Sanding Equipment

Synopsis
This document sets out requirements for sanding systems fitted to trains and sand types. It also includes guidance on how to achieve technical compatibility with track circuits, sanding to improve stopping distances in low adhesion conditions, good practice design for sanding equipment and operational practices for the use of sanding equipment.
Issue Record

<table>
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<th>Issue</th>
<th>Date</th>
<th>Comments</th>
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Revisions have been marked by a vertical black line in this issue. Definitions and References may also have been updated but these are not marked by a vertical black line.

Superseded Documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

<table>
<thead>
<tr>
<th>Superseded documents</th>
<th>Sections superseded</th>
<th>Date when sections are superseded</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMRT2461 issue two Sanding Equipment</td>
<td>All</td>
<td>02/03/2019</td>
</tr>
</tbody>
</table>

Supply

The authoritative version of this document is available at www.rssb.co.uk/railway-group-standards. Enquiries on this document can be submitted through the RSSB Customer Self-Service Portal https://customer-portal.rssb.co.uk/
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part 1</strong></td>
<td><strong>Purpose and Introduction</strong></td>
<td>4</td>
</tr>
<tr>
<td>1.1</td>
<td>Purpose</td>
<td>4</td>
</tr>
<tr>
<td>1.2</td>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>1.3</td>
<td>Approval and authorisation of this document</td>
<td>5</td>
</tr>
<tr>
<td><strong>Part 2</strong></td>
<td><strong>Requirements for Sanding and Train Detection</strong></td>
<td>6</td>
</tr>
<tr>
<td>2.1</td>
<td>General requirements for sand type</td>
<td>6</td>
</tr>
<tr>
<td>2.2</td>
<td>Requirements for sand types used in braking sanders</td>
<td>6</td>
</tr>
<tr>
<td>2.3</td>
<td>Requirements for sand type used in traction sanders</td>
<td>7</td>
</tr>
<tr>
<td>2.4</td>
<td>Requirements for technical compatibility with track circuits</td>
<td>7</td>
</tr>
<tr>
<td>2.5</td>
<td>Requirements for switching off sanding equipment</td>
<td>10</td>
</tr>
<tr>
<td><strong>Part 3</strong></td>
<td><strong>Application of this Document</strong></td>
<td>12</td>
</tr>
<tr>
<td>3.1</td>
<td>Scope</td>
<td>12</td>
</tr>
<tr>
<td>3.2</td>
<td>Exclusions from scope</td>
<td>12</td>
</tr>
<tr>
<td>3.3</td>
<td>General enter into force date</td>
<td>12</td>
</tr>
<tr>
<td>3.4</td>
<td>Exceptions to general enter into force date</td>
<td>12</td>
</tr>
<tr>
<td>3.5</td>
<td>Applicability of requirements for projects already underway</td>
<td>12</td>
</tr>
<tr>
<td>3.6</td>
<td>Deviations</td>
<td>13</td>
</tr>
<tr>
<td>3.7</td>
<td>Health and safety responsibilities</td>
<td>13</td>
</tr>
<tr>
<td><strong>Appendices</strong></td>
<td>Sanding to Improve Stopping Distances in Low Adhesion Conditions</td>
<td>14</td>
</tr>
<tr>
<td>Appendix A</td>
<td>Good Practice Design Guide for Sanding Equipment</td>
<td>16</td>
</tr>
<tr>
<td>Appendix B</td>
<td>Operational Practices for the Use of Sanding Equipment</td>
<td>19</td>
</tr>
<tr>
<td>Appendix C</td>
<td>Sand for Braking Sanders</td>
<td>21</td>
</tr>
<tr>
<td>Appendix D</td>
<td>Sand for Traction Sanders</td>
<td>22</td>
</tr>
<tr>
<td><strong>Definitions</strong></td>
<td>Sand for Braking Sanders</td>
<td>23</td>
</tr>
<tr>
<td><strong>References</strong></td>
<td>Sand for Traction Sanders</td>
<td>24</td>
</tr>
</tbody>
</table>
Part 1 | Purpose and Introduction

1.1 | Purpose

1.1.1 This document sets out requirements for vehicle mounted sanding equipment that can be used to mitigate low rail head adhesion conditions, the specification of sand for use in that sanding equipment and guidance on the design and operational use of sanding equipment.

1.2 | Introduction

Background

1.2.1 GMRT2045 Compatibility Requirements for Braking Systems of Rail Vehicles defines the performance of the braking systems fitted to rail vehicles. The performance is expressed as required stopping distances.

1.2.2 GMRT2045 explains that: ‘The existing rail system is predominantly signalled by lineside signals with established signal spacing, and the braking performance of vehicles when operating in train formations needs to be sufficient to ensure they can stop within such signal spacing. The braking performance requirements mandated by this standard are intended to achieve the compatibility between the signal spacing and the braking performance of rail vehicles when operating in train formations.’

