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Railway Group Standard
GM/RT2461
Issue One
Date August 2001

Sanding
Equipment Fitted to Multiple Units and On-Track Machines

Synopsis
This document sets out the requirements for the performance, installation and operation of sanding equipment when fitted to multiple units and on-track machines.

Submitted by

Signatures removed from electronic version

Karl Reilly
Standards Project Manager

Authorised by

Signatures removed from electronic version

Brian Alston
Controller, Railway Group Standards

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Sanding Equipment Fitted to Multiple Units and On-Track Machines

Contents

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Sanding Equipment Fitted to Multiple Units and On-Track Machines

Part A

Issue Record

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

Issue	Date	Comments
One	August 2001	Original Document

Technical Content

Approved by:

Keith Rose, Principal Vehicles Engineer, Railway Safety

Haydn Peers, Principal Plant Engineer, Railway Safety

Richard Evans, Principal Operations, Railway Safety

Enquires to be directed to Railway Safety – Tel: 020 7904 7518

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 PLC, Railway Safety, and the train and station operators who hold railway safety cases for operation on or related to infrastructure controlled by Railtrack PLC.

Railtrack PLC is known as Railtrack.

Implementation

This document comes into force on 6 December 2001.

Railway Group members are mandated to implement the requirements of this document from this date, subject to any specific compliance requirements set out in Part B.

Railway Group members shall not deviate from the requirements set out in this document unless they have obtained prior authorisation to do so in accordance with the requirements of GA/RT6001, GA/RT6004, or GA/RT6006.

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In issuing this document, Railway Safety makes no warranties, express or implied, that compliance with all or any documents published by Railway Safety 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.

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Sanding Equipment Fitted to Multiple Units and On-Track Machines

Part B

1 Purpose

This document sets out the requirements for the design, installation and operation of sanding equipment where fitted to multiple units.

2 Responsibilities, Scope & Compliance

2.1 Responsibilities

This document contains requirements which are applicable to Railway Safety and the duty holders of the following categories of Railway Safety Case:

a) train operator

2.2 Scope

The overall scope of Railway Group Standards is as specified in Appendix A of GA/RT6001.

This document specifically applies to all multiple units (including non-passenger vehicles and on-track machines) as defined in section 3. The contents of this document do not apply to other types of traction and rolling stock, road-rail vehicles or rail-mounted maintenance machines. In addition, the requirements of this document do not apply to vehicles specifically adapted to apply substances used to improve wheel/rail adhesion levels for other trains (including, for example 'SANDITE').

2.3 Compliance

All requirements in this document shall be complied with from the date the document comes into force, with the exceptions given below:

The provisions of section 5.2 of this document are to be complied with by all multiple units with a Certificate of Conformance for Vehicle Design signed on or after 4 December 2003. In addition to this, the requirements mandated in section 5.2 shall be complied with from 1 December 2006 by any future multiple units built to the same design as a multiple unit already having engineering acceptance.

The requirements mandated in this document do not apply retrospectively to any existing multiple units with Engineering Acceptance.

With the exception of section 5.2 all other requirements shall apply to all new installations of sanding equipment fitted to multiple units and the operation of sanding equipment on Railtrack controlled infrastructure from the effective date of this document. Where sanding equipment is modified in an area covered by the scope of this document, the requirements shall be applied so far as is reasonably practicable.

Section 12 of this document is excluded from the requirements set out in GM/RT2000 for the purpose of engineering acceptance.

3 Definitions

Full service brake application
The brake application that gives the minimum retardation rate meeting the performance requirements set out in GM/RT2044.

Multiple unit
For the purposes of this document, a self-propelled fixed formation (including on-track machines) with a minimum of 8 axles and a driving cab(s). The formation may be capable of working in multiple with other similar formations.

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On-track machines
For the purpose of this document, a rail mounted machine with a minimum of 8 axles and meeting the requirements of GM/RT2400 that is permitted by the Rule Book to be moved self-propelled, outside a possession.

