****GE/RT8012 section 6.2.2**

The **Enhanced Permissible Speed** warning indicators shall use a unique and distinctive form so that drivers can distinguish them easily from conventional warning indicators.

The form of the indicators is mandated in [GK/RT0033](#) and is different in both shape and colour from conventional warning indicators.

*There are no specific recommendations relating to [GE/RT8012](#) section 6.2.2.*

**C2.9 Height of Enhanced Permissible Speed Warning Indicators****GE/RT8012 section 6.2.3**

An **Enhanced Permissible Speed** warning indicator, where provided, shall always be positioned immediately below a **Permissible Speed** warning indicator applying to the same reduced **speed** section of line. An **Enhanced Permissible Speed** warning indicator shall not be provided in isolation.

*Where the **permissible speed** changes at the same location as the **enhanced permissible speed**, where required for one of these, warning boards should be provided for both.*

**C2.10 The Enhanced Permissible Speed Warning Value to be Displayed****GE/RT8012 section 6.2.4**

The **speed** value shown on the **Enhanced Permissible Speed** warning indicator shall be the same as that shown on the corresponding **Enhanced Permissible Speed** indicator.

*There are no specific recommendations relating to [GE/RT8012](#) section 6.2.4.*

**C2.11 Location of Enhanced Permissible Speed Warning Indicators****GE/RT8012 section 6.2.5**

The position of each warning indicator and AWS magnet is determined by the train which requires the greatest braking distance on the approach to the lower **speed** restriction. The tables of distances and the other requirements for selecting the position of the warning indicator and AWS magnet are set out in Railway Group Standard [GK/RT0038](#).

*For a given **speed** restriction, the warning indicators for **permissible** speeds and for **enhanced permissible** speeds being co-located, the following should be considered to determine their location:*

- In the general case, the warning indicators for a reduction in **permissible speed** will be placed in accordance with [GK/RT0038](#).*
- The reduction in **enhanced permissible speed** could require a greater warning distance than the associated change in **permissible speed**, therefore the position of all relevant warning indicators should be reviewed when an **enhanced permissible speed** is to be put in place.*
- The distance between a warning indicator displaying an **enhanced permissible speed** and the associated **speed** indicator should be at least that necessary to ensure that a train being driven correctly to its **enhanced permissible speed** profile published in the sectional appendix does not suffer intervention by the **speed** control system. The train requiring the longest warning distance determined in accordance with appendix A, for **enhanced permissible** speeds, and [GK/RT0038](#), for **permissible** speeds, should be considered.*
- Where the degraded mode analysis recommended in section E4.3 requires, the warning distance for the signed **enhanced permissible speed** should be increased so that it is possible for the driver to brake from a prevailing **enhanced permissible speed** to the **permissible speed** applicable to the following **enhanced permissible speed** section before its commencement.*