1.2.3 Clause 4.2.4.6.1 of the Locomotive and Passenger Rolling Stock Technical Specification for Interoperability (LOC & PAS TSI) sets out applicable adhesion values that are considered realistic maximum available adhesion values when designing braking systems that utilise wheel rail adhesion. In some circumstances and locations, real adhesion levels can be significantly lower than these values (adhesion levels as low as 0.01 have been measured on the Great Britain (GB) mainline network).

1.2.4 To reduce the likelihood that trains do not stop within established signal spacings when low adhesion conditions are encountered, additional control measures are required. Sanding equipment provides a means of locally improving adhesion levels, so reducing the likelihood of a signal overrun as a result of low adhesion.

1.2.5 RSSB research project T1107 (2018) has demonstrated the significant improvement in adhesion levels and braking performance that can be achieved both by increasing the number of sanding positions on a train and by using variable rate sanders to control sand-laying density. Section 2.4, Appendix A and Appendix B of this document set out good practice for the design and configuration of sanding equipment to optimise braking performance.

1.2.6 However, the use of sand to improve adhesion levels, if not adequately controlled, can interfere with the ability of track circuits to detect a train.

1.2.7 Sections 2.2 and 2.3 of this document therefore set out established GB specifications for sand and section 2.4 sets out established GB practice for the specification of sanding equipment. These have demonstrated compatibility with track circuits currently used on the GB mainline network.
1.2.8 Consistent and effective use of sanding equipment depends on the adoption of appropriate operational practices. Guidance to support the operational use of sanders is provided in Appendix C.

**Principles**

1.2.9 The requirements of this document are based on the following principles.

1.2.10 This document sets out National Technical Rules (NTRs) for the mainline railway in GB. Compliance with NTRs is required under the Railways (Interoperability) Regulations 2011 (as amended).

1.2.11 The NTRs in this document are used for the following purposes:

a) Sections 2.1 to 2.3 close the open point in clause 3.1.4.2 (sand characteristics) of Index 77 of the Control-Command and Signalling TSI (CCS TSI).

b) Section 2.4 sets out a requirement to maintain technical compatibility between the rolling stock subsystem and CCS subsystem.

c) Section 2.5 sets out a requirement to ensure compatibility of existing GB rolling stock with the TSI compliant infrastructure subsystem and with legacy infrastructure systems.

**Structure of this document**

1.2.12 Where relevant, the national rules relating to relevant TSI parameters have been identified together with the relevant clause from the TSI.

1.2.13 This document sets out a series of requirements that are sequentially numbered. This document also sets out the rationale for the requirement, explaining why the requirement is needed and its purpose and, where relevant, guidance to support the requirement. The rationale and the guidance are prefixed by the letter ‘G’.

1.2.14 Some subjects do not have specific requirements but the subject is addressed through guidance only and, where this is the case, it is distinguished under a heading of ‘Guidance’ and is prefixed by the letter ‘G’.

**Related requirements in other documents**

1.2.15 There are no related requirements in other documents.

**Supporting documents**

1.2.16 There are no Rail Industry Guidance Notes, Rail Industry Standards or Rail Industry Approved Codes of Practice supporting this Railway Group Standard.

**1.3 Approval and authorisation of this document**

1.3.1 The content of this document was approved by Rolling Stock Standards Committee on 07 September 2018.

1.3.2 This document was authorised by RSSB on 26 October 2018.
Part 2 Requirements for Sanding and Train Detection

2.1 General requirements for sand type

2.1.1 Only the sand types specified in Appendix D or Appendix E shall be used in vehicle mounted sanding equipment.

Rationale

G 2.1.2 These requirements close the open point in Index 77 of the CCS TSI, clause 3.1.4.2.

Guidance

G 2.1.3 Use of these sand types in sanders complying with the guidance in 2.4 is existing GB practice to avoid interference with track circuits, and proven to be effective at improving the available adhesion on the GB mainline network.

G 2.1.4 Sections 2.2 and 2.3 set out further requirements concerning the use of each of the sand types specified.

G 2.1.5 The specifications of sand used elsewhere in the European Union (EU) may differ from that specified for use in GB.

2.2 Requirements for sand types used in braking sanders

2.2.1 Where rolling stock is equipped with braking-only sanders, the type of sand used shall comply with the specification in Appendix D.

Rationale

G 2.2.2 Operational experience has shown the type of coarse / medium grain size sand specified in Appendix D is more suitable for use in braking sanders (compared to the fine sand specified in Appendix E). This is because the grain size tends to be larger than the rail contaminant layer; this grain size penetrates the contaminant layer providing a mechanical link between the wheels and rails.

Guidance

G 2.2.3 For multiple units containing both traction and braking sanders or combined traction and braking sanders, the sand defined in Appendix D can be used in both applications. This can simplify the operating requirements.

G 2.2.4 This requirement 2.2.1 does not apply in the case of G 2.3.4.