Operation in braking mode
Activation of the sanding equipment whilst a brake application is taking place.

Operation in traction mode
Activation of the sanding equipment whilst the multiple unit is under traction power.

Sanding equipment
Equipment designed to deliver sand to the railhead to improve the level of adhesion available between the rail and the wheels of the train it is fitted to.

Manual sander control
Part of the cab controls enabling manual operation of the sanding equipment.

Wheel slide protection system
A system designed to make the best use of available adhesion between wheels and rail by a controlled reduction of the brake force.

4 Principle

This document supports HMRI Railway Safety Principles and Guidance Part 1: Principle 29(c):

'The speed regulation system of the train should meet the operational requirements of the railway without endangering people and goods carried. The factors for consideration should include … the performance of the braking system under all foreseeable conditions of adhesion.'

It has been shown through development that the application of sand between the wheel and the rail can significantly improve braking performance during condition of low adhesion.

This document sets out the current position of sanding equipment development. It is recognised that further developments in this evolving field will continue and they are to be encouraged. Railway Group members are permitted to deviate from the requirements set out in this document when they have obtained prior authorisation in accordance with the requirements set out in GA/RT6001, GA/RT6004, or GA/RT6006.

5 Requirements for fitting sanding equipment

5.1 Fitting of sanding equipment

Sanding equipment fitted to multiple units shall be capable of operation in both braking and traction modes (dual function sanding equipment) or in braking mode only.

Traction-only sanding equipment shall not be fitted to multiple units.

5.2 New vehicle design

All new multiple units of previous uncertified designs shall include, as a minimum, the provision of sanding equipment capable of operation in braking mode that meets the requirements set out in section 6.1. These requirements shall apply to all multiple units with a Certificate of Conformance for Vehicle Design signed on or after 4 December 2003.

For full compliance requirements for this section see section 2.3.

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6 Activation of sanding equipment

6.1 Conditions for sanding equipment activation in braking mode

When operating in braking mode, as a minimum the sanding equipment shall discharge sand during full service and emergency brake applications when the presence of low adhesion is automatically detected.

6.2 Wheel slide detection system interface

Where the means of detection of low adhesion is from a wheel slide detection system the wheel slide detection output signal shall be capable of ensuring that the sanding equipment is activated when any wheelset on the leading vehicle is suffering a significant level of slide due to low adhesion in braking. In this context, a significant level of slide is generally recognised as a wheelset rotational speed at 95% or less than the true train speed.

6.3 Optimisation of wheel slide protection system performance

When retrofitting sanding equipment to existing multiple units consideration shall be given to optimising the performance of any wheel slide protection system before fitting of sanding equipment. This is to minimise the likelihood of wheel lock up preventing operation of the sanding.

6.4 Emergency brake application

For all multiple units it is also permissible to lay sand, either automatically and/or via the manual sanding control, during an emergency brake application, irrespective of whether low adhesion has been detected.

6.5 Conditions for sanding equipment activation in traction mode

When operating in traction mode, the sanding equipment shall only discharge sand when traction power is demanded and the driver activates the manual sander control.

An automatic traction sanding system may be utilised where it can be demonstrated that sand will not be discharged over switches and crossings.

7 Cab controls and indicators

7.1 Isolation of sanding equipment

Means shall be provided for isolating the sanding equipment.

Suitably positioned reminder(s) located in the driving cab and visible to the driver shall indicate the sanding function not available if isolation has been performed.

7.2 Manual sander control

The manual sander control shall be non-latching device that is protected from accidental operation.

The manual sander control shall be positioned to provide easy access for the driver without distraction from other driving duties. For this purpose it shall be considered a ‘primary control’ with respect to the requirements for positioning of primary controls, as set out in GM/RT2161.

8 Design for reliability and maintenance

8.1 System interfaces

The installation of the sanding equipment shall not compromise the safety or reliability of any other vehicle system.

