Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

Issue record

<table>
<thead>
<tr>
<th>Issue</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
</table>
| One   | April 2006 | Original document  
This document replaces GM/RT1300 issue four and GM/RT2402 issue two |
| Two   | December 2009 | Supersedes issue one |
| Three | March 2011  | Supersedes issue two  
Small scale change amendment – revision of clauses 1.1.5, 3.4.1.2,  
GN21, 5.7.8.2, 5.11.1, 6.1.3, 8.7.1.5,  
GN333, Appendix G, Appendix K  
clause K.2.1 and Appendix L clause L.5.1 |
| Four  | December 2012 | Supersedes issue three  
Requirement for rail wheel brake on type 9B machines added.  Requirement for whole system assessment of control system at design stage including guidance on performance levels, additional requirements for design of access systems and other clarifications throughout document |
| Five  | June 2014   | Supersedes issue four  
Additional guidance on fleetwide modifications added in 3.4.2.6 and all 9B machines are now required to have rail wheel braking |
| Six   | December 2015 | Supersedes issue five  
Requirements for Engineering Acceptance removed (and put into RIS-1710-PLT). Technical requirements for trolleys added (Part 8) and requirements for all OTP generalised to be applicable to any infrastructure manager. New requirement added for specific design review by manufacturer (clause 5.1) |

Revisions have not been marked by a vertical black line in this issue because the document has been revised throughout.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

Superseded or replaced documents

The following Rail Industry Standard is superseded or replaced, either in whole or in part as indicated: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Superseded documents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Sections superseded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Date when sections are superseded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>RIS-1530-PLT issue five Rail Industry Standard for Engineering Acceptance of On-Track Plant and Associated Equipment</td>
<td>All except Part 3</td>
<td>05 December 2015</td>
</tr>
<tr>
<td>RIS-1701-PLT issue three Rail Industry Standard for Portable and Transportable Plant Used for Infrastructure Work</td>
<td>Section 4.1</td>
<td>05 December 2015</td>
</tr>
</tbody>
</table>

RIS-1530-PLT issue five Rail Industry Standard for Engineering Acceptance of On-Track Plant and Associated Equipment, ceases to be in force and is withdrawn as of 05 December 2015.

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.
## 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>Introduction</strong></td>
<td>7</td>
</tr>
<tr>
<td>1.1</td>
<td>Purpose of this document</td>
<td>7</td>
</tr>
<tr>
<td>1.2</td>
<td>Application of this document</td>
<td>7</td>
</tr>
<tr>
<td>1.3</td>
<td>Health and safety responsibilities</td>
<td>7</td>
</tr>
<tr>
<td>1.4</td>
<td>The structure of this document</td>
<td>7</td>
</tr>
<tr>
<td>1.5</td>
<td>Copyright</td>
<td>7</td>
</tr>
<tr>
<td>1.6</td>
<td>Approval and authorisation of this document</td>
<td>7</td>
</tr>
<tr>
<td><strong>Part 2</strong></td>
<td><strong>Document Specific Information</strong></td>
<td>8</td>
</tr>
<tr>
<td>2.1</td>
<td>Scope of this document</td>
<td>8</td>
</tr>
<tr>
<td>2.2</td>
<td>Relevant legislation</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>Definitions</td>
<td>8</td>
</tr>
<tr>
<td><strong>Part 3</strong></td>
<td><strong>Engineering Assessment</strong></td>
<td>13</td>
</tr>
<tr>
<td>3.1</td>
<td>General</td>
<td>13</td>
</tr>
<tr>
<td><strong>Part 4</strong></td>
<td><strong>Classification of Machines</strong></td>
<td>14</td>
</tr>
<tr>
<td>4.1</td>
<td>Machines in scope of this document</td>
<td>14</td>
</tr>
<tr>
<td>4.2</td>
<td>Demountable machine</td>
<td>14</td>
</tr>
<tr>
<td>4.3</td>
<td>RRV – Type 9 machines</td>
<td>14</td>
</tr>
<tr>
<td>4.4</td>
<td>Trailers and wheeled attachments – Type 0 machines</td>
<td>15</td>
</tr>
<tr>
<td>4.5</td>
<td>Trolleys</td>
<td>16</td>
</tr>
<tr>
<td>4.6</td>
<td>Miscellaneous machines and attachments</td>
<td>16</td>
</tr>
<tr>
<td><strong>Part 5</strong></td>
<td><strong>Common Design Requirements</strong></td>
<td>18</td>
</tr>
<tr>
<td>5.1</td>
<td>Design assessment</td>
<td>18</td>
</tr>
<tr>
<td>5.2</td>
<td>Gauge</td>
<td>18</td>
</tr>
<tr>
<td>5.3</td>
<td>Track condition</td>
<td>24</td>
</tr>
<tr>
<td>5.4</td>
<td>Machine speeds</td>
<td>25</td>
</tr>
<tr>
<td>5.5</td>
<td>Wheel loadings</td>
<td>26</td>
</tr>
<tr>
<td>5.6</td>
<td>Dynamic stability</td>
<td>30</td>
</tr>
<tr>
<td>5.7</td>
<td>OTP rail mode brakes</td>
<td>34</td>
</tr>
<tr>
<td>5.8</td>
<td>Movement limiting devices</td>
<td>40</td>
</tr>
<tr>
<td>5.9</td>
<td>Personnel areas (where fitted)</td>
<td>43</td>
</tr>
<tr>
<td>5.10</td>
<td>Setting up and packing away</td>
<td>48</td>
</tr>
<tr>
<td>5.11</td>
<td>Other safety features</td>
<td>48</td>
</tr>
<tr>
<td>5.12</td>
<td>Data logging</td>
<td>52</td>
</tr>
<tr>
<td>5.13</td>
<td>Failure recovery conditions</td>
<td>54</td>
</tr>
<tr>
<td>5.14</td>
<td>Retention of components</td>
<td>55</td>
</tr>
<tr>
<td>5.15</td>
<td>Visibility and audibility</td>
<td>55</td>
</tr>
<tr>
<td>5.16</td>
<td>Electrical equipment and electrical safety bonding</td>
<td>60</td>
</tr>
<tr>
<td>5.17</td>
<td>Electromagnetic compatibility</td>
<td>64</td>
</tr>
<tr>
<td>5.18</td>
<td>Protection from overhead line equipment and / or conductor rails</td>
<td>65</td>
</tr>
<tr>
<td>5.19</td>
<td>On and off tracking system</td>
<td>68</td>
</tr>
<tr>
<td>5.20</td>
<td>Towing requirements</td>
<td>71</td>
</tr>
<tr>
<td>5.21</td>
<td>Rail wheels</td>
<td>74</td>
</tr>
<tr>
<td>5.22</td>
<td>Doors, door handles, steps, handrails and railings</td>
<td>78</td>
</tr>
<tr>
<td>5.23</td>
<td>Audible warning device (in working mode)</td>
<td>78</td>
</tr>
<tr>
<td>5.24</td>
<td>Demountable modules</td>
<td>79</td>
</tr>
<tr>
<td>5.25</td>
<td>Windscreens and windows</td>
<td>79</td>
</tr>
<tr>
<td>5.26</td>
<td>Remote control systems</td>
<td>80</td>
</tr>
<tr>
<td>5.27</td>
<td>Noise emissions</td>
<td>80</td>
</tr>
<tr>
<td>5.28</td>
<td>Vibration emissions</td>
<td>80</td>
</tr>
<tr>
<td>5.29</td>
<td>Structural integrity</td>
<td>81</td>
</tr>
<tr>
<td>5.30</td>
<td>Fire prevention</td>
<td>82</td>
</tr>
</tbody>
</table>
5.31 Design requirements for machines intended for predominant use in enclosed locations 83
5.32 Owner identification 85