G 2.2.5 Testing undertaken in the Netherlands, as presented in JRRT442 ‘Field Investigations on the Adhesion Recovery in Leaf Contaminated Wheel-Rail Contacts with Locomotive Sanders’, has demonstrated that coarse / medium grain size sand, such as specified in Appendix D, is capable of improving traction, but is less effective than finer sands such as specified in Appendix E.
2.3 Requirements for sand type used in traction sanders

2.3.1 Where rolling stock is equipped with traction-only sanders, the type of sand used shall comply with the specification in Appendix E.

Rationale

G 2.3.2 Operational experience has shown the type of fine grain size sand specified in Appendix E is more suitable for use in traction sanders (compared to the coarse / medium sand specified in Appendix D). The fine grain sand is able to more effectively enter the wheel / rail nip under traction conditions and tends to form a paste between the wheel and rail, which is more effective at allowing the transmission of tractive effort between the wheels and rails.

Guidance

G 2.3.3 The sand specification in Appendix E is derived from the British Rail specification, BR 600.

G 2.3.4 For locomotives and on-track machines (OTMs) containing both traction-only and braking-only sanders or combined traction and braking sanders, the sand defined in Appendix E can be used in both applications. This can simplify the operating requirements.

G 2.3.5 This requirement 2.3.1 does not apply in the case of G 2.2.3.

G 2.3.6 Testing undertaken in the Netherlands, as presented in JRRT308 'Laboratory investigation of some sanding parameters to improve the adhesion in leaf-contaminated wheel–rail contacts', has demonstrated that fine grain size sand such as specified in Appendix E is capable of improving braking, but is less effective than coarse / medium grain size sand such as specified in Appendix D.

2.4 Requirements for technical compatibility with track circuits

2.4.1 Sand deployed by trainborne sanding equipment shall not adversely affect the operation of track circuits.

Rationale

G 2.4.2 This requirement is additional to the requirements of the LOC & PAS TSI, in order to maintain compatibility between vehicles and track circuits.

G 2.4.3 Track circuits are a type of train detection system that is provided by the infrastructure manager (network) to locate the position of rail vehicles within the infrastructure. The output from train detection systems is used to control safety-critical functions, for example, level crossings and interlocking functions.

G 2.4.4 Introducing excessive amounts of sand at the wheel / rail interface would increase the likelihood of train detection failure.
Guidance on demonstration of conformity with 2.4.1

G 2.4.5 Compliance with the limits on sand-laying density suggested in this standard gives a presumption of compatibility with existing GB track circuits and of conformity with 2.4.1.

G 2.4.6 Track testing undertaken for RSSB research project T1107 (2018) has demonstrated the significant improvements in braking performance under low adhesion conditions that can be achieved by using distributed, variable-rate sanders. At a sand-laying density of 7.5 grams / metre, distributed variable-rate sanders could in low adhesion conditions enable 6 %g braking performance, which is generally considered sufficient for normal service braking.

Guidance on TSI requirements

G 2.4.7 Index 77 of the CCS TSI, clause 3.1.4.1, specifies different sand dispensing rates to those suggested in this standard. As stated in the LOC & PAS TSI application guide clause 4.2.3.3.1, rolling stock, and by extension any installed sanding systems, are permitted to be non-compliant with the specification in Index 77 of the CCS TSI.

G 2.4.8 Sanders are required to comply with the sand dispensing rates specified in Index 77 of the CCS TSI only if the rolling stock to which they are fitted is declared to have characteristics compatible with the CCS TSI target train detection system based on track circuits.

G 2.4.9 Train detection systems that conform to the requirements of Index 77 of the CCS TSI can only be assumed to be compatible with trains also complying with the requirements Index 77 of the CCS TSI. However, sanders designed to meet the guidance provided in this section achieve technical compatibility with the track circuits currently used in GB.

G 2.4.10 A separate compatibility assessment will be required for new types (or configurations) of track circuit introduced after the compliance date of this standard.

G 2.4.11 Neither the CCS TSI nor the LOC & PAS TSI impose limits on sand dispensing rates for sanders installed on rolling stock which is not declared compatible with train detection systems based on track circuits.

G 2.4.12 If vehicles are operated on infrastructure which makes use of a technology other than track circuits for train detection it is not necessary to limit sand-laying density to ensure train detection. Nevertheless, it may be beneficial to limit sand-laying density to that given in G 2.4.15 d) for other reasons, for example to prevent excessive sand use resulting in additional maintenance interventions to refill sanding equipment.

Guidance on design of sanders

G 2.4.13 Characteristics of sanding systems and vehicles that have the potential to affect track circuit operation are:

a) Position of first sander.
b) Number of wheelsets between sanding positions.
c) Number of wheelsets after the rearmost sanding position.
d) Sand-laying density (grams / metre on the rail).
e) Type of sand (guidance provided in this section assumes sand complying with the requirements in 2.1 is used).

f) Axle load.

