

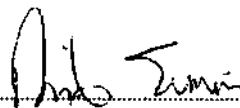
Ref	NR/GN/SIG/02022
Issue	2
Date	December 2005

Business Process Document

Requirements for TASS Infrastructure - System Description

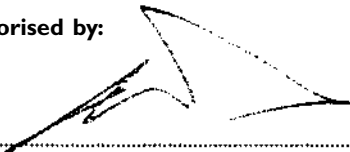
Endorsement & Authorisation

Endorsed by:



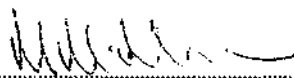
Andrew Simmons, Professional Head of Signal Engineering

Authorised by:



Andrew McNaughton, Chief Engineer

Accepted for issue by:



Mick McManus, National Standards Manager

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of the Standard Owner.

©Copyright 2005 Network Rail

Uncontrolled copy once printed from its electronic source.

Published & Issued by: Network Rail 40 Melton Street, London NW1 2EE



Documents
Document Sharing Hub

Ref:	NR/GN/SIG/02022
Issue:	2
Date:	December 2005

Issue record

Issue	Date	Comments
1	December 2003	New Code of Practice
2	December 2005	Updated to reflect change to TPWS isolation to align with the Alstom TASS Trackside Application Principles. Document reference changed to new lettering system. Previous reference RT/E/C/02022.

Disclaimer

In issuing this document for its stated purpose, Network Rail makes no warranties, express or implied, that compliance with all or any documents it issues is sufficient on its own to ensure safe systems of work or operation. Users are reminded of their own duties under health and safety legislation.

Supply

Copies of documents are available electronically, within Network Rail's organisation. Hard copies of this document will be available to Network Rail employees on request to the Document Controller and to other organisations from Technical Indexes Ltd (01344 404409).

Ref:	NR/GN/SIG/02022
Issue:	2
Date:	December 2005

Contents

1	Purpose	4
2	Scope	4
3	Reference Documentation	5
4	Definitions	5
5	Concept	8
6	Safety Performance	10
7	Interfaces	11
8	Operational Overview	14
9	Functional Overview	19
10	Operational Scenarios	26

I Purpose

I.1

This Guidance Note describes the Tilt Authorisation And Speed Supervision (TASS) system developed to deliver the principal requirements of Railway Group Standards [GE/RT8012](#) 'Controlling The Speed Of Tilting Trains Through Curves' and [GE/RT8019](#) 'Tilting Trains: Controlling Tilt Systems To Maintain Clearances'. This Guidance Note covers the following aspects of the system:-

- The overall TASS concept and its role in the safe operation of tilting trains.
- The context in which TASS operates, its external interfaces and major subsystems.
- The top-level application tasks and rules which govern the use of TASS.
- The normal and degraded operation modes of TASS, and the transitions between them.
- The set of operational scenarios, in which TASS functions, and which will form the basis of acceptance of the delivered system.
- TASS performance measures, which will form the basis of acceptance of in-service performance of the system.
- The physical aspects of the system and relationships with other systems.

2 Scope

2.1

This document provides details of the TASS system developed by ALSTOM for use on Network Rail infrastructure. The document includes a description of the infrastructure part of the TASS system. In order to ensure that the functionality of the system and the operating requirements are understood it also includes a description of some of the elements of the trainborne part of the system.

Copyright Network Rail
Provided by IHS under license with Network Rail
No reproduction or networking permitted without license from IHS

3 Reference Documentation

GE/RT8012	Controlling The Speed Of Tilting Trains Through Curves
GE/RT8019	Tilting Trains: Controlling Tilt Systems To Maintain Clearances
NR/GN/SIG/02025	Guidance for Consideration of TASS Balises During Railway Engineering Activities
NR/SP/SIG/02023	Requirements For TASS Infrastructure – System Design
NR/SP/SIG/02024	Requirements For TASS Infrastructure – Installation, Test and Maintenance
NR/SP/SIG/02026	Requirements for the Provision and Management of TASS Infrastructure Data

4 Definitions

Automatic Warning System (AWS)

A track inductor based system in use on the Network Rail network, linked to the aspects of fixed lineside signals and capable of providing driver alerts and braking intervention.

