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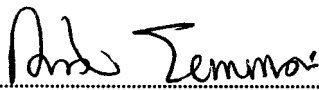
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Business Process Document

Methodology for the Demonstration of Compatibility with TPWS Track Sub-system

Endorsement & Authorisation

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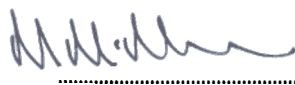
A Simmons, Head of Engineering

Authorised by:



A McNaughton, Chief Engineer

Accepted for issue by:



M McManus, National Standards Manager

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Issue record

Issue	Date	Comments
1	February 2003	New Code of Practice
2	April 2006	Issue validated and endorsed by ESRP

Implementation

The provisions of this code of practice may be used from the date of issue.

Compliance

This Network Rail Specification is mandatory and must be complied with by all parties seeking acceptance from the date of issue.

When this Specification is implemented, it is permissible for all projects, which have formally completed GRIP Level 4, to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the designated [Standard Owner] has stipulated otherwise in the accompanying Briefing Note.

Where the [Standard Owner] has specified that all projects will comply with the requirements, specific authority not to comply can be sought in the usual manner using the appropriate non-compliance authority processes described in Network Rail Standard, [NR/SP/STP/045](#) Managing the Process for Non-compliance Authority (formerly RT/LS/P/045).

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I Purpose

The purpose of this document is to provide a methodology to demonstrate compatibility with Train Protection and Warning System (TPWS) track sub-system equipment on Network Rail controlled infrastructure.

This document describes a method by which a train's compatibility with TPWS used on Network Rail's infrastructure, both electrified and non-electrified can be assessed. The scope of this document is limited to electromagnetic interference (EMI) emanating from trains and its effect on TPWS equipment installed on the track. It does not consider the effect of train EMI on trainborne TPWS mounted on that train, or on adjacent trains.

2 Scope

The scope of the document only concerns the TPWS track sub-system that is manufactured by Thales Communications Ltd. that is the subject of Network Rail Product Acceptance Certificates No.s PA05/00446 and PA05/01615. This covers all of the TPWS track sub-system equipment that has been supplied to Network Rail at the time this document was prepared.

3 Reference documentation

3.1 Railway Group Standards

[GE/RT8030](#) 'Requirements for a Train Protection and Warning System', Issue 1, August 2000

3.2 Network Rail Company Standards

[RT/E/S/10134](#) 'Train Protection and Warning System (TPWS) – Track Sub-System Equipment' Issue 3, April 2004

[RT/E/S/10138](#) 'TPWS Transmitter loop requirements and positioning' Issue 3, April 2004

[RT/E/S/10173](#) 'TPWS Track sub-system installation requirements' Issue 3, April 2004

RT/E/C/50002 'Methodology for the demonstration of compatibility with reed track circuits on the a.c. railway.' Issue 1, February 2003

RT/E/C/50009 'Methodology for the demonstration of compatibility with FS2600 track circuits on the d.c. railway.' Issue 1, February 2003

RT/E/C/50015 'Methodology for the demonstration of compatibility with reed FDM systems on the a.c. and d.c. railways.' Issue 1, February 2003

RT/E/C/50005 'Methodology for the demonstration of compatibility with 50 Hz single rail track circuits.' Issue 1, February 2003

3.3 Other documentation

ESID9004 [AEAT Rail]	Redifon MEL TPWS Track Sub-System: Technical Characteristics for EMC Assessments', issue 1.0, January 2000
ESID9010 [AEAT Rail]	'TPWS – Rolling Stock Test Strategy', issue 2.0, July 1999
TR0192 [Thales Communications]	'Train Protection and Warning System Technical Report: Class 315 Interference with Trackside TPWS Equipment' Issue A, March 2004
BS EN 50121-4:2000 BS IEC 61508	'Railway applications Electromagnetic compatibility Part 4: Emission and immunity of the signalling and telecommunications apparatus' Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems, January 2001
TR0013 [Thales Communications]	'Train Protection and Warning System Technical Report: FMEA for trackside equipment' Redifon MEL (now Thales Communications), Issue A, dated March 2000

4 Description of TPWS System

4.1 Overview

TPWS has been developed for national implementation in the UK as a means to reduce the number of and minimise the potential consequences of:

- Signals passed at danger (SPADs)
- Excessive train speeds at Permanent Speed Restrictions
- Collisions between trains and buffer stops

To meet this requirement, TPWS provides the functions of a Train Stop System (TSS) and an Overspeed Sensor System (OSS). To increase the flexibility of the system both 'normal and 'opposite' direction TSS and OSS functions are provided. The 'opposite' direction TSS and OSS functions are used most commonly, but not exclusively, on bi-directional lines.

An emergency brake application will occur on a train fitted with operational TPWS equipment if it passes over an active TSS in the correct direction at any speed, or an active OSS in the correct direction at a speed in excess of a set speed.