G 2.4.14 All references in this standard to sand-laying density and sand dispensing rates are to the quantity of sand being ejected from each sanding device. The quantity of sand that remains on the railhead and enters the wheel / rail nip will be lower than the rates quoted.

G 2.4.15 For braking sanding systems on multiple units containing eight wheelsets or more, conformity with 2.4.1 can be achieved with sanding systems where:

a) Sanders are positioned at a location to the rear of the second wheelset of the train formation in the direction of travel. This means that reliable detection of the front wheelset is not adversely affected.

b) There are a minimum of six wheelsets between active sanders for multiple units with 14 wheelsets or more. There are a minimum of four wheelsets between active sanders for multiple units with fewer than 14 wheelsets. This prevents a gradual build-up of sand on the rail head because the intermediate wheelsets clear the rail head before sand is deposited again.

c) There are a minimum of six wheelsets to the rear of the last position where sand is laid (for either traction or braking). This clears the rail head so that detection of the rear wheelset is not affected and sand deployed by a train does not affect the detection of a following train, at any speed.

d) The sanding system is installed and designed such that the last two wheelsets of the train formation do not come to rest on sand laid at a density of 7.5 grams / metre / rail or greater. This is based on the ability of low voltage track circuits to detect a train when sand is present between the wheel and rail. This can be achieved by use of variable-rate sanders with a flow rate proportional to vehicle speed, such that a sand laying density not exceeding 7.5 grams / metre / rail can be maintained as the vehicle speed reduces.

Note: G 2.4.15 is existing practice on the GB mainline railway for multiple units and train formations with eight or more wheelsets, derived initially from testing carried out using a Class 165 multiple unit during trials at Old Dalby in 1995/96. Subsequent testing of the braking performance benefit of using distributed variable-rate sanders using Class 387 multiple units at Rail Innovation and Development Centre (RIDC) Melton in 2017 did not exceed 7.5 grams / metre / rail.

G 2.4.16 For braking sanding systems for multiple units with less than eight wheelsets (for example, Class 14x and 153), it is not possible to sand at a location to the rear of the second wheelset and also have six wheelsets to the rear of the sanding position. In these cases it is still beneficial to use sanders in order to achieve stopping distances in low adhesion. In this case a sanding system can be employed, where:

a) Sanders are positioned in front of the leading wheelset only. Placing sanders in front of the first wheelset will give the maximum number of wheelsets to the rear of the sanding position in order to achieve the lowest overall impact on train detection.
b) There are a minimum of four wheelsets between sanding positions (when units are operating in multiple).

c) There are a minimum of four wheelsets behind the last sanding position.

d) The sanding system is installed and designed such that the sand laying density does not exceed 7.5 grams / metre / rail. This is based on the ability of low voltage track circuits to detect a train when sand is present between the wheel and rail.

**Note:** G 2.4.16 is existing practice on the GB mainline railway, for multiple units and train formations with less than eight wheelsets; these criteria have been derived from testing carried out at High Marnham in 2011 using a Class 142 and 153.

G 2.4.17 For locomotives equipped with combined traction and braking systems, conformity with 2.4.1 can be achieved with sanding systems where:

a) Sanders are positioned in front of the leading wheelset of each bogie in the direction of travel.

b) Sand is dispensed at a rate of 1 kg / minute / rail for speeds up to 90 mph.

c) Sand is dispensed at a rate of 1.6 kg / minute / rail for speeds over 90 mph.

G 2.4.18 Locomotives operating in propelling mode (pushing a train from the rear, for example in conjunction with a driving van trailer (DVT) vehicle) or as a single vehicle, may only have two wheelsets between sanders and two wheelsets after the last sander, and thus the guidance on sand rates in G 2.4.15 and G 2.4.16 may not be appropriate. The guidance in G 2.4.17 is derived from the sand rates in Index 77 of the CCS TSI, which give a presumption of compatibility. Higher sand dispensing rates or sand-laying densities may be used if compatibility with the infrastructure train detection system can be demonstrated.

G 2.4.19 For traction sanding systems, 2.4.1 can be achieved with sanding systems where the sand dispensing rate is a maximum of 2 kg / minute / rail. This can be achieved with either a sander dispensing sand at a fixed rate of 2 kg / minute / rail or a pulsed sander where the total sand dispensed over a minute is up to 2 kg (for example, a laying rate of 3 kg / minute / rail for 40 seconds, followed by no sanding for the next 20 seconds).

G 2.4.20 If manual traction sanding systems can only discharge sand when traction power is demanded, this will limit the chance of excess sand being laid accidentally when traction power is not demanded.

G 2.4.21 Appendix C contains suggested operational practices to help control the risk from a loss of train detection through the use of sanders.

### 2.5 Requirements for switching off sanding equipment

2.5.1 It shall be possible for the driver to inhibit automatic traction sanding equipment, where provided.

**Rationale**

G 2.5.2 At particular points along the track operational rules may require sanding to be suspended.
G 2.5.3 Avoiding laying sand through switches and crossings prevents sand contamination, which could lead to premature degradation of bearer surfaces.

