

Controlling the Speed of Tilting Trains Through Curves

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Synopsis

This document mandates the means by which Tilting Trains may be operated at higher speeds than non-tilting trains around **curves**.

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Part A

Issue Record

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

Amended or additional parts of revised pages will be marked by a vertical black line in the adjacent margin.

Issue	Date	Comments
One	December 1999	Original Document

Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group * and apply to all relevant activities that fall into the scope of each individual's Railway Safety Case. If any of those activities are performed by a contractor, the contractor's obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

* The Railway Group comprises Railtrack and the duty holders of the Railway Safety Cases accepted by Railtrack.

Compliance

The provisions in this document are to be complied with from 1 April 2000 and will take effect from the date when Tilting Trains, designed to travel at a higher speed than conventional trains through curves, commence service operation at Enhanced Permissible Speeds on curves.

Health and Safety Responsibilities

In issuing this document, Railtrack PLC makes no warranties, express or implied, that compliance with all or any documents published by the Safety & Standards Directorate is sufficient on its own to ensure safe systems of work or operation. Each user is reminded of its own responsibilities to ensure health and safety at work and its individual duties under health and safety legislation.

Supply

Controlled and uncontrolled copies of this document may be obtained from the Industry Safety Liaison Dept, Safety and Standards Directorate, Railtrack PLC, Railtrack House, DP01, Euston Square, London, NW1 2EE.

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Part B

1 Purpose

The purpose of this document is to mandate the requirements for controlling the **speed** of Tilting Trains in order to prevent overturning on **curves**.

2 Scope

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

Specifically the contents of this document apply to Tilting Trains operating at Enhanced Permissible Speeds and to the routes over which they have authority to operate.

This document facilitates compliance with section 3 of the Railway Safety Regulations 1999 only in respect of controlling the **speed** of Tilting Trains on **curves**.

This document supplements, but does not replace, the requirements of Railway Group Standard [GK/RT0038](#).

3 Definitions

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.

Permissible Speed

The maximum permitted **speed** over a section of line which applies to all trains when not operating at an Enhanced Permissible **Speed**. Permissible Speeds are detailed in the Sectional Appendix.

Enhanced Permissible Speed

The permitted **speed** (higher than the Permissible **Speed**) over a section of line which applies to a specific type of Tilting Train. Enhanced Permissible Speeds are detailed in the Sectional Appendix. [GC/RT5021](#) describes the requirements for calculation of the Enhanced Permissible **Speed**.

Automatic Train Protection

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.

Cab signalling

Provision of in-cab movement authority and **speed** limit information to the driver of a train, instead of using **lineside** signals and **signs**.

4 Introduction

4.1

It is necessary to apply controls to ensure that Tilting Trains do not exceed their Enhanced Permissible **Speed** on a curve because the margin between the Enhanced Permissible **Speed** and the **speed** at which the train will overturn is significantly less than the margin for trains travelling at the Permissible **Speed**.

4.2

On routes where **speed** limit information is provided by **lineside signs**, this document mandates the use of additional **signs** to indicate the Enhanced Permissible **Speed**. As with all **lineside speed signs**, they serve as a reminder to drivers. A driver's actual authority to drive at a given **speed** comes from the **speed** limit information contained in the relevant Sectional Appendix of the Rule Book.

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4.3

At any given location, a different Enhanced Permissible **Speed** may apply for each type of Tilting Train authorised to operate on the route. All Enhanced Permissible Speeds are detailed in the Sectional Appendices. However, to minimise the risk of drivers of Tilting Trains being confused by a multiplicity of Enhanced Permissible **Speed signs**, this document mandates that only one Enhanced Permissible **Speed** is displayed on the sign at any given location. Although the driver of a Tilting Train is required to traverse the curve at the **speed** permitted by the Sectional Appendix, the **speed** value displayed will be the highest Enhanced Permissible **Speed** at which all Tilting Trains authorised to use the route can safely traverse the curve without an unacceptable risk of overturning.

4.4

To further reduce the risk of drivers of both tilting and conventional trains inadvertently reading a **speed** sign that is not intended for them, the document also mandates that:

- Enhanced Permissible **Speed signs** must be distinctive in form;
- the total number of speeds indicated at any given location must not be greater than three (one Enhanced Permissible **Speed** and two speeds for conventional trains, for example passenger and freight);
- all changes in Permissible **Speed** and Enhanced Permissible **Speed** on a route must be signed (that is continuous route signing is to be applied);
- the positions of Permissible **Speed** and Enhanced Permissible **Speed signs** for any given **speed** change must be coincident;
- Enhanced Permissible **Speed signs** must not be positioned in isolation (ie. where provided, they must always have an accompanying sign for conventional trains).

4.5

At locations where an Enhanced Permissible **Speed** applies, the document mandates the use of a **speed supervision** and control system. The purpose of this system is to ensure that the train **speed** at the start of the curve does not exceed the Enhanced Permissible **Speed** by a margin which would give an unacceptable risk of overturning.

4.6

The document permits the use of Cab Signalling with full Automatic Train Protection, instead of using **lineside signs**, as the means for indicating the permitted speeds to the driver and for ensuring that he does not exceed those speeds.