Part 6 Road-Rail Vehicle Design Requirements 86
6.1 On and off tracking 86
6.2 Rail wheel systems 86
6.3 Steering 89
6.4 Road vehicle conversions 90

Part 7 Trailers 91
7.1 Trailer design 91
7.2 Trailer general design requirements 91
7.3 Brakes 93
7.4 Jacking points for recovery 94

Part 8 Trolleys 95
8.1 General 95
8.2 Rail wheels 96
8.3 Brake system 97
8.4 Manual propulsion 97
8.5 Dynamic stability 98

Part 9 Machines with Moveable Parts Affecting Stability 99
9.1 General requirements 99
9.2 Cranes (including excavators / loaders used as cranes) 100
9.3 Mobile elevating work platforms 100
9.4 Attachments 102
9.5 Static stability 103
9.6 Dynamic stability 108
9.7 Rated Capacity Indicator (RCI) 110
9.8 Condition of variables during calculation and testing 114
9.9 Burst protection 115
9.10 Load lifting points 115

Part 10 Information for Users 119
10.1 Instruction handbook 119
10.2 Maintenance 125

Appendices
Appendix A Track Twist Geometry 136
Appendix B Machine Number 137
Appendix C Data Panel 139
Appendix D Labelling Guidance Diagram 141
Appendix E Example of Good Practice Maintenance Instruction Documentation 142
Appendix F Check List for Conformity 152
Appendix G Engineering Conformance Certificate (ECC) 169
Appendix H Air Brake Inter-machine Connections 175
Appendix I Not used 178
Appendix J Couplings 179
Appendix K Noise Measurement Test Code 182
Appendix L Vibration Measurement 187
Appendix M CCTV Specification 189

References 190
Tables

Table 1  Maximum permitted load on rail wheels  27
Table 2  Machine stopping distances for speeds \(\leq 35\) mph  36
Table 3  Performance levels for safety devices  51
Table 4  Rail wheel profiles (\(^*\) these figures vary depending on wheel diameter)  76
Table 5  Wheel profile tolerances  76
Table 6  Neat exhaust emission limits for diesel engines  84
Table 7  Load cases for calculating stability  104
Table 8  Load cases for calculating stability of excavators used in digging or grabbing configuration 105
Table 9  Static stability  107
Table 10  Load cases for testing stability  110
Table 11  Definition of terms in maintenance instructions  128
Table 12  Examples of maintenance activities and intervals  130
Table 13  Maintenance summary (star chart) (selected sections only)  131
Table 14  Noise measurement of personnel areas (working condition is for travelling and working mode)  182
Table 15  Noise measurement of machine  183
Table 16  Example of a noise emission declaration  186