Guidance

G 2.5.4 Clause 2.5.1 can be achieved with a sanding isolation switch in the driving cab.

G 2.5.5 Use of a non-latching isolation switch means that the driver cannot isolate the sanding equipment and forget to turn it back on.

G 2.5.6 Where a non-latching isolation switch is considered to not be appropriate a suitably positioned reminder in the driving cab will help remind the driver when the sanding function has been isolated.

G 2.5.7 Clause 4.2.3.3.1.1 (7) of the LOC & PAS TSI includes a requirement that it shall be possible for the driver to inhibit automatic sanding. Clause 2.5.1 is only applicable to modifications that are not deemed new, renewed or upgraded as defined in the Railways (Interoperability) Regulations 2011 (as amended). New, renewed and upgraded vehicles are already required to apply the LOC & PAS TSI.
Part 3  Application of this Document

3.1  Scope

3.1.1 The requirements of this document apply to all new and modified equipment used for sanding on vehicles (this excludes like-for-like replacement of components), unless as set out in 3.1.2 and 3.1.3.

3.1.2 New, renewed and upgraded vehicles as defined in the Railways (Interoperability) Regulations 2011 (as amended) are required to comply with the LOC & PAS TSI and all relevant NTRs.

3.1.3 The requirements set out in 2.5 only apply to modifications on vehicles set out in 3.1.1 where the vehicles are deemed not to be new, renewed or upgraded.

3.1.4 Action to bring existing sanders into compliance with the requirements of this document is not required.

3.2  Exclusions from scope

3.2.1 There are no exceptions to the scope specified in 3.1 of this document.

3.3  General enter into force date

3.3.1 The requirements in this document enter into force from 02 March 2019, except as specified in 3.4. Where the dates specified in 3.4 are later than the above date, this is to allow sufficient time to achieve compliance with the specified exceptions.

3.4  Exceptions to general enter into force date

3.4.1 There are no exceptions to the general enter into force date specified in 3.3.

3.4.2 If, at the time the requirements in this document are to be complied with, a project is at an advanced stage of development, having regard to the impact that a change in technical specification would have on the project, it is permissible to continue to meet the equivalent requirements in the Railway Group Standards applying before the requirements are to be complied with.

3.4.3 If the project requires an authorisation for placing into service, a decision to continue to meet the equivalent requirements in the Railway Group Standards applying before the requirements are to be complied with should be discussed with the Office of Rail and Road.

3.5  Applicability of requirements for projects already underway

3.5.1 The Office of Rail and Road (ORR) can be contacted for clarification on the applicable requirements where a project seeking authorisation for placing into service is already underway when this document enters into force.
3.6 Deviations

3.6.1 Where it is considered not reasonably practicable to comply with the requirements of this document (including any requirement to comply with a TSI requirement referred to in the Scope), permission to comply with a specified alternative should be sought in accordance with the deviation process set out in the Railway Group Standard Code.

3.6.2 In the case where TSI compliance is required for a new, renewed or upgraded vehicle or structural subsystem, the derogation process to be followed is set out in the Railways (Interoperability) Regulations 2011 (as amended).

3.7 Health and safety responsibilities

3.7.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their 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.
Appendices

Appendix A  Sanding to Improve Stopping Distances in Low Adhesion Conditions

A.1  General
A.1.1  The content of this appendix is provided for guidance only.
A.1.2  GMRT2045 specifies the stopping distances that rail vehicles are required to achieve.
A.1.3  The guidance laid out in this appendix has been updated in light of the findings of RSSB research project T1107 (2018).

A.2  Considerations for effective control when sanding
A.2.1  Low adhesion conditions increase the risk from the hazard of not achieving the required stopping distances specified in GMRT2045. This potential risk needs to be controlled in order to meet the railway undertaking’s safety obligations as required under ROGS 2006 (as amended). The use of sanding equipment that operates in the braking mode can help in controlling this risk. Alternative means can also be used to address the risk, subject to a suitable and sufficient risk assessment.

A.2.2  In order for sanding to be an effective control measure the following factors need to be taken into account:

a)  Sand is delivered to both rails simultaneously at each wheelset where sanding is activated.

b)  As a minimum sand is delivered to the rail head by the leading vehicle of a train formation at a location forward of the third wheelset in the direction of travel.

c)  Sand is discharged during service brake demand of 6 %g and higher (equivalent to ‘Step 2’ on disc-braked multiple units) and emergency brake application when the presence of low adhesion is detected. Sanding during lower service brake demands when the presence of low adhesion is detected may also be beneficial.

d)  Where the means of detection of low adhesion is from a wheel slide detection system, the wheel slide detection system activates the sanding equipment when any wheelset on the vehicle containing the sanding equipment suffers a significant level of slide due to low adhesion (a significant level of slide is generally recognised as a wheelset rotational speed at 95 % or less than the true train speed).

e)  Where the means of detection of low adhesion is from a wheel slide detection system as described in A.2.2 d), positioning the sanding delivery immediately ahead of the third or second wheelset means that at least one wheelset on that vehicle is able to detect when the vehicle is running on track on which low adhesion is present. This can prevent an adhesion improvement from dispensed sand incorrectly resulting in sanding being deactivated.