5 General requirements for operation at Enhanced Permissible Speeds

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:

- a) use of **lineside signs**, with a **speed supervision** and control system, or
- b) 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.

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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.

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.

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.

6 Provision of **lineside signs**

6.1 Provision of **speed** indicators

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.

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.

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.

6.1.4

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

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](#).

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.

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6.2 Provision of warning indicators and associated AWS magnets

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.

6.2.2

The Enhanced Permissible **Speed** warning indicators shall use a unique and distinctive form so 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.

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.

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.

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](#).

6.3 Positioning and visibility of signs

Signs provided for Enhanced Permissible Speeds shall be subject to an on-site assessment, to ensure so far as possible that the positioning is adequate, taking into account:

- the time for which the sign needs to be visible for the driver to observe and assimilate the information conveyed by it;
- other tasks which the driver may be required to perform at the same time as observing the sign.

7 Speed supervision and control system

7.1 Capability of **speed supervision and control system**

The **speed supervision** and control system shall monitor and be capable of controlling the **speed** of each Tilting Train on the approach to all **curves** where an Enhanced Permissible **Speed** applies, to ensure that, when the train reaches the start of the curve, the train **speed** does not exceed the Enhanced Permissible **Speed** applicable to the train by a margin which would give an unacceptable risk of overturning.

7.2 In-cab displays and warnings

7.2.1

No in-cab **speed** limit information shall be displayed to the driver by the system (in order to avoid any possible conflict of information with **lineside** signals and **speed** sign information) unless the system is fitted throughout the route and continuously displays **speed** limit information to the driver. Where in-cab **speed** limit information is displayed, it shall be consistent with the Permissible Speeds (or Enhanced Permissible Speeds, where applicable) and **speed** restrictions on the route, and with the movement authorities given by the signalling system.

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7.2.2

It is permissible to provide an audible and/or visual indication to warn the driver, in order that the driver can take action to prevent imminent intervention by the system.

7.2.3

If the system intervenes to reduce the train speed, an audible and/or visual warning shall be given to the driver.

7.3 Record of system intervention

Intervention by the system to reduce the speed of the train shall be recorded by the train data recorder.

7.4 System performance requirements

7.4.1

The system shall not cause interference to other infrastructure equipment or train-borne equipment which could jeopardise safe operation.

7.4.2

All other systems and equipment which provide input to the speed supervision and control system shall be designed and maintained to a sufficient level of integrity to ensure that the safety performance of the system is not jeopardised.

7.4.3

So far as is reasonably practicable, any failure of the train-borne equipment shall be indicated to the driver.

7.4.4

So far as is reasonably practicable, there shall be no credible failure mode of the system whereby it could fail to provide the required speed supervision and control, except where such a failure is indicated to the driver.

7.4.5

For essential operational purposes (for example, in the event of a system failure), it is permissible to provide facilities for the isolation of the system on the train.

7.5 Operation and maintenance of speed supervision and control systems

The Infrastructure Controller and Train Operators shall devise and implement appropriate arrangements in respect of the speed supervision and control system for:

- ensuring that only those Tilting Trains that are fitted with a train-borne sub-system which is compatible with the track-based sub-system are authorised to operate at Enhanced Permissible Speeds;
- the maintenance of the system (in accordance with the requirements of [GK/RT0170](#) and [GM/RT2004](#));
- the reporting and investigation of failures of the system (in accordance with the requirements of [GK/RT0106](#));
- enabling the safe movement of trains in the event of a system failure or isolation. These arrangements shall prohibit Tilting Trains from travelling through curves at Enhanced Permissible Speeds under system failure and isolation conditions;
- the configuration management and change control of the system.

7.6 Interface with TPWS or other speed supervision and control systems

Where TPWS (or other speed supervision and control system) is used on the approach to a curve for the safety of conventional trains, its effectiveness in fulfilling that purpose shall not be significantly degraded by the need to operate Tilting Trains over the same curve at Enhanced Permissible Speeds.

Risk assessment shall be applied to assist in deciding whether or not effectiveness has been "significantly" degraded.

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8 Provision of Cab Signalling

8.1 Speed display

A Cab Signalling system which is used to meet the requirements of this document shall, as a minimum, provide a continuous display of speed limit information that is consistent with the Permissible Speeds (or Enhanced Permissible Speeds, where applicable) and speed restrictions on the route, and with the movement authorities given by the signalling system.

8.2 Automatic Train Protection

An Automatic Train Protection system shall be provided in conjunction with the Cab Signalling. This system shall, as a minimum, meet the requirements of section 7.

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References

- GA/RT6001** Railway Group Standards Change Procedures
- GC/RT5021** Track System Requirements (Programmed to be issued February 2000)
- GK/RT0033** **Lineside Signs**
- GK/RT0038** **Speed** Restrictions
- GK/RT0106** Management of Safety Related Failures of Signalling and Operational Telecommunications Systems
- GK/RT0170** Asset Management for the Safety of Signalling and Operational Telecommunications Systems and Equipment
- GM/RT2004** Rail Vehicle Maintenance and Overhaul Policy

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by the Safety & Standards Directorate.