Figures

Figure 1  Type 9A self-powered rail wheels (braking and traction directly on the rail wheels)  14
Figure 2  Type 9B high ride machines (traction indirect, from road wheels to rail wheels, braking direct on the rail wheel)  14
Figure 3  Type 9C low ride machines (braking and traction on road wheels)  15
Figure 4  Type 0A rail trailers (parking brake and service brake)  15
Figure 5  Type 0C road-rail trailers  16
Figure 6  Type 0D attachment with rail wheels and trailers with only two rail wheels  16
Figure 7  Plant gauge  19
Figure 8  Plant gauge showing areas of exceedance permitted for some OTP  20
Figure 9  Lower sector area reserved for infrastructure use (mirrored both sides of track centre-line)  22
Figure 10  Worst case position of raised check and guard rails  24
Figure 11  Lamp iron dimensions  57
Figure 12  Indicative space to be left to fit lamp  58
Figure 13  Definition of dimensions in Tables 4 and 5  77
Figure 14  The normal nomenclature for parts of the wheel  77
Figure 15  Ratio of wheel load on guiding wheels to road axle load  89
Figure 16  Exceedance allowed at lower gauge (up to 1000 mm above rail level) for railborne portable and transportable Plant over 20 kg  95
Figure 17  Exceedance allowed at lower gauge (up to 1000 mm above rail level) for railborne portable and transportable Plant 20 kg and less  96
Figure 18  Example label for warning of moveable superstructure  100
Figure 19  Load lifting point labels  116
Figure 20  Example of a duty chart  118
Figure 21  Track twist geometry diagram  136
Figure 22  Powered machine  139
Figure 23  Trailer machine  140
Figure 24  Schematic of parking brake connections  175
Figure 25  Schematic of service brake connections  176
Figure 26  Schematic of charge air connections  177
Figure 27  Drawing of typical automatic trailer coupler  179
Figure 28  Schematic drawing of coupling heights  180
Figure 29  Microphone positions to measure pass by noise  184
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

Part 1  Introduction

1.1  Purpose of this document

1.1.1  This document provides a voluntary standard defining the engineering requirements for on-track plant (OTP), trolleys and associated equipment.

1.2  Application of this document

1.2.1  A member of RSSB may choose to adopt all or part of this document through internal procedures or contract conditions. Where this is the case the member of RSSB will specify the nature and extent of application.

1.2.2  Therefore specific compliance requirements and dates have not been specified since these will be the subject of internal procedures or contract conditions.

1.3  Health and safety responsibilities

1.3.1  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.

1.3.2  Users of this document are reminded of their responsibilities under health and safety legislation. RSSB does not warrant that compliance with this document is sufficient to ensure safety systems of work or adequate performance.

1.4  The structure of this document

1.4.1  This document comprises requirements, in some cases followed by guidance. The guidance clauses are identified by the letter ‘G’.

1.5  Copyright

1.5.1  Copyright in Railway Group documents is owned by Rail Safety and Standards Board Limited. All rights are hereby reserved. No Railway Group document (in whole or in part) may be reproduced, stored in a retrieval system, or transmitted, in any form or means, without the prior written permission of Rail Safety and Standards Board Limited, or as expressly permitted by law.

1.5.2  RSSB members are granted copyright licence in accordance with the Constitution Agreement relating to Rail Safety and Standards Board Limited.

1.5.3  In circumstances where Rail Safety and Standards Board Limited has granted a particular person or organisation permission to copy extracts from Railway Group documents, Rail Safety and Standards Board Limited accepts no responsibility for, nor any liability in connection with, the use of such extracts, or any claims arising therefrom. This disclaimer applies to all forms of media in which extracts from Railway Group documents may be reproduced.

1.6  Approval and authorisation of this document

1.6.1  The content of this document was approved by Plant Standards Committee on 15 October 2015.

1.6.2  This document was authorised by RSSB on 28 October 2015.
2.1 **Scope of this document**

2.1.1 This document applies to all On-Track Plant (OTP) and trolleys.

2.1.2 The engineering requirements set out in Parts 5 to 10 of this document refer to the machine in rail mode only, unless explicitly stated otherwise.

2.1.3 The clauses in this document contain requirements that relate to, and could be mandated by, an infrastructure manager, to be complied with by the following industry parties:

a) Manufacturers of OTP and trolleys.

b) Plant assessment bodies (PABs).

c) Owners of OTP and trolleys.

d) Operators of OTP and trolleys.

e) Maintainers of OTP and trolleys.

2.1.4 Throughout this document references to ‘towing’ shall be taken to include propelling movements, unless explicitly stated otherwise in a particular clause.

2.2 **Relevant legislation**

2.2.1 Regulations of particular relevance to this standard are the Supply of Machinery (Safety) Regulations 2008 – as amended by the Supply of Machinery (Safety) (Amendment) Regulations 2011. These regulations transpose the Machinery Directive 2006/42/EC into UK law – henceforward known in this document as the Machinery Directive.

2.2.2 Provision and Use of Work Equipment Regulations 1998.

2.3 **Definitions**

**Above rail level**

The distance measured perpendicularly to an imaginary surface in the plane of the top of both rails of a track.

**Associated equipment**

Attachments, demountable modules and lifting accessories used with OTP.

**Attachment**

Any equipment that is mechanically fixed to and / or powered or controlled from the host machine; this could be a lifting accessory.

**Axle**

For the purposes of this document the meaning of axle is taken as two rail wheels joined by a shaft so that they rotate together, or two independently-rotating wheels joined by a central structure which maintain the wheels at a set spacing.
Bogie
A frame which connects two or more axles. The machine body could be mounted on one or more bogies.

Demountable machine
A demountable machine is a machine that can travel on rail under its own power system. Such machines are not allowed to operate, work or travel outside possessions. Rail in this definition refers to permanent rails intended for use by normal rail machines. A demountable machine was formerly known as rail mounted maintenance machine (RMMM).

