

Equipotential Bonding of Rail Vehicles to Running Rail Potential

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Synopsis

This standard mandates the requirements for equipotential **bonding** of rail **vehicles** to comply with the Electricity at Work Regulations and to prevent danger arising from electrically charged exposed conductive parts.

Submitted by

.....
Vicki Austen
Acting Standards Project Manager

Authorised by

.....
Anne E Blakeney
Acting Department Head,
Railway Group Standards Management

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Equipotential Bonding of Rail Vehicles to Running Rail Potential

Railway Group Standard

GM/RT2304

Issue Three

Date April 2004

Page 1 of 8

Contents

Section	Description	Page
Part A		
A1	Issue record	2
A2	Implementation of this document	2
A3	Scope of Railway Group Standards	2
A4	Responsibilities	2
A5	Health and safety responsibilities	3
A6	Technical content	3
A7	Supply	3
Part B		
B1	Purpose	4
B2	Application of this document	4
B3	Definitions and acronyms	5
B4	General requirements	5
B5	Special provisions	6
B6	Maintenance	7
References		8

Equipotential Bonding of Rail Vehicles to Running Rail Potential

Part A

A1 Issue record

Issue	Date	Comments
One	June 1995	Original Document
Two	February 1998	Replaces issue one Updated to include maintenance of the equipotential bonding systems.
Three	April 2004	Replaces issue two Updated to re-state the requirements for vehicles with pantographs and to add the requirement for consideration of the effect of traction return current in the running rail.

Significant changes from issue two of GM/RT2304 have been marked by a vertical black line in the adjacent margin.

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

A2 Implementation of this document

The publication date of this document is 3 April 2004.

This document comes into force on 5 June 2004.

The dates by which compliance with the requirements of this document is to be achieved are set out in Part B2. Where those dates are later than the date on which this document comes into force, this is to give Railway Group members additional time to plan and commence implementation so as to achieve full compliance by the dates set out in Part B2.

This document supersedes the following Railway Group Standards, either in whole or in part as indicated:

Railway Group Standard	Issue No.	Title	RGS sections superseded by this document	Date(s) as of which sections are superseded
GM/RT2304	2	Equipotential Bonding of Rail Vehicles to Running Rail Potential	All	5 June 2004 (document withdrawn as of this date)

A3 Scope of Railway Group Standards

The overall scope of Railway Group Standards is set out in Annex F of the Railway Group Standards Code, Issue 1, January 2004. The specific scope of this document is set out in Part B2.

A4 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.

Equipotential Bonding of Rail Vehicles to Running Rail Potential

Railway Group Standard

GM/RT2304

Issue Three

Date April 2004

Page 3 of 8

* The Railway Group comprises Network Rail Infrastructure Limited, Rail Safety and Standards Board Limited, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Network Rail Infrastructure Limited.

Network Rail Infrastructure Limited is also known as Network Rail.

Rail Safety and Standards Board Limited is also known as RSSB.

A5 Health and safety responsibilities

Each Railway Group member is reminded of the need to consider its own responsibilities to ensure health and safety at work and its own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.

A6 Technical content

The technical content of this document has been approved by:

Haydn Peers, Principal Traction & Rolling Stock Engineer, RSSB.

David Knights, Principal Electrification Engineer, RSSB

Enquiries should be directed to RSSB – Tel: 020 7904 7518 or e-mail enquiries@rssb.co.uk.

A7 Supply

Controlled and uncontrolled copies of this document may be obtained from the Corporate Communications Dept, Rail Safety and Standards Board, Evergreen House, 160 Euston Road, London NW1 2DX or e-mail enquiries@rssb.co.uk. Railway Group Standards can also be viewed at www.rssb.co.uk.

Equipotential Bonding of Rail Vehicles to Running Rail Potential

Part B

B1 Purpose

This standard mandates requirements:

- a) to reduce the risk of electric shock to persons by ensuring that the exposed conductive parts of rail **vehicles** and their constituent parts are at running rail potential; and
- b) to ensure that any current that flows through mechanical components is controlled to a level such that safety is not adversely affected.

This standard mandates the use of BS EN 50153: Railway Applications - Rolling Stock - Protective Provisions Relating to Electrical Hazards. The requirements of this standard are complementary to those of BS EN 50153 and include additional requirements for maintenance of **equipotential bonding** systems on new and existing **vehicles**.

B2 Application of this document

B2.1 To whom the requirements apply

This document contains requirements that are applicable to duty holders of the train operator category of Railway Safety Case.