Balise

A track mounted spot transmission unit that uses magnetic transponder technology. Its function is to transmit/receive telegrams to/from the train passing overhead. A TASS balise is passive with no interface to a Lineside Electronic Unit (LEU) and will therefore only transmit the fixed telegram stored in its memory. This data can only be changed by reconfiguration.

Braking Distance (BD)

The distance required to bring a train from one designated speed to another.

Cant Deficiency (CD)

Cant is the cross level angle of track on a curve, used to compensate for lateral forces generated by a train passing through the curve. Cant deficiency is the difference between the applied cant on the track and the equilibrium cant for the vehicle at the particular stated speed.

Driver Machine Interface (DMI)

Controls and indicators on the train that are available to the driver.

Enhanced Permissible Speed (EPS)

The permitted speed (higher than the Permissible Speed) over a section of line which applies to a specific type of tilting train. However, in the speed supervised section, the single speed profile transmitted to the train at any one time will be the higher of either the PS or the EPS for the appropriate train.

Ref:	NR/GN/SIG/02022
Issue:	2
Date:	December 2005

ERTMS

European Rail Traffic Management System is the new signalling and management system for Europe, enabling interoperability throughout the European Rail Network.

Gradient

The actual gradient of the track or, for gradient changes of less than 200 yards, the average over the distance. Gradients are signed (+ve or -ve) when standing with back to zero or lowest absolute mileage irrespective of direction of travel.

High Cant Deficiency

A Cant Deficiency greater than 150mm (see Cant Deficiency above).

International Union of Railways (UIC)

The worldwide organisation for railway cooperation.

Mileage

The distance along the track from a defined datum.

Overspeed Sensor System (OSS)

The means by which TPWS provides overspeed protection at certain speed restrictions.

Permissible Speed (PS)

The maximum permitted speed over a section of line which applies to all trains when not operating at an Enhanced Permissible Speed.

TASS

Tilt Authorisation and Speed Supervision system (ALSTOM's tilt management solution).

Tilt Authorised

The tilt supervision system provided to fulfil requirements defined in Railway Group Standards *authorises* the train to tilt when it is within a tilt permitted area. A Tilt Authority (TA) output is generated by TASS. As trains leave tilt permitted areas, this authorisation is removed.

Tilt Control System

The trainborne system controlling the tilting of the train.

Tilt Enabled

The tilt control system on the train *enables* tilting, when authorised by the tilt supervision system, and when related driver controls and tilt self-monitoring indicate that it is desirable to do so.

Tilt Permitted

The Network Rail defined areas of the network where tilting by particular train types is *permitted*.

Ref:	NR/GN/SIG/02022
Issue:	2
Date:	December 2005

Train Protection Warning System (TPWS)

A system in use on Network Rail lines to provide protection against signals being passed at danger and overspeed protection at certain speed restrictions.

TASS Vital Computer (TVC)

ALSTOM's trainborne computer used for TASS.

Zone

Comprises of a start and end mileage with a single value describing an entity within these limits. A change in value of the entity requires a new zone to be defined.

5 Concept

5.1 Overview

5.1.1

TASS is a generic system, including the following elements:-

- A track-based system requiring no connection to trackside signalling systems or trackside power supplies, which can be applied in a variety of ways, in order to meet both generic and project-specific requirements. This primarily consists of a series of balises and track mountings.
- A generic design of trainborne equipment, that acts in accordance with data in telegrams from the track-based equipment.