In particular, the use of compressed air from the vehicle compressor or reservoir system to discharge sand should not impair the operation of other safety systems on the multiple unit.

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8.2 System integrity and reliability

The sanding equipment and all other systems and equipment that provide input to the sanding equipment system shall be designed and maintained to ensure that braking performance is not jeopardised. Overall reliability of the sanding equipment shall be considered at the design stage.

8.3 Interfaces between braking and traction modes

The functionality of the sanding equipment capable of operating in traction mode shall not impair the safety or reliability of the sanding equipment operating in braking mode.

Sander operation in the traction mode shall not inhibit operation in the braking mode because of lack of sand. The following measures should be considered to assist in the delivery of this requirement:

a) Adequate inspection and sand top-up regimes based on known or predicted worst case consumption rates.

b) Inhibiting traction sanding at low sand levels.

c) Limitation of sand usage in traction by means of a discharge timer.

d) Auto-detecting and logging of sand usage.

e) Limitation of traction sand usage by linking to wheel spin activity.

8.4 Design of sand reservoirs

Sand reservoirs shall be designed and installed to prevent ingress of unwanted contaminants, particularly liquids. Sand reservoirs shall be designed for ease of access and filling.

8.5 System testing facility

A manual test facility shall be provided on the vehicle underframe. The facility shall:

a) test as much of the system functionality as practicable

b) permit observation of the sand discharging.

9 Sand delivery systems

9.1 Delivery to the rail head

For operation in braking mode, sand shall be delivered to the railhead by the leading vehicle only for all train formations (including multiple formations), at a location forward of the third axle and after the second axle, in the direction of travel.

Where sanding equipment for operation in traction mode is located remotely from sanding equipment for operating in braking mode this shall only be permitted where it can be demonstrated that at least a further six axles of the multiple unit are beyond the laying position. The laying position shall always be after the second axle, in the direction of travel.

To avoid long-term contamination of the railhead, there shall be a minimum of six wheelsets to the rear of the location whenever the sand is delivered to the railhead.

Sand shall be delivered to both rails.

9.2 Spread of sand

The means of delivery shall be designed to maximise the proportion of sand deposited on the railhead and minimise spread of sand to the adjacent infrastructure.

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9.3 Sand deposition rate

9.3.1 Braking mode

The sand deposition rate per rail during braking shall be such that the rear two axles of the multiple unit do not come to rest on sand laid at rate of 7.5 grams/metre or greater. The sand shall, as far as is reasonably practical, be evenly distributed

Calculation of the stopping distance shall take into account the effects of gradients and the expected deceleration rate with sand applied.

A recognised method of achieving the above is a laying rate approaching, but not exceeding, 2kg/minute per rail when using a full service or emergency brake application.

9.3.2 Traction mode

The sand deposition rate per rail, for traction mode, shall not exceed, 2kg/minute at all speeds.

9.4 Sand reservoir capacity

The sand reservoir shall be of sufficient capacity to ensure that sand will be available whenever demanded for operation in braking mode.

In determining the reservoir capacity, account shall be taken of:

a) the mileage operated between replenishments of the reservoir

b) the anticipated maximum demand due to poor adhesion between replenishments.

In assessing the reservoir capacity for a dual function sander, account shall be taken of the aggregate usage for the two modes of operation.

10 Sand specification

The sand used in sanding equipment shall meet the specification set out in Appendix A.

Before use in the sanding equipment on a multiple unit sand shall be stored in clean dry conditions to prevent contamination.

11 Inspection and maintenance

11.1 Inspection and maintenance regime

Sanding equipment shall be included in vehicle maintenance plans sufficient to ensure that:

a) vehicles do not run short of sand

b) that operational reliability is maintained

c) that system performance is maintained.

11.2 Monitoring of sand delivery rates

Vehicle maintenance plans shall ensure that sand delivery rates are regularly monitored to ensure sand delivery rates are not exceeded. Reductions in sand delivery rates shall be kept to a minimum to ensure that braking performance is not significantly affected.