Demountable module
Removable component which is capable of being attached with a dedicated fastening system to a trailer or machine, to perform a specific function.

Driving position
Driving position should be taken to be any position where a self-propelled machine is controlled for movement along the track.

Enclosed locations
Any locations that are substantially below ground or where the presence of structures or features of the local environment may reduce the level of natural ventilation to an extent that will enable noxious gases to accumulate or oxygen to be depleted sufficiently to render the local environment unsafe. Enclosed locations include confined spaces, as defined in UK health and safety legislation.

Engineering acceptance
The process whereby conformance of machines to the mandatory requirements is confirmed and certificated.

Engineering Conformance Certificate (ECC)
A certificate issued by a plant assessment body confirming conformance of the design and construction of OTP and associated equipment, and its maintenance instruction, with all relevant mandatory requirements of this document.

Flat level track
Any track with a gradient less than 1 in 750 and cant less than 50 mm.

Four-foot
The space between the running rails of one track.

Host machine
A machine which has been converted to form an OTP machine. (This is normally the case where a road machine has rail gear added to form a road-rail machine.)

Instruction handbook
Text, drawing and pictorial information for an individual machine as a controlled document. It is permissible for this to consist of one or more volumes, with or without supplements, appendices, loose sheets (test results etc).

Lift and carry duty
Lifting loads and moving along the track with the machine in working mode with the suspension allowing movement along the track.

Lifting accessories
Equipment fitted between a crane hook, or designated load lifting point, and a load to enable the load to be moved, often formerly known as loose lifting tackle.
Load lifting points
Load lifting points are the points on the machine where lifting accessories are attached in order for the machine to lift a load.

Maintenance instruction
The document which details the standard of maintenance required for OTP and associated equipment.

Manufacturer
The company assembles the complete item of OTP or associated equipment, or converts a host machine to run on railway lines. This is the entity which completes the CE marking.

Mobile elevating work platform (MEWP)
A mobile machine that is intended to move persons to working positions where they are carrying out work from the work platform with the intention that persons get on and off the work platform at one defined access position and which consists, as a minimum, of a work platform with controls, an elevating structure and a chassis.

On-track plant (OTP)
Machines with rail wheels capable of running on railway track, limited by their engineering acceptance to running within a possession only. For the purposes of this document they are split into three main groups: demountable machines, road-rail vehicles (RRVs), and trailers.

Operator
For the purposes of this document, from Part 3 onwards, the Operator, when written with a capital ‘O’, means the company responsible for the operation of the train / machine.

operator
For the purposes of this document, from Part 3 onwards, the operator, when written with a lower case ‘o’, means the person who is handling the controls of the machine.

Operating cab or working position
The place from where a machine is operated.

Pedestrian controlled powered machine
A machine which moves itself along the track while controlled by an operator who is walking.

Plant Assessment Body (PAB)
For the purpose of this document, a Plant Assessment Body (PAB) is a body with authority to issue Engineering Conformance Certificates for OTP and associated equipment by the process set out in RIS-1710-PLT.

Positively locked
Retained in position by a locking system that does not require power to maintain its locked state and that maintains equipment at a predetermined position until the lock is actuated to release it.

Possession
A line is under possession when the arrangements set out in GE/RT8000 Rule Book Handbook 11 or Handbook 13, have been carried out to block the line to the normal passage of trains. The only movements allowed within a possession are on-track plant and engineering trains as set out in Handbook 11. Possession limit boards normally indicate the limits of a possession. The handbooks should also be taken to include HB11 ERTMS and HB13 ERTMS.
Rail mode
Any state in which the rail wheel guidance system is fully deployed, fully meeting the requirements of travel or working mode.

Rated Capacity Indicator (RCI)
A rated capacity indicator including rated capacity limiter as set out in section 9.7.

Road mode
Any state where the rail wheel guidance system has been fully retracted and the machine is being fully supported by the road wheels / tracks.

Road-rail vehicle (RRV)
A road-rail vehicle (RRV) is one that can travel on the ground and also travel on rail by virtue of a rail wheel guidance system under its own power system. Such machines are not allowed to operate, work or travel on rail outside possessions.

This definition does not imply that the machine is suitable for use on the public road.

Rolling Stock Library
The national central database of rail machine design and operational data, which is maintained by Network Rail’s authorised agent.

Service brake
A service brake is a progressive brake used in dynamic conditions, for which the brake force can be infinitely varied, or stepped, by the operator using a control to simultaneously apply brakes on all connected machines, except where fitted with UIC air brakes compatible with mainline trains.

Stepped should be interpreted as having sufficient steps to enable the operator to control the speed to within an accuracy that enables safe and efficient operation.

Stowed
When components are stowed in position it means there is an allocated location for the component to keep it within gauge during travelling mode and that the component cannot accidentally move or vibrate away from that position.

Tow bar
Independent rigid mechanical bar connector between two trailers capable of pulling and pushing the maximum load imposed by the gross train weight, fitted with a compatible eye at each end.

Towing
One machine being moved by a connected powered machine, either directly or through other machines. For the purposes of this document, references to ‘towing’ shall be taken to include propelling movements, unless otherwise explicitly stated for a particular clause. This includes both operational and emergency situations.

Towing adaptor
Rigid mechanical bar connector between towing machine and trailer capable of pulling and pushing the maximum load imposed by the total train load, fitted with a compatible eye at each end. The towing adaptor is specifically designed to suit the individual towing machine. It is permissible for a tow bar to be used as a towing adaptor where authorised by the manufacturer.
Trailer
A non-self-propelled, rail-mounted machine capable of being towed or propelled; (this includes attachments with two or more rail wheels).