5.1.2

TASS is able to fulfil requirements defined in more detail in later sections of this document, and it provides a means of managing the operation of different types of tilting trains running on railway infrastructure, in the following respects:-

- Authorising tilting operation of trains only in areas of the track network where the infrastructure controller defines that it is safe for the particular type of train to tilt. This function is referred to as Tilt Authorisation (TA). Even when tilt is authorised by TASS, the driver still retains the ability to isolate or temporarily inhibit tilting.
- Supervising the speed of tilting trains approaching and running through curves and other sections of the route where speed supervision of Permissible Speed (PS) and Enhanced Permissible Speed (EPS) operation appropriate for the type of train is permitted by the infrastructure controller. PS sections can also be monitored in an identical manner to EPSs. This function is referred to as Speed Supervision (SS). This TASS function can apply the train brakes in the event of an excessive speed being detected, whatever the actions of the driver.

5.1.3

TASS will not instruct drivers of the appropriate speed value. There is a continuing requirement embodied in current Railway Group Standards for lineside signs, and system responsibility for the overall interface with drivers of tilting trains lies outside the scope of TASS.

Ref:	NR/GN/SIG/02022
Issue:	2
Date:	December 2005

5.1.4

TASS track-based balises (standard Eurobalises) will not be interfaced to the lineside signalling and are compatible with other systems such as AWS and TPWS.

5.1.5

TASS is based on European Rail Traffic Management System (ERTMS) technology and can be applied on routes and trains not fitted with ERTMS. It is compatible with ERTMS Level 1, 2 and 3 trackside and trainborne implementation. It is possible in many cases to share trackside and trainborne equipment between ERTMS and TASS functions.

6 Safety Performance

6.1 Overview

6.1.1

TASS is based on a simple safety philosophy, which can be summarised as follows:-

- Positive data needs to be received to authorise a train to tilt. Failure to receive this data causes reversion to non-tilting operation. Authority to tilt is limited by distance travelled.
- Train speed can be supervised, including EPS permitted by lineside signs, within any section of a route defined by data sent from balises to passing trains.
- TASS can temporarily isolate the trainborne TPWS equipment when protecting a speed restriction where an overspeed intervention would otherwise occur at the EPS and TASS is supervising the speed. TPWS isolation is not permitted if there is insufficient separation from any signal overspeed or train stop loop.
- Braking to lower speeds is supervised according to braking curves generated by trainborne TASS equipment, which are appropriate to the train type and the track gradient.
- Failure to receive data means that no authorisation will be given to the driver to follow EPSs, and TPWS will not be temporarily isolated.
- Data is transmitted using ERTMS compatible balise technology, and utilises secure coding to guarantee that only correctly received data is acted upon.
- A robust applications process is defined for acquiring, storing, preparing, checking and transferring of data into a balise, and for record keeping.
- A robust applications process is defined to install, test and commission balises on the infrastructure.
- Train speed and train position relative to balise positions are determined by means of an odometry system consisting of multiple trainborne tachometer sensors and processing equipment.
- Trainborne processing is carried out in a safe computer system, the TASS Vital Computer (TVC), using software developed to appropriate standards.
- The system is not affected by external electromagnetic fields of the magnitudes expected on railway vehicles.

7 Interfaces

7.1 Track-based and trainborne

7.1.1

The track-based system interfaces consist of:-

- Infrastructure data definition and management interface (documentation and data).
- Balise data definition and management interface (documentation and tools).
- Engineering interface for programming TASS balises (programming tools).
- Balise installation and test interface (documentation and test tool).
- Balise maintenance (documentation).

7.1.2

Telegram data requirements are provided in [NR/SP/SIG/02023](#). Installation, test and maintenance requirements are provided in [NR/SP/SIG/02024](#). Information on TASS balises and mounting brackets including ordering details are provided in [NR/SP/SIG/02024](#). Infrastructure data requirements are provided in [NR/SP/SIG/02026](#).

7.1.3

The trainborne system has several interfaces including the driver display, data recorder and connections to TPWS, tilt control and braking systems. The primary trainborne interface functions of TASS are:-

- Interface to the temporary isolation / de-isolation facility of TPWS, without modification to TPWS. TASS does not affect AWS functionality in any way.
- Provision of the facility to implement a two-stage removal of tilt authorisation, if required in a particular application. Stage I informs the train's tilt control system of the impending removal of tilt authorisation, allowing the tilt control system to restore the train to a non-tilting state. After a defined time interval, the tilt authorisation signal to the train's tilt control system is removed, inhibiting tilt. Both stages of tilt authorisation removal are initiated from the same balise. The two-stage removal of tilt authorisation need not be used on all train types.
- Interface with the train data recorder.
- Interface with the train traction and braking systems, to cut power, and to apply the full service and/or emergency brakes on intervention.

