

Railway Group Standard

GM/RT2113

Issue One

Date September 2015

Rolling Stock Subsystem and Interfaces to DC Conductor Rail Energy Subsystem

Synopsis

This document defines the interface requirements to the DC conductor rail energy system for all rolling stock operating over the DC electrified railway.

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Issue record

Issue	Date	Comments
One	September 2015	Original document. Replaces GE/RT8025 issue one, and GM/RT2304 issue three.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GE/RT8025 issue one Electrical Protective Provisions for Electrified Lines	B5.5, B5.6	04 June 2016 for new vehicles, and from 03 June 2017 for previously authorised designs
GM/RT2304 issue three Equipotential Bonding of Rail Vehicles to Running Rail Potential	All	

GE/RT8025 issue one Electrical Protective Provisions for Electrified Lines, ceases to be in force and is withdrawn as of 04 June 2016 for new vehicles of new designs, and from 03 June 2017 for new vehicles of previously authorised designs.

GM/RT2304 issue three Equipotential Bonding of Rail Vehicles to Running Rail Potential, ceases to be in force and is withdrawn as of 04 June 2016 for new vehicles of new designs, and from 03 June 2017 for new vehicles of previously authorised designs.

Supply

The authoritative version of this document is available at www.rssb.co.uk/railway-group-standards. Enquiries on this document can be forwarded to enquirydesk@rssb.co.uk.

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Part 1 Purpose and Introduction

1.1 Purpose

- 1.1.1 This document mandates requirements for all rolling stock operating over the 750 V DC conductor rail energy subsystem. This document does not cover requirements for vehicles operating on 1500 V DC or 750 V DC overhead contact line systems.
- 1.1.2 This document does not contain any 'open points', that is to say, requirements that have not yet been specified, but which are within the scope of the document.

1.2 Introduction

1.2.1 Background

- 1.2.1.1 This document consolidates existing practice for rolling stock operating on the 750 V DC conductor rail energy subsystem, and mandates requirements in line with a migration towards operation on electrification systems that are compliant with the uniform system for the Great Britain (GB) mainline 750 V DC electrified railway, while continuing to give compatibility with existing infrastructure.

1.2.2 Supporting documents

- 1.2.2.1 The following Rail Industry Guidance Note supports this Railway Group Standard:

GM/GN2613	Guidance on Rolling Stock Subsystem and Interfaces to DC Conductor Rail Energy Subsystem
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1.3 Approval and authorisation of this document

- 1.3.1 The content of this document was approved by Multifunctional Standards Committee on 02 July 2015.
- 1.3.2 This document was authorised by RSSB on 05 August 2015.

Part 2 Requirements for all Vehicles that Traverse 750 V DC Electrified Lines

2.1 Bonding

- 2.1.1 Protective bonding shall be provided on all rail vehicles that traverse the 750 V DC electrified lines. The bonding shall be provided as set out in BS EN 50153:2014 clause 6.4, except as permitted by 2.1.2 below.
- 2.1.2 Protective bonding shall be provided to prevent damage to the vehicle caused by the creation of parallel paths for DC return current, as set out in 2.1.4. It is permissible for rail vehicles that traverse 750 V DC electrified lines to have only a single protective bonding path between the vehicle's main body structure and the running rail.
- 2.1.3 Bonding connections and vehicle circuit breakers shall be designed taking into account the following parameters:
 - a) A maximum prospective sustained short circuit fault level at the vehicle of 200 kA.
 - b) A maximum short circuit fault level when interrupted at 20 ms of 64 kA and a time constant T1, as set out in BS EN 60077-3:2002 clause 5.3.4.
 - c) The bonding shall be designed to withstand the following strategy for reclosing of the track feeder circuit breakers after a short circuit fault has occurred:
 - i) Reclosure of the track feeder circuit breakers after 15 seconds has elapsed.
 - ii) If the track feeder circuit breaker then trips on closure, a delay of at least 15 seconds before a second reclosure of the track feeder circuit breakers.
 - iii) If the track feeder circuit breaker trips on closure a second time, a delay period of at least one minute before any further reclosure of the track feeder circuit breakers.
- 2.1.4 Vehicle bonding shall be provided on the basis that a maximum total DC traction load current of 9 kA is flowing in the running rails of any section of track over which a train may pass.

2.2 Heat emissions from train-mounted equipment

- 2.2.1 Where heat from vehicles is emitted below or to the side of a vehicle, it shall not raise the surface temperature of the guard board to greater than 70 degrees Celsius for more than 5 minutes. Dimensions of the guard boarding are as set out in GL/RT1212.

2.3 Electrical clearance

- 2.3.1 The minimum static electrical clearance shall be 75 mm. The minimum passing (dynamic) electrical clearance shall be 25 mm.

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Part 3 Electrical Requirements for 750 V DC Electric Rail Vehicles

3.1 System voltage

- 3.1.1 750 V DC electric rail vehicles shall be designed on the basis that the conductor rail and therefore the current collector is positive with respect to the traction return rail.
- 3.1.2 750 V DC electric rail vehicles shall operate over the voltage range, as specified in BS EN 50163:2004+A1:2007 clause 4.1, including the special national condition for the United Kingdom (UK) with respect to low voltage, as set out in BS EN 50163:2004+A1:2007 Annex B.
- 3.1.3 For 750 V DC electric rail vehicles that will only operate over routes compliant with BS EN 50163:2004+A1:2007 clause 4.1, excluding the special national conditions for the UK, it is permissible to omit compliance with the special national condition for UK low voltage set out in BS EN 50163:2004+A1:2007 Annex B.