Travelling mode
A machine is considered to be in travelling mode when it is on the rail, with its suspension allowing movement along the track, and all parts stowed and everything within the applicable gauge.

G Travelling mode is required to move machines outside of worksites within possessions.

Trolley
A manually propelled, rail-mounted device supported simultaneously on both running rails, as set out in 4.5.1.

Working mode
A machine is in working mode as soon as any part of the machine or equipment is unstowed from its travelling mode, or not within the applicable gauge.

$\Delta Q/Q$
The wheel unloading quotient. The ratio between the instantaneous reduction in a wheel load, $\Delta Q$, and the average static wheel load, $Q$. 

Uncontrolled When Printed
Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015
Amendments to this document can be found on the RSSB Standards Catalogue - http://www.rssb.co.uk/railway-group-standards
Part 3 Engineering Assessment

3.1 General

3.1.1 The verification process shall be as set out in RIS-1710-PLT.

3.1.2 The Plant Assessment Body (PAB) shall assess the machine for compliance with this document (see Appendix F) and, when satisfied that the machine is compliant, shall issue an Engineering Conformance Certificate (ECC).
Part 4  Classification of Machines

4.1  Machines in scope of this document

4.1.1 This section provides a classification system for the following types of machine:

a) Demountable machine (4.2).

b) RRV (4.3).

c) Trailers (4.4).

d) Trolleys (4.5).

e) Attachments with two or more rail wheels (4.6).

4.2  Demountable machine

4.2.1 Demountable machines are restricted by their ECC to be used inside a possession only.

4.3  RRV – Type 9 machines

4.3.1 RRVs shall be classified as shown in the following figures:

G 4.3.1.1 For harmonization with Europe, RRVs used within a possession are known as Type 9 machines.

Figure 1  Type 9A self-powered rail wheels (braking and traction directly on the rail wheels)

G 4.3.1.2 Type 9A machines have the advantage that the traction and braking are directly on the rail wheels, making them more consistent with normal rail machines and hence removing the potential interface problem between rubber tyre and either steel wheel or rail.

Figure 2  Type 9B high ride machines (traction indirect, from road wheels to rail wheels, braking direct on the rail wheel)
G 4.3.1.3 Type 9B machines are recognised as a convenient and cost effective conversion from a standard road machine. Care has to be taken in the design so that the load of the road wheel on the rail wheel is maintained during all wear of the rubber tyre.

Figure 3 Type 9C low ride machines (braking and traction on road wheels)

G 4.3.1.4 Type 9C machines have the advantage over 9B machines in that the rubber tyres are providing traction and braking directly onto the rail. However, care needs to be taken so that the load is shared correctly between the machine’s road and rail wheels to provide adequate guidance from rail wheels and traction / braking from road wheels, as mandated in 6.2.4. Similarly, care needs to be taken in the design for when the machine is traversing level crossings (and high check rails) that the load on the rail wheels is not reduced.

4.3.2 Engineering assessment shall be carried out for all permissible modes of the machine. For standardisation, the machine category for numbering shall be the mode in which the machine is used for travelling.

G 4.3.2.1 There is the potential for machines to be designed to be capable of operating in two or more categories. Commonly this could be the difference between travelling and working modes.

4.4 Trailers and wheeled attachments – Type 0 machines

4.4.1 Trailers and wheeled attachments shall be classified as shown in the following figures:

Figure 4 Type 0A rail trailers (parking brake and service brake)
G 4.4.1.1 For type 0A machines, the trailer braking is sufficient to brake its own laden weight; hence the load (number of trailers) of the towing machine is limited by other factors such as traction, coupling strength or brake signal propagation.

![Figure 5 Type 0C road-rail trailers](image)

G 4.4.1.2 For type 0C machines, the type of trailer is relatively uncommon. It has the advantage that it can be brought to site towed behind a host machine rather than as a load. The trailer could either be fitted with service and parking brake, or parking brake only.

![Figure 6 Type 0D attachment with rail wheels and trailers with only two rail wheels](image)

G 4.4.1.3 For type 0D machines, any attachment that has two rail wheels or more is classified as a trailer and needs to meet the requirements for trailers set out in this document.

4.5 Trolleys

4.5.1 Trolleys are railborne plant which are propelled along the track solely by manual effort. These include conventional track trolleys used for transporting materials, tools and equipment and also inspection or maintenance tools fitted with any combination of rail wheels, rollers or low friction slides and supported on both running rails simultaneously.

4.6 Miscellaneous machines and attachments

4.6.1 Some machines or attachments do not fit into the above machine types. For machines or attachments that do not meet the definitions above, the manufacturer shall seek guidance from Network Rail, Professional Head (Plant & T&RS) before submission for engineering acceptance. In all cases, these miscellaneous machines or attachments shall meet the requirements set out in 7.3.4.
4.6.2 Some attachments and even parts of machines, (for example a dozer blade bogie), have rail wheels and, if left unattended and unbraked on the track, have the potential to run away. Therefore all equipment fitted with rail wheels shall be provided with a parking brake capable of holding the attachment (or part of machine) on a 1 in 25 (40/00) gradient, unless their design prevents a runaway.
Part 5  Common Design Requirements

5.1  Design assessment

5.1.1  For machines first certificated after 1 January 2016 the manufacturer shall assess the overall machine design to identify hazards. The hazards shall be evaluated and assessed with the aim to control the risk from the hazards to an acceptable level.