7.2 The Airgap

7.2.1

In addition to the above external interfaces, there is an important interface between TASS elements. This is the airgap between track-based and trainborne TASS subsystems. The full definition of the requirements for this interface is essential for the safe and correct application of TASS, and for the maintenance of compatibility between track-based and trainborne components of TASS and ERTMS, on different routes and on different train types.

7.2.2

TASS telegrams conform to ERTMS principles, and are fully specified in [NR/SP/SIG/02023](#), but are based on the following transmission principles:-

- All TASS telegrams are transmitted within the ERTMS Packet 44 structure (Data used by applications outside the European Train Control System/ERTMS system). Packet 44 allows for the transmission of non-ERTMS information in a form which will be safely ignored by standard ERTMS-fitted trains.
- TASS data is transmitted within Packet 44 in several UK system sub-packets, allocated to TASS by Rail Safety & Standards Board. These Sub-packets include Tilt Management, Tilt Authorisation and EPS Definition (the latter including data defining Gradient Profile and optionally TPWS Isolation locations). Each packet contains an application-specific field (NID_XUSER) which is unique to the UK.
- Each sub-packet used by TASS conforms to the principles of the ERTMS language. Where the meaning is the same, TASS data is conveyed using the same format as standard ERTMS data packets, but identified as TASS sub-packets to avoid misinterpretation. Where the meaning is different, new TASS-specific packets and variables are defined, using the same structural principles as for ERTMS packets.

7.2.3

The TASS balise telegram structures use values of variables allocated by UIC for use on the UK network, and then allocated by Rail Safety & Standards Board in the UK for TASS use. TASS balise telegrams consist of discrete data packets, which comply with Rail Safety & Standards Board requirements for identification of data for UK non-ERTMS applications.