B2.2 Compliance requirements

B2.2.1 Trains

This document applies to all **vehicles** intended to operate on Network Rail controlled infrastructure.

The vehicle design requirements mandated in sections B4 and B6 of this document are to be complied with by **vehicles** of previously uncertificated designs, with a Certificate of Conformance for Vehicle Design signed on or after 5 June 2004. In addition, the design requirements shall be complied with by any future **vehicles**, built to the same design as a vehicle already having Engineering Acceptance, which enter service on Network Rail controlled infrastructure on or after 2 June 2007.

B2.2.2 General compliance requirements

Until the compliance dates, or the date by which compliance is achieved (if earlier), the applicable requirements of the predecessor documents shall continue to be met (see Part A for details).

After the compliance dates, or after the date by which compliance is achieved (if earlier), Railway Group members shall not deviate from the requirements set out in this document.

Where it is considered not reasonably practicable to comply with the requirements set out in this document, authorisation not to comply shall be sought in accordance with section 8 of the Railway Group Standards Code, Issue 1, January 2004.

B2.2.3 Exemptions

The following are exempted from the requirements of this standard:

- a) parts of Safety Extra Low Voltage (SELV) systems and double insulated equipment to BS 2754: Memorandum, Construction of Electrical Equipment for Protection Against Electric Shock
- b) exposed conductive parts not forming part of the electrical installation, for example small items of interior trim in an environment otherwise protected by **bonding** or insulation

Equipotential Bonding of Rail Vehicles to Running Rail Potential

- c) equipment which is inaccessible when energised, including the exposed conductive parts of secondary insulation.

B2.3 Related requirements in other documents

The requirements contained within this document are modified by the requirements set out in GM/RT1300, Engineering Acceptance of Road-Rail Vehicles and Associated Equipment, GM/RT1310, Design Requirements and Acceptance of Portable/Transportable Infrastructure Plant and Equipment and GM/RT2402, Engineering Acceptance of Rail Mounted Maintenance Machines for those vehicles covered by the scope of those Railway Group Standards.

B2.4 Supporting documents

RSSB Approved Code of Practice GM/RC2514 provides recommendations and guidance on achieving the requirements of this standard by describing the methods previously accepted in the railway environment.

B3 Definitions and acronyms

Electric shock

A dangerous physiological effect resulting from the passing of an electric current through the human body or livestock.

Equipotential bond

An electrical connection putting various exposed conductive parts at a substantially equal potential. This can be abbreviated to 'bond' or 'bonding'.

Exposed conductive part

A conductive part of equipment which can be touched and which is not a live part but which may become live under fault conditions.

Failure

The termination of the ability of an item to perform a required function.

Live part

Any conductor and any conductive part of electrical equipment intended to be energised in normal use.

Rail vehicle

Any vehicle described as traction and rolling stock (that is to say locomotive, coaching stock or wagon), on-track machine, road rail vehicle or rail mounted maintenance machine.

Safety Extra Low Voltage system

Safety Extra Low Voltage (SELV) system is an extra low voltage system which is electrically separated from earth and from other systems in such a way that a single fault cannot give rise to electric shock.

B4 General requirements

B4.1 Bond impedance

The impedance between any exposed conductive part of the rail vehicle and the running rail shall, under any conditions pertaining to the rail vehicle and its source of electrical energy, be low enough to ensure that the voltage between them shall not exceed safe values by the criteria of IEC 60479: Guide to effects of current on human beings and livestock. The impedance of the wheel/rail interface shall be assumed to be negligible compared to the impedance of the overall rail/rail vehicle impedance.

Equipotential Bonding of Rail Vehicles to Running Rail Potential

B4.2 Bonding provision

B4.2.1

Bonding shall be provided for any exposed conductive parts which are capable of causing electric shock through induction or contact with live parts under foreseeable failure conditions.

B4.2.2

The method of providing the **bonding** shall either minimise or withstand the effect of traction return current normally in the running rail, which could pass through the **equipotential bonding** and mechanical components of **vehicles** that operate over electrified lines.

B4.3 Bonding connection capacity

Bonding connections shall provide a safe return path, and be capable of conducting the fault current of any supply to which the equipment or its circuit could be subjected, for the duration of the fault, without compromising the integrity of the **bonding**. The strategy for re-closing traction supply circuit breakers after a fault has occurred shall be obtained from the infrastructure controller.