G 5.1.1.1  The requirement set out in 5.1.1 should be considered similar to the process in the Common Safety Method on Risk Assessment and Evaluation used for railway locomotives and rolling stock. Guidance on compliance with the Common Safety Method on Risk Assessment and Evaluation is given in the GE/GN8640 to GE/GN8645 suite of standards.

G 5.1.1.2  Additional guidance is given in PD CLC/TR 50126-3 on how reliability, availability, maintainability and safety in the railway environment are able to be specified and demonstrated.

G 5.1.1.3  To demonstrate compliance with 5.1.1 the manufacturer should present an analysis that has been made for the overall machine design, including intended use and foreseeable misuse. For example, using failure modes and effects analysis (FMEA), failure modes, effects and criticality analysis (FMECA), decision tree etc.

G 5.1.1.4  The PAB is expected to check that such analysis has been undertaken and documented to be satisfied that the assessment is appropriate, but it is not intended that the PAB would need to repeat or carry out additional analysis to verify accuracy and completeness.

5.1.2  The manufacturer shall state in the instruction handbook the intended use(s) of the machine that has been assessed, with the hazards identified and considered, as set out in 10.1.3.1 r).

5.1.3  Machines that are declared compliant with the Machinery Directive shall use the following standards as a basis for the presumption of conformity:


b)  BS EN 15954-2:2013 for trailers.

c)  BS EN 15955-2:2013 for demountable machines.

d)  BS EN 13977:2011 for trolleys.

G 5.1.3.1  The PAB is not expected to assess compliance of the machine to the Machinery Directive, but is expected to check that the manufacturer has self-certificated against the appropriate European standard.

5.2  Gauge

5.2.1  OTP travelling mode gauge

5.2.1.1  The manufacturer shall provide dimensioned drawings of the maximum size cross-section of the machine.
### 5.2.1.2 Machines shall either not exceed the Plant gauge shown in Figure 7, (which is a combination of the W6a gauge for use on Network Rail, the LG2 gauge for use on London Underground and the Lower Sector Vehicle gauge) or shall comply with 5.2.1.4. The Plant gauge is static, assuming a bogie centre or wheelbase of non-bogie machines of 10.363 m and a bogie wheelbase of 2 m. If these dimensions are exceeded, the overthrow in the centre and at the ends shall be calculated to demonstrate that the design of machine does not exceed the assumed envelope. This also needs to be demonstrated where the end of the machine is greater than 2.2 m from bogie centre or wheel of non-bogied machine.

**G 5.2.1.2.1** The machine is permitted to be built to any size. The larger it becomes the more restricted is the use that can be made of the machine. The Plant gauge is deliberately chosen as the reference gauge in order to be as compatible with as much railway infrastructure as possible. If the machine is built to W6a gauge, (as set out in GE/RT8073), it is able to be declared as compliant with W6a and is then usable on the majority of Network Rail managed infrastructure. The check for compatibility of the size of the machine to the infrastructure will always need to be made, irrespective of the size of the machine.

---

**Figure 7** Plant gauge
5.2.1.3 The Plant gauge shown in Figure 7 is a load gauge, that is to say, the machine can be built to it but it assumes a conventional machine suspension. If the machine has greater suspension movement than typical, then this has to be taken into account. GE/RT8073 Appendix A sets out the maximum dynamic movement assumed for the W6a gauge.

5.2.1.4 When a machine is built to other than Plant gauge, except for the agreed exceedance set out in 5.2.1.6, details of all exceedances from Plant gauge shall be detailed in the instruction handbook, (as set out in 10.1.3.3.), and a statement included on the ECC 'Exceeds Plant gauge'. For machines first certificated before December 2015, a statement of compatibility with W6a gauge is acceptable.

5.2.1.5 The manufacturer shall provide a diagram or illustration clearly defining the stowed position of the components on the machine in travelling mode. This diagram shall be included in the instruction handbook (as set out in 10.1.3.2 e)).

5.2.1.6 For OTP, when using Plant gauge and where there is no conductor rail, exceedances are permitted for rubber road wheel tyres, providing they do not protrude beyond a vertical plane greater than a maximum of 705 mm outside the running edge of the rail up to a height of 1 m above rail level. When using Plant gauge and where clearance is required over routes equipped with conductor rails, then the extreme dimension over the road wheels / tyres shall not protrude beyond a vertical plane greater than 210 mm outside the running edge of the rail, unless the lowest points of the wheels are at least 152 mm higher than the running rail, in which case the dimension may be increased to 705 mm. It shall be shown on the ECC, and included in the instruction handbook (as set out in 10.1.3.4.), if the machine is outside Plant gauge. The equivalent maximum dimensions are applicable for machines quoted compliant with W6a.

Figure 8  Plant gauge showing areas of exceedance permitted for some OTP
Figure 8 shows the detail drawing of the lower part of the Plant gauge profile. The bottom left-hand side of Figure 8 shows the exceedance allowed from Plant gauge in a third or fourth rail area. The bottom right-hand side gives the exceedance allowed from the Plant gauge if the machine is to be excluded from use in third or fourth rail areas.

The clearance of 114 mm shown in Plant gauge in the ‘four foot’, between the machine wheels, is considered to be the minimum acceptable throughout the life of the machine and needs to take account of worn wheels and loaded suspension etc.

5.2.1.7 Only rubber tyres shall be permitted to encroach into the area reserved for infrastructure equipment shown in Figure 9.