A.2.3  Further adhesion benefits compared with the use of a fixed rate sander can be achieved through the use of a variable rate sander, which delivers sand at a rate proportional to train speed, bearing in mind the guidance on sand density given in G 2.4.15 d).
Further adhesion benefits compared with the use of a single sander can be achieved through the use of multiple, distributed sanders, bearing in mind the guidance on sanding positions given in G2.4.15. Distributed sanding can be achieved both by the installation of sanders at additional positions within a unit, and by activating sanders on non-leading units when units are coupled together and operating in multiple.

Optimum adhesion benefits can be achieved by combining the guidance given in A.2.4 and A.2.3, and utilising distributed variable rate sanders. Testing undertaken for RSSB research project T1107 (2018) demonstrated that this arrangement may be able to support 6%g braking performance in low adhesion conditions.

Testing undertaken for RSSB research project T1107 (2018) demonstrated that, as multiple wheelsets pass over low adhesion in the absence of sand, wheelsets towards the rear of the unit can experience higher adhesion than wheelsets towards the front of the unit. Positioning distributed sanders towards the front of longer train formations (for example of five vehicles or more) can be more beneficial than positioning them further to the rear.

Laying sand automatically and/or via a manual sander control during an emergency brake application, irrespective of whether low adhesion has been detected, can also be beneficial.
Appendix B  Good Practice Design Guide for Sanding Equipment

B.1  General
B.1.1  The content of this appendix is provided for guidance only.
B.1.2  The guidance laid out in this appendix has been developed from the findings of RSSB research projects T796 (2010) and T797 (2013).
B.1.3  Sanding equipment will be more effective in reducing the risk from low adhesion if the discharged sand is effectively focused just in front of the wheel / rail contact point and delivered at a rate within the design and maintenance parameters of the equipment. This appendix provides guidance on how to achieve this.

B.2  Sand boxes
B.2.1  Avoiding shallow angles of fall or restrictions in sand box filler pipes will avoid unnecessary blockages.
B.2.2  Systems which operate on the venturi principle require sand box breathers; adequately sized sand box breathers will ensure target sanding rates are achieved.
B.2.3  The choice of filter type will affect the susceptibility of the filter to become clogged.
B.2.4  Positioning sand box breathers for ease of maintenance and located away from areas susceptible to build-up of dirt reduces the likelihood of them becoming blocked in service.
B.2.5  Seals which prevent the ingress of water in the sand box will stop the sand becoming wet.
B.2.6  A heater element in the sand box will keep the sand dry if there is a small amount of water ingress; agitation systems can also prevent clogging of the sand box.
B.2.7  Sand box level monitoring is beneficial to inform the driver, or maintenance organisation, when sand box levels are low. This can be achieved either through sand level detection or measuring the amount of sand discharged. Sand box levels can also be communicated back to the maintenance control centre; this would be most useful for trains which do not typically go back to the depot on a frequent basis.
B.2.8  A suitable sand box size can be calculated based on the mileage operated between opportunities to fill the sand boxes and the anticipated maximum demand between filling.
B.2.9  Sanding systems which only store enough sand to assist one brake application during low adhesion are unlikely to adequately control the risk of extended stopping distances due to low adhesion.

B.3  Sand discharge test buttons
B.3.1  A sand discharge test button which controls the real operational control valves (as opposed to a separate test valve) will give a suitable test to replicate the operation of the sanding system in service.
B.4 Manual sander control

B.4.1 Use of a non-latching device that is protected from accidental operation for manual sander control reduces the likelihood of inadvertent sand application and unnecessary sand consumption.

B.4.2 Protection from accidental operation could be achieved with a button that is recessed from the surface level of the cab desk.

B.4.3 If the manual sander control is positioned to provide easy access for the driver, this is less likely to distract the driver from other duties.

B.5 Sand delivery systems

B.5.1 Minimising discharge hose lengths will increase sand discharge rates for some systems.

B.5.2 The use of a lower diameter bore stainless steel nozzle (for example, 19 mm) attached to a larger bore hose (for example, 25 mm) increases the amount of sand passing through the wheel / rail interface, compared to earlier designs which used a 19 mm bore hose. Small bore sizes can reduce the sand delivery rate.

B.5.3 The use of a straight stainless steel nozzle focuses the sand more effectively on to the wheel / rail interface.

B.5.4 Experience shows that aiming the discharge nozzle at a point on the rail just in front of the wheel / rail contact point with a shallow angle to the rail (10° to 15°) gives the best adhesion improvements for braking. As wheels wear, the alignment of the discharge nozzle relative to the wheel / rail contact point can be affected. Provision for nozzle alignment allows this to be adjusted during maintenance.