B4.4 Bonding connection design

The design of the **bonding** connections shall take into account the effects of fatigue, fretting and corrosion.

B4.5 Bonding conductors and terminations

Bonding conductors and terminations shall be the minimum length necessary to perform the functions required of them and be installed such that they are clearly visible and easily accessible for regular scheduled examination by maintenance staff.

B4.6 Bonding continuity

The removal of any single piece of equipment shall not interrupt the **bonding** of any other bonded equipment which remains in use.

B4.7 Traction return current circuits

Rail vehicle traction load currents shall be returned direct to the source of power through designated paths without passing through any parts of the rail vehicle structure, or other components, not designated to carry such currents.

B4.8 Current in bearings and mechanical components

The level of current from any source, which is permitted to flow through bearings or mechanical components, shall be limited to such a value that the safe operation of the bearing or mechanical component is not compromised.

B5 Special provisions

B5.1 Rail **vehicles** fitted with shoe gear

Rail **vehicles** fitted with shoe gear shall be provided with mechanical protection of the cable connected to the shoe gear to prevent damage to this cable, which may otherwise result in a destructive arc being sustained to bonded metalwork in close proximity to the damaged cable or associated live parts. Provision shall also be made to prevent propagation of the arc along the cable.

Equipotential Bonding of Rail Vehicles to Running Rail Potential

B5.2 Rail vehicles fitted with pantographs and other roof mounted equipment

B5.2.1

To facilitate safe working on the high voltage (HV) electrical equipment on rail vehicles which can be supplied from an overhead line equipment (OLE) system there shall be a method of:

- a) disconnecting the train from the OLE and
- b) discharging any residual electrical charge in the HV electrical equipment and
- c) bonding the disconnected normally live parts of the rail vehicle main primary circuit and the pantograph to running rail potential in such a way as to safely discharge any applied electrical energy until such time as the relevant protection permanently disconnects the energy source concerned and
- d) preventing the pantograph from being operated such that it could come into contact with the OLE.

B5.2.2

Rail vehicles that are fitted with more than one pantograph, where the pantographs are permanently electrically connected together, shall have the requirements of B5.2.1 applied as if they were a single pantograph.

B5.2.3

Rail vehicles that are fitted with more than one pantograph, where the pantographs are not permanently electrically connected together, shall have the requirements of section B5.2.1 applied separately to each pantograph.

B5.2.4

Except as described in sections B5.2.5 and B5.2.6, any pantograph that is stowed out of use on an in-service rail vehicle shall be bonded to running rail potential to protect against re-energisation from other HV equipment on the train.

B5.2.5

Where bonding of the stowed pantograph would result in a non-compliance with other Railway Group Standard(s) it shall be permissible not to bond the pantograph to running rail potential, but compliance with the clearance to accessible parts dimensions quoted in BS EN 50122-1 shall be achieved.

B5.2.6

It is permissible not to bond to running rail potential a pantograph that is stowed out of use on a rail vehicle where there is no possible source of re-energisation at HV on the vehicle, but compliance with the clearance to accessible parts dimensions quoted in BS EN 50122-1 shall be achieved.

B6 Maintenance

B6.1 Bonding system inspection

All bonding systems shall be inspected to a declared schedule and time interval and, when necessary, appropriate corrective action shall be taken.

B6.2 Bonding system maintenance

The bonding on all rail vehicles shall be maintained so as to retain its design performance. The published maintenance documentation applicable to the particular vehicles shall contain the information required.

Equipotential Bonding of Rail Vehicles to Running Rail Potential

References

Railway Group Standards and other Railway Group Documents

The Railway Group Standards Code, Issue 1, January 2004

GM/RT1300 Engineering Acceptance of Road-Rail **Vehicles** and Associated Equipment

GM/RT1310 Design Requirements and Acceptance of Portable/Transportable Infrastructure Plant and Equipment

GM/RT2402 Engineering Acceptance of Rail Mounted Maintenance Machines

GM/RC2514 Code of Practice – Rail **Vehicles** – **Equipotential Bonding**

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rssb.co.uk.

Other References

BS EN 50122-1 Railway applications. Fixed installations. Protective provisions relating to electrical safety and earthing

BS EN 50153 Railway Applications - Rolling Stock - Protective Provisions Relating to Electrical Hazards

IEC 60479 Guide to effects of current on human beings and livestock

BS 2754 (IEC 536) Memorandum, Construction of Electrical Equipment for Protection Against Electric Shock