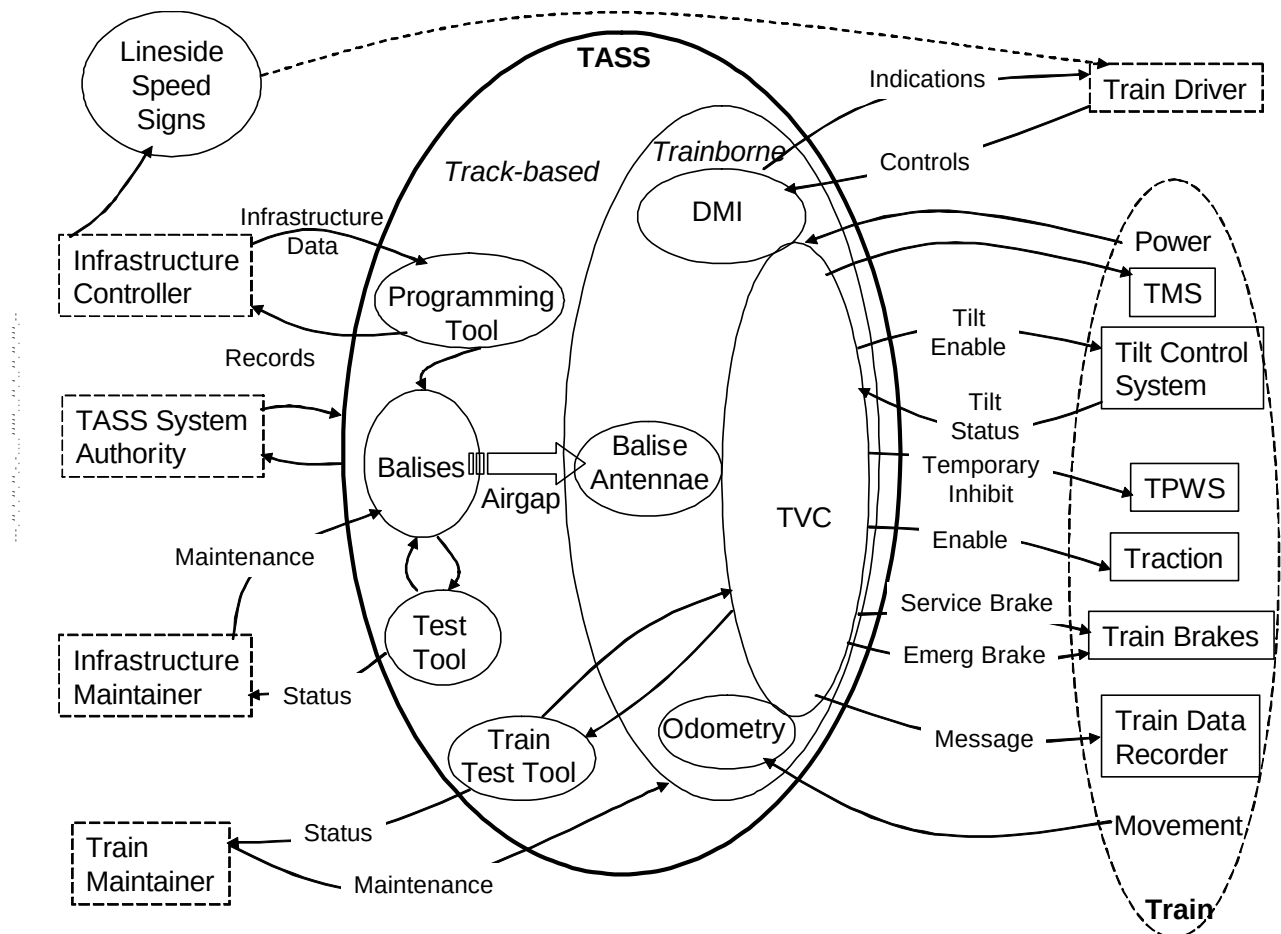
7.2.4

Transmissions involve a 'downlink' to telepower balises, and an 'uplink' to convey data from balises to passing trains. The frequencies used by TASS balises are 27.095 MHz $\pm$ 5 kHz (downlink) and 4.234 MHz $\pm$ 200kHz (uplink).

7.2.5

The interfaces to TASS are illustrated in figure 1.

Figure 1: TASS Interfaces



8 Operational Overview

8.1 Introduction

8.1.1

The trainborne system is based on ERTMS hardware consisting of a safe computing system (the TVC), antennae, odometry system and a Driver Machine Interface (DMI). The TVC takes input for speed and distance measurement from the odometry system, and receives telegrams from track-based balises via a pair of train-mounted balise antennae. The system interfaces with the train for its power supply, the tilt control system, the braking and traction control system, TPWS and the train data recorder. TVC faults are recorded within the TVC for later analysis.

8.1.2

On passing a balise, the balise antenna activates it via a process called telepowering and the balise replies with its pre-programmed telegram.

8.1.3

If the first balise encountered contains TASS system information (as opposed to other system information, e.g. ERTMS), and is decoded without error, the train system then stores this data without enabling tilting or speed supervision. On encountering the next TASS balise, the system will enter the supervised state, provided that the measured distance from the first to second balise is consistent with data received in the first balise telegram. Tilt will now be authorised, and speed supervised, according to the balise data, so long as the sequence of balises remains unbroken.

8.1.4

Throughout TASS operation, the measured distance from one balise to the next is always checked against data in the balise telegram. This allows TASS to detect a misplaced balise or a gross odometry error. If the train reaches the end of the distance defined in the balise data without seeing the expected balise, it supervises a speed reduction, removes any tilt authorisation and reverts to an inactive state again. If the train encounters a balise before the expected location, the trainborne equipment shuts down, (initiating an emergency brake application). Any event causing TASS to shut down will result in application of the train brakes.