3.2 Maximum train current

- 3.2.1 In the absence of a published maximum allowable train current for a particular route, a value of 6.8 kA shall be assumed for design purposes.

3.3 Automatic train current regulation

- 3.3.1 750 V DC electric rail vehicles shall be fitted with automatic regulation control of train current with line voltage, as set out in BS EN 50388:2012 clause 7.2.

3.4 Train current limitation device

- 3.4.1 750 V DC electric rail vehicles shall be fitted with a power or current limitation device, as set out in BS EN 50388:2012 clause 7.3.
- 3.4.2 It shall be possible for the driver to limit the power or current demand to half the actual train power or current when operating on a degraded power supply.
- 3.4.3 Multiple units and locomotives designed for multiple operation shall have the facility to limit the maximum current demand of the whole train to the maximum train current for the route.

3.5 Current collector

- 3.5.1 Current collectors shall be positioned to collect current from a conductor rail system compliant with GL/RT1212.
- 3.5.2 Current collectors at the extreme end of any locomotive or single vehicles that can operate from the 3rd rail supply, shall be interconnected.
- 3.5.3 Current collectors on multiple units shall be connected to provide acceptable gapping performance.
- 3.5.4 Where retractable current collectors are provided, to avoid arcing, current collectors shall only be retracted or deployed once all vehicle loads, other than essential voltage measurement devices, are disconnected.
- 3.5.5 When controlled from the operative cab, current collectors shall be retracted or deployed on all vehicles of a train.

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3.6 Regenerative brake control

- 3.6.1 750 V DC electric rail vehicles shall be equipped for regenerative braking.
- 3.6.2 The regenerative brake shall be provided with a function to prevent operation in areas where regenerative braking is not permitted.
- 3.6.3 750 V DC electric rail vehicles shall not initiate regenerative braking if the DC contact line voltage is less than 550 V.
- 3.6.4 If regeneration has been initiated and the DC line voltage falls below 500 V, regeneration shall cease.
- 3.6.5 750 V DC electric rail vehicles shall not initiate regenerative braking or continue to regenerate if the DC line voltage detected at the vehicle is above 900 V. The limit shall be selectable over the range of 850 V to 1000 V in 50 V steps.
- 3.6.6 The maximum regenerating current (per train) shall be controlled with respect to voltage at a fixed but selectable control impedance. Automatic detectors shall be provided to measure the line current and the line voltage. Regeneration shall cease within 200 ms if the impedance of the conductor rail, as seen from the current collector, is less than the value defined by the control impedance. The value of regenerative control impedance shall be selectable between the value of 0.05 Ω and 0.2 Ω in steps of 0.01 Ω with an accuracy of +/- 3%, including all transducers.
- 3.6.7 The maximum regenerative braking current of the train shall be the same as the maximum traction motoring current.

3.7 Electrical insulation coordination

- 3.7.1 750 V DC electric rail vehicle components connected to the 750 V DC conductor rail system shall have minimum dielectric withstand values (impulse and power frequency) selected in accordance with BS EN 50124-1:2001.

3.8 External power supply interconnection

- 3.8.1 Where a vehicle is provided with multiple external power supply sources such as dual voltage 25 kV AC / 750 V DC EMUs, or shore supplies, the power supply systems associated with those sources shall not be interconnected.

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Part 4 Mechanical and Clearance Requirements for 750 V DC Electric Rail Vehicles

4.1 Current collector dimensioning

- 4.1.1 The minimum static electrical clearance shall be 75 mm. The minimum passing (dynamic) electrical clearance shall be 25 mm. These dimensions do not apply to the clearances to insulated guard boarding.
- 4.1.2 The across track dimension of the shoe shall be 100 ± 5 mm.
- 4.1.3 The along track dimension of the shoe shall be within a maximum of 360 mm and a minimum of 300 mm.
- 4.1.4 The included angle between the contact surface and leading and trailing faces of the shoe shall be nominally 90° .
- 4.1.5 The lateral displacement of the current collector measured from the track centre line shall be:
 - a) Maximum lateral displacement (shoe outer face) 1202 mm.And
 - b) Minimum lateral displacement (shoe inner face) 1032 mm.

4.2 Current collector material

- 4.2.1 The current collector material forming an interface with the conductor rail head shall be grey cast iron to BS EN 1561:2011 or spheroidal graphite cast iron to BS EN 1563:2011.

4.3 Current collector frangibility

- 4.3.1 The current collector shall be designed to break away cleanly from the shoe support when subject to a longitudinal impact energy greater than 500 Joules.
- 4.3.2 The electrical connection between the vehicle and current collector shall be frangible and designed to minimise the risk from arcing and flashover from the live parts after fracture.

4.4 Working height range of non-retracted current collector

- 4.4.1 The maximum height of the upper limit of a deployed current collector shall be 227 mm above the plane of the running rails.
- 4.4.2 The current collector shall be capable of being lifted from the lineside and, once lifted, retained in that position. The current collectors are to be retained above the highest position of the conductor rail by the clearances set out in 4.1.1. The maximum height of the conductor rail shall be assumed to be 116 mm above rail level.
- 4.4.3 The setting of the down-stop shall prevent any part of the current collector going below 34.5 mm above the plane of the running rails under all dynamic operating conditions.