B.5.5 If a larger bore size hose is fitted to replace a smaller bore hose on an existing sand system, this may increase the delivery rate beyond intended limits; to address this the air pressure of the system can be reduced.

B.5.6 Sags in the discharge hoses will reduce the discharge rate (and could affect clearances with the infrastructure); sufficient support of the hose will prevent sags developing.

B.5.7 The means of securing discharge hoses can compress the hose in a way that reduces the bore and therefore the sand flow rates; if hoses are compressed in this way it will reduce the ability of the sander to improve adhesion.

B.5.8 The discharge hose or nozzle should be located as close to the interface as possible without contacting the wheel or rail.

B.5.9 Sand hoses or nozzles should be longitudinally aligned with the wheel, aiming at the centre of the rail laterally.

B.5.10 It may be possible to improve the discharge rates by changing the diameter of the orifices in the orifice plate.

B.5.11 The performance of valves and other components can become degraded as a result of corrosion. Performance can more easily be maintained if orifice plates are made
from non-corrosive materials; this is particularly applicable for sand valves that operate on the venturi principle.

B.5.12 When low sand box levels are detected for units with braking and traction sanding, where possible the use of sand for braking is a priority.

B.5.13 In the past the discharge of some braking sanders has been limited by timers to limit sand usage; this has proved to be unsafe in low adhesion conditions as stopping distances may not be achieved if the train is still slipping after sand delivery has stopped.

B.5.14 When retrofitting sanding equipment to existing multiple units, optimising the performance of any wheel slide protection (WSP) system before fitting of sanding equipment will minimise the likelihood of wheel lock up preventing operation of the sanding.

B.5.15 When modifying existing sanding equipment this can affect the air consumption of the sanding system, which could affect brake and WSP performance.

B.6 Recording sand use

B.6.1 Recording the use of the sander by the on-train management system (with a link to global positioning system (GPS) data) would allow maintenance and operational teams to identify when / where the sand is being used and hence identify faults, areas / times of poor adhesion and / or overuse.
Appendix C Operational Practices for the Use of Sanding Equipment

C.1 General

C.1.1 The content of this appendix is provided for guidance only.

C.2 Driving practices

C.2.1 Providing drivers with instructions or training on how to use the sanding equipment can help achieve consistent use of sanding equipment across a train fleet, and ensure that when braking in low adhesion conditions the brake controller is maintained in a position that will activate sanding.

C.2.2 As set out in G 2.5.3, discharging sand over switches and crossings could lead to premature degradation of bearer surfaces; this can be avoided by not using traction sanding as the train travels through these locations.

C.2.3 Operating traction sanders in anticipation of traction problems, give no adhesion benefit and may increase the likelihood of loss of train detection; it is better to only use manual traction sanders when wheel spin and consequent poor acceleration occur.

C.2.4 Traction sanders can be used at all speeds including starting from rest.

C.2.5 When used at speeds below 10 mph, use of traction sanding equipment is most effective on multiple units when a moderate power demand is selected (for example greater than notch 4 on a Class 165 or equivalent power level on other stock).

C.2.6 When track circuit failures due to sanding are reported, this could be an indication that sanding equipment on trains that operate over that particular track circuit are laying sand at a rate higher than the design rate; in this case it will be beneficial for the railway undertaking to check sanding equipment is functioning correctly.

C.2.7 Locations where sanding has frequently been used can highlight an area where there is a low adhesion risk; also if sand deposits build up in a particular location this may affect the ability of a track circuit to detect trains, and may also affect drainage at these locations. If a railway undertaking communicates the details of locations where sand is frequently used to the infrastructure manager, this can help the infrastructure manager manage low adhesion and risk from a loss of train detection.

C.2.8 Where manual braking sanders are provided with a fixed discharge rate of 2 kg / minute / rail, the 7.5 grams / metre sand-laying density suggested in G 2.4.7 d) will be exceeded if they are used at speeds below 10 mph.

C.2.9 For trains with traction and braking sanders, if both sander types use the same sand box, when the driver is aware of low sand levels, sanding for braking is a priority over sanding for traction.

C.3 Sand storage

C.3.1 Storing sand in clean dry conditions reduces the likelihood of the sand becoming damp or contaminated.
C.3.2 Controls that prevent sand of one grade being inadvertently contaminated with another will help reduce the risk that sand boxes are filled with the wrong grade of sand.

C.4 Maintenance and inspection of sanding equipment

C.4.1 Maintenance limits for sand discharge rates that are as close to the maximum design values as practicable (for example, ≥80%) will give the best likelihood that sanders will provide the necessary levels of adhesion improvement.

C.4.2 When undertaking measurement of sand discharge rates, testing for a suitably long time period will give the best measure of the discharge rate; at least 30 seconds is typically used.

C.4.3 Sand discharge rates can be measured by mass of sand discharged over a fixed time period.

C.4.4 If sand is lost during the discharge test, before it is weighed, this will affect the accuracy of the results.