5.2.1.8 The manufacturer shall make an assessment of the load exerted by the rubber tyre on any item of infrastructure located in the hatched area shown in Figure 9. The predicted load shall be shown on the ECC and included in the instruction handbook (as set out in 10.1.3.5).

5.2.1.9 Where the rubber tyre encroaches into the area reserved for infrastructure equipment shown in Figure 9 (including parts of rubber road wheel tyres) the ECC, and the instruction handbook (as set out in 10.1.1.3 j)), shall:

a) State the exceedance in both vertical and horizontal plane.

And

b) State ‘This has the potential to strike some platforms and underbridge girders. A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use’.

5.2.1.10 Where any part of the machine is below rail head level (including parts of rubber road wheel tyres) the ECC, and the instruction handbook (as set out in 10.1.1.3 k)), shall:

a) State the exceedance below rail head level.

And

b) State ‘A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use’.
The assessment for the potential to damage the infrastructure equipment by non-metallic components on the machine, (in most cases this will mean the road wheel rubber tyres), needs to also include the deformation that will occur if the rubber tyre is in contact with the top of the rail, that is to say, it is probable that the rubber tyre will deform and actually be below rail head level.

The stiffness of the rubber used for a road wheel tyre is a compromise between the need to minimise the incursion below rail level and the ability of the machine to negotiate raised check rails and guard rails, and the braking and traction ability of type 9C machines.

When the machine is in travelling mode, any movable equipment which has the capacity to go outside the gauge shall be capable of being stowed in a manner which prevents inadvertent or unintended movement out of the gauge.

Stowed, means that a component cannot accidentally move; it is considered that in most cases this requires that the component be locked into its stowed position while the machine is in travelling mode. Controls for components that are able to move out of gauge need to be capable of being disabled when in travelling mode.

In order to allow the machine to work in rail and non-rail mode all assemblies forming part of the machine that are unpacked shall, in their stowed state, be secured by devices capable of resisting the foreseeable forces encountered during travelling. Such devices shall not rely upon a power source to retain the locking function. There shall be an indication that the system is locked.

The locking device shall not rely on any powered source. Any component which is held within gauge by trapped hydraulic pressure / lock shall be held in place by devices such as pins, chains or failsafe powered check valves.
The requirement is that nothing comes out of the stated machine profile unintentionally. There need to be devices in place to prevent movement, in the event of accidental operation of the controls of moveable parts, when the machine is in travelling mode. These devices may consist of automatic interlocks with travel controls, isolation of the controls, or physical restraint of the component strong enough to withstand the operating mechanism (and any other likely force such as gravity or centrifugal force). In the case of hydraulic excavators, it is recommended that once the operator has placed the machine into the configuration for travelling mode, the relevant controls then need to be isolated / inhibited to prevent inadvertent movement out of gauge.

If a machine is transported to the railway in pieces, which are then put together to form the machine, for example, a crane jib brought to site separately from the crane, then all such components are covered by this requirement to prevent their inadvertent movement after they are fixed in place.

The indication that the system is locked can take the form of any externally visible mechanical device (bolts, brackets etc) or indicator (electrical or mechanical). The indicator can be at the location of the locking device or in a remote control position. Consideration needs to be given to making the indication failsafe (for example, lamp illuminated when locked).

Where a machine does not have a travelling mode this shall be clearly stated as a restriction on the ECC, included in the instruction handbook (as set out in 10.1.2.4) and shown on the data panels, where fitted (see Appendix C).

The manufacturer shall provide a diagram of the machine in travelling mode. The manufacturer shall additionally provide all appropriate instructions for setting and maintaining the machine in the travelling mode configuration. The manufacturer shall include all appropriate information and diagrams in the instruction handbook (as set out in 10.1.3.2 b) iv)).

5.2.2 Working mode gauge

If the possible movement of the machine in working mode exceeds the travelling mode gauge, then the extent by which the gauge is exceeded shall be shown on the ECC and included in the instruction handbook (as set out in 10.1.3.6), and the certificate shall be endorsed ‘This machine may be used with adjacent lines open to traffic, only if a safe system of work has been adopted to take account of the extra gauge exceedance caused by attachments’.

The radius of the swept area of the tail of an item of OTP shall be shown, as a distance measured from the running edge of the rail on which the machine is standing, on the ECC, and included in the instruction handbook (as set out in 10.1.3.1 o)). Where the machine tail / counterweight does not exceed the machine’s own Plant gauge profile, this shall be displayed on the data panel of the machine as ‘zero tail swing’.

For machines that are capable of working with attachments, the ECC, and the use of Plant safety plan (as set out in 10.1.5.3), shall be endorsed ‘If adjacent lines are open to traffic, this machine shall be used only if a safe system of work has been adopted to take account of the extra gauge exceedance caused by attachments’.

Machines for use with an adjacent line open to traffic shall be fitted with lateral movement limiting devices, as set out in 5.8, to prevent the inadvertent or unintended intrusion by any part or component of the machine into the kinematic envelope of the adjacent line.
5.2.2.5 The inadvertent or unintended vertical intrusion by any part or component of the machine above the top of the machine gauge shall be controlled by means of height limiting devices, as set out in 5.8. This clause does not apply to mobile elevating work platforms (MEWPs).

G 5.2.2.5.1 Where a machine is designed always to work above gauge height (for example a piling rig) then a height limiting device is not mandated.

G 5.2.2.5.2 It is recommended that the manufacturer provides a diagram or illustration clearly showing the working mode envelope.