A schematic of the TPWS Track Sub-System is shown in figure 1:

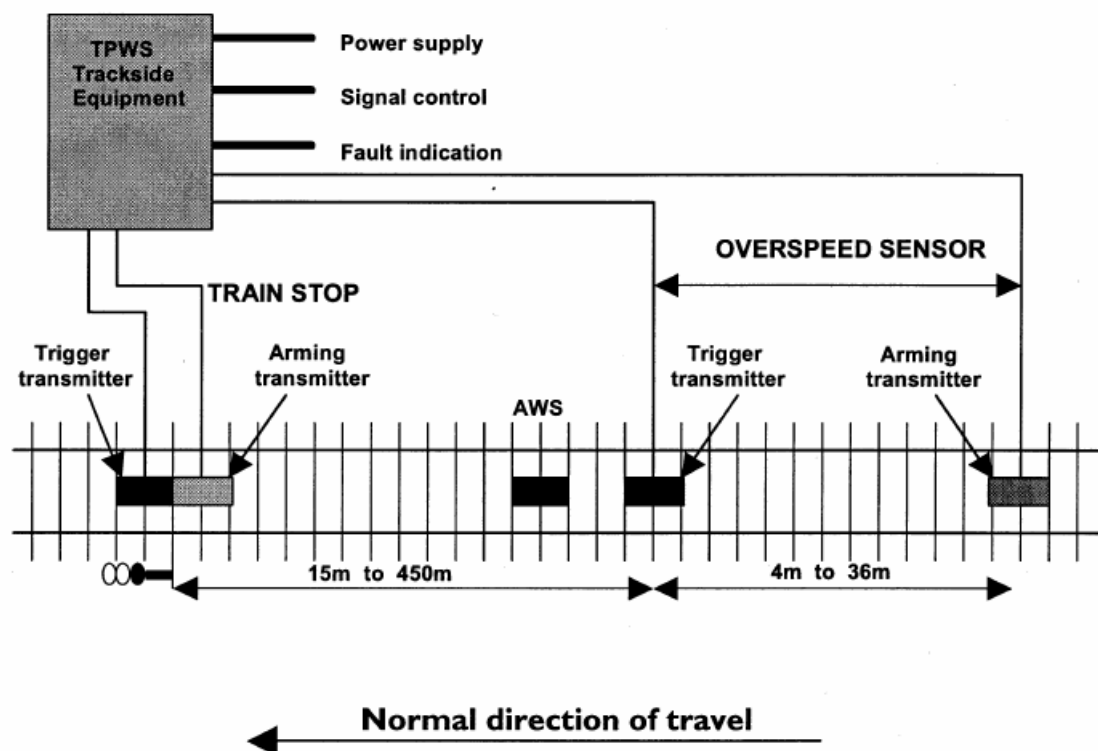


Figure 1: Schematic of TPWS Track Sub-System (reproduced from [2])

The operation of TPWS is achieved by the transmission of un-modulated tones from transmitter loops located within the four foot. The transmitted tones are received by an antenna located on the underside of a train, in proximity to the operational driving cab. No information is transmitted from the vehicle sub-system to the track sub-system.

Both the TSS and OSS functions require two discrete frequency tones to be detected by a train passing over two transmitter loops. For the TSS function, the arming and trigger loops abut each other. An emergency brake application is made if the TPWS train equipment detects a TSS arming frequency, and whilst still detecting the arming frequency, also detects the corresponding TSS trigger frequency.

For the OSS function, the arming and trigger loops are separated by a defined distance that is a measure of the set speed of the OSS installation. An emergency brake application is made if the TPWS train equipment detects an OSS arming loop, and then the corresponding OSS trigger loop, within the time period of the pre-set timer that is incorporated within the TPWS train equipment.

At TPWS installations associated with signals, the track loops are energised when the corresponding signal is at danger. For OSS installations that protect Permanent Speed

Restrictions or the approach to buffer stops, the track loops are normally energised continuously [[GE/RT8030](#), [ESID9004](#)].

TPWS works alongside the Automatic Warning System (AWS), and does not affect the functionality of AWS.

4.2 Operating Frequencies

A total of six discrete frequencies are used by TPWS, indicated in Table I below, although only one tone frequency is transmitted by each transmitter loop.

Function	Arming Frequency (kHz)	Trigger Frequency (kHz)
Trainstop Sensor (Normal Direction*)	66.25	65.25
Trainstop Sensor (Opposite Direction**)	66.75	65.75
Overspeed Sensor (Normal Direction*)	64.25	65.25
Overspeed Sensor (Opposite Direction**)	64.75	65.75

Table I: Nominal tone frequencies

* Normal Direction

On a line for which signalling is provided for one direction only, 'Normal' applies to the signalled direction.

On a bi-directional line, 'Normal' applies to one direction (which may be chosen arbitrarily).

** Opposite Direction

On bi-directional lines 'Opposite Direction' applies to the direction opposite to 'Normal' [[GE/RT8030](#), [ESID9004](#)]

4.3 Transmitter Loops

There are two types of TPWS transmitter loop installed on the railway. There is a 'Standard' sized loop and a smaller type, commonly known as buffer stop 'Mini' loops. The 'Mini' loops are only installed on the approach to buffer stops at terminus platforms that are served by passenger carrying trains. Since both types of loop are installed throughout the network, any analysis should cover both types of loop.

5 Infrastructure Assumptions

The TPWS transmitter loops are installed within the 'four-foot' and are not directly connected to the rails. On this basis the condition of the infrastructure does not influence