C.4.5 Regular inspection of the hoses making up part of the sanding equipment (and implementation of any necessary corrective actions identified) can prevent blockages building up or sagging which would affect the performance.

C.4.6 Hoses can deteriorate with age and use; periodic replacement of the hoses will avoid this affecting performance of the sanding equipment.

C.4.7 If blockages build up in sand box breathers this can affect the performance of the sander; the likelihood of this occurring can be controlled through regular inspections.

C.4.8 Maintaining sand discharge nozzle alignment is necessary to maintain performance of the sanding equipment; this can be maintained through regular checking and correcting of the alignment.

C.4.9 Regularly inspecting sand valves will help prevent the potential for corrosion building up or valves wearing beyond allowable tolerances, which could affect the performance of the sanding equipment.

C.4.10 When wheels are re-profiled this can affect how well the sanding nozzles are aligned relative to the rails and the wheel / rail contact point; checking the alignment after wheel re-profiling can help maintain performance of the sanding equipment.
Appendix D  Sand for Braking Sanders

D.1  General
D.1.1  Clauses 2.1.1 and 2.2.1 require the use of sand meeting the specification in this appendix.

D.2  Grain shape
D.2.1  The sand shall, as far as possible, consist of rounded irregular shaped grains.

D.3  Grain size
D.3.1  The maximum proportion of grains of diameter <0.71 mm (22 British Standard Sieve (BSS) mesh) shall not exceed 5% by weight.
D.3.2  The maximum proportion of grains of diameter >2.8 mm (6 BSS mesh) shall not exceed 5% by weight.
D.3.3  The uniformity coefficient shall be less than 1.5. The uniformity coefficient (Uc) is a factor for determining the uniformity of sand and is a means of determining its resistance to compaction.
D.3.4  Uc 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:

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

D.4  Other characteristics
D.4.1  The sand shall be uniform and consist of at least 90% by weight hard grains of quartz or siliceous material.
D.4.2  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.
D.4.3  It is permissible for the remaining materials to be of other mineral content.
D.4.4  Quarry sands are preferable to river or sea sands, to avoid possible salt contamination.
Appendix E  Sand for Traction Sanders

E.1  General

E.1.1  Clauses 2.1.1 and 2.3.1 require the use of sand meeting the specification in this appendix.

E.2  Sand characteristics for traction sanders

E.2.1  The sand shall be sharp silica sand and all passing through a 1.25 mm screen and shall not cake on drying.

E.2.2  The proportion of sand with grain size > 1.18 mm (14 BSS mesh) shall not exceed 15% by weight.

E.2.3  The proportion of sand with grain size < 0.15 mm (100 BSS mesh) shall not exceed 15% by weight.

E.2.4  The proportion of clay or fine silt with grains of diameter < 75 µm (200 BSS mesh) shall not exceed 1% by weight.

E.2.5  Quarry sands are preferable to river or sea sands, to avoid possible salt contamination.
Sanding Equipment

Definitions

Breather  A component linking the airspace at the top of the sand box with the outside air.

Fixed rate sander  A sanding device that operates at a constant sand dispensing rate, so that the sand-laying density increases as vehicle speed decreases.

Multiple unit  A fixed formation of one or more vehicles capable of operation under their own traction power; the formation may be capable of working in multiple with other similar formations.

On-Track Machine (OTM)  Any rail-mounted machine, whose primary function is for the renewal, maintenance, inspection or measurement of the infrastructure, meeting the requirements of GMRT2400 and permitted by the Rule Book to be moved, either self-propelled or in train formation, outside a possession.

Orifice Plate  A plate within the sand control system containing a hole (orifice) that regulates the rate of sanding.

Sand Box  An on-board storage vessel for the sand supply to sanding equipment.

Sand dispensing rate  The quantity of sand ejected from a sanding device with respect to elapsed time, expressed in kilograms per minute (kg / min).

Sand-laying density  The quantity of sand ejected from a sanding device with respect to distance travelled, expressed in grams per metre (g / m).

Sanding position  The wheelset at which sand is delivered.

Variable rate sander  A sanding device for which the sand dispensing rate varies with vehicle speed, and which can be used to control sand-laying density.
Sanding Equipment

References

The Catalogue of Railway Group Standards gives the current issue number and status of documents published by RSSB. This information is also available from http://www.rssb.co.uk/railway-group-standards.

RGSC 01 Railway Group Standards Code
RGSC 02 Standards Manual

Documents referenced in the text

Railway Group Standards

GMRT2045 Compatibility Requirements for Braking Systems of Rail Vehicles

RSSB Documents

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T797 RSSB 2013 Performance and installation criteria for sanding systems
T1107 RSSB 2018 Trials of sanders and sand laying rates

Other References

BR 600 Braking Sand for Locomotives
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JRRT308 Laboratory investigation of some sanding parameters to improve the adhesion in leaf-contaminated wheel-rail contacts
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