The train operator shall maintain records and monitor the total sand usage annually. Records shall be made available to the infrastructure controller on request.

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11.3 Security of sanding equipment

Sanding hoses shall be regularly inspected to check for damage and security of attachment.

11.4 Staff training

Maintenance staff shall be trained and briefed in the maintenance and replenishment of the train equipment and that the approved material is used.

12 Operational requirements

12.1 Deployment of multiple units fitted with sanding equipment

Train operators shall advise the infrastructure controller of each class of multiple unit that is fitted with sanding equipment, how many units are so fitted, and the routes to be used.

The train operator shall not allow the use of traction sanders on its rolling stock until the infrastructure controller has confirmed that infrastructure monitoring arrangements are in place.

Train operators shall ensure that the use of sanding equipment is conducted within the scope of their Railway Safety Case.

12.2 Driving requirements and low adhesion monitoring

The train operator shall issue instructions to drivers concerning the operation of the sanding equipment and the application of sand. Train operators shall also arrange for training or briefing to be undertaken.

Sand shall not be discharged over points and crossing when the sanding equipment is being used in the traction mode.

Drivers should be discouraged from operating traction sanders in anticipation of traction problems. The traction sander shall only be used where wheel spin and consequent poor acceleration occurs.

It is permissible for the traction sander to be used at all speeds including starting from rest.

When used at speeds below 10mph, a moderate power demand (for example, greater than notch 4 on a Class 165, or equivalent power level on other stock) shall be selected whenever a sand application in traction mode is made.

The train operator shall review reported track circuit failures caused by sand contamination and shall arrange for the checking of the unit involved for correct functioning of the sanding equipment at the earliest opportunity. This shall include the sand discharge rate. Results of checks shall be forwarded to the infrastructure controller.

The train operators shall encourage drivers to report locations where sanding has frequently been used. Train operators shall collate this data and report the results to the infrastructure controller to aid identification of previously unknown low adhesion sites.

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Appendix A
Sand for sanding equipment

A1 Material

The sand shall be uniform and consist of at least 90% by weight hard grains of quartz or siliceous material.

The clay and other impurities content (for example, pebbles, gravel, pieces of glass, vegetable remains, earth, silt or dust) shall not exceed 2% by weight.

It is permissible for the remaining materials to be of other mineral content.

A2 Grain shape

The sand shall, as far as possible, consist of rounded irregular shaped grains; quarry sands are preferable to river or sea sands, to avoid possible salt contamination.

A3 Grain size

The maximum proportion of grains of diameter <0.71mm (22 BSS mesh) shall be not more than 5% by weight and the maximum proportion of grains of diameter >2.8mm (5 BSS mesh) shall be not more than 5% by weight. The uniformity coefficient shall be less than 1.5.

The uniformity coefficient (Uc) is a factor for determining the uniformity of, in this case, sand and is a means of determining its resistance to compaction. It is the ratio of D_{60} to D_{10} where D_{60} is the sand diameter at which 60% of the sand weight is finer and D_{10} is the corresponding value at 10% finer, thus:

$$Uc = \frac{D_{60}}{D_{10}}$$

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References

Railway Group Standards

GA/RT6001	Railway Group Standards Change Procedures
GA/RT6004	Temporary Non-Compliance with Railway Group Standards
GA/RT6006	Derogations from Railway Group Standards
GM/RT2000	Engineering Acceptance of Rail Vehicles
GM/RT2044	Braking System Requirements and Performance for Multiple Units
GM/RT2161	Requirements for Driving Cabs of Railway Vehicles
GM/RT2400	Design of On-Track Machines

Other Related References

BS 410	Test sieves. Technical requirements and testing
BS 1377	Methods of testing soils for civil engineering purposes.

Other References

HS(G)153/1	HMRI Railway Safety Principles and Guidance

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