5.3 Track condition

5.3.1 The following track conditions shall be used for all assessments required by this document:

a) Plain track, both jointed and continuous welded rail.

b) 200 mm cant.

c) 50 m radius curve (for calculation) and 80 m (if physical test required).

d) 1 in 25 (40\%/00) gradient.

e) Switches and crossings.

f) Raised check rails and guard rails as shown in Figure 10.

g) Track twist, as set out in Appendix A.

![Image of track conditions]

**Figure 10** Worst case position of raised check and guard rails

G 5.3.1.1 The track conditions shown are for general design purposes. Machines for use in particular locations could be more onerous, (for example Ealing Common depot has 46 m curves). The infrastructure manager will be able to provide information for any particular location.

G 5.3.1.2 The actual track condition found on British infrastructure is potentially more onerous than those shown due to transient discrete faults at any particular time. The machine design tolerances set out in this document will give the necessary design allowance for these anomalies.
G 5.3.1.3 The dimensions shown are for general design purposes and are based on track that is in a condition suitable for the operation of service trains. Machines which are intended for use on track that is undergoing construction, renewal or other significant maintenance may need additional features and allowances to enable safe operation.

G 5.3.1.4 The minimum radius curve shown is for design purposes; the actual capability is set out in 5.6.1.

5.3.2 OTP shall be stable on all cants and gradients, as set out in 5.3.1, in working mode by design or controlled by engineering means.

5.4 Machine speeds

5.4.1 The maximum speed of machines shall be shown on the ECC and included in the instruction handbook (as set out in 10.1.3.1 c)). Excluding trailers and trolleys, the speed on-rail shall be controlled or indicated by:

a) Engineering means to suit the particular maximum permitted machine speed.

Or

b) A speedometer.

Or

c) An audible and visual warning given to the operator whenever the maximum permitted speed is being exceeded.

G 5.4.1.1 The maximum speed is either the maximum permitted speed in travelling mode on rail, or the maximum achievable speed if this is less than maximum permitted speed. The preference is for the machine to be incapable of exceeding its maximum permitted speed.

G 5.4.1.2 The maximum speed as shown on the ECC, and included in the instruction handbook (as set out in 10.1.3.1 c)), is the speed at which the machine is tested in accordance with 5.6.

G 5.4.1.3 The limitation or indication of speed needs to be automatically applied in rail mode and not capable of isolation by the operator.

5.4.2 Pedestrian controlled powered machines shall be limited to 3 mph (5 km/h).

5.4.3 The machine shall be tested, in accordance with 5.6, at the maximum speed as shown on the ECC and included in the instruction handbook (as set out in 10.1.3.1 c)).

5.4.4 A notice shall be permanently displayed at the driving position, stating the maximum permitted travelling speeds of the machine on both plain track and over switches and crossings; for forward and reverse directions, if different. The notice shall be visible from the driving / operating position.

5.4.5 Machines with driving positions shall be fitted with a speedometer, capable of operation in either direction.

5.4.6 Where a speedometer is fitted it shall be capable of indicating the speed on rail in mph and km/h.
G 5.4.6.1 The display of mph and km/h does not necessarily have to be simultaneous (although this is permitted) but the actual requirement is that both have to be capable of being displayed.

5.4.7 The accuracy of the speedometer, or other option set out in 5.4.1, shall be $\pm 10/0\%$ in rail mode.

5.4.8 The speedometer shall always give a positive indication of speed irrespective of direction of travel and direction the driving cab is facing. The speedometer shall always work while the rail wheels are turning on the track.

G 5.4.8.1 The accuracy of the speedometer should be demonstrated at maximum travelling speed, maximum working speed, and any other limiting speed shown on the ECC and included in the instruction handbook (as set out in 10.1.3.1 c)).

G 5.4.8.2 For a machine with maximum speed below 20 mph (32 km/h), the manufacturer is encouraged to state the maximum speed available in each gear and display this at the driving position.

5.4.9 The maximum travelling and working speeds shall be displayed on the data panels, where fitted (see Appendix C).

5.5 Wheel loadings

5.5.1 Rail wheel loading

5.5.1.1 Where any axle load is less than 4 tonnes (wheel load of 2 tonnes), the machine cannot be expected to activate train-operated points. Such limitations shall be shown on the ECC and included in the instruction handbook, as set out in 10.1.2.2 d).

G 5.5.1.1.1 There needs to be a minimum of 2 tonnes per wheel to activate train-operated points reliably in either direction.
Table 1: Maximum permitted load on rail wheels

<table>
<thead>
<tr>
<th>Wheel diameter</th>
<th>Travelling mode load per rail wheel</th>
<th>Working mode load per rail wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No load control</td>
<td>With load control</td>
</tr>
<tr>
<td></td>
<td>Static</td>
<td>Rail with $\sigma_B = 880$ N/mm$^2$</td>
</tr>
<tr>
<td>(mm)</td>
<td>(t)</td>
<td>(t)</td>
</tr>
<tr>
<td>$\varnothing \geq 920$</td>
<td>11.25</td>
<td>24.8</td>
</tr>
<tr>
<td>920 $&gt;\varnothing \geq 840$</td>
<td>11.25</td>
<td>22.6</td>
</tr>
<tr>
<td>840 $&gt;\varnothing \geq 760$</td>
<td>10</td>
<td>20.5</td>
</tr>
<tr>
<td>760 $&gt;\varnothing \geq 680$</td>
<td>9.25</td>
<td>18.3</td>
</tr>
<tr>
<td>680 $&gt;\varnothing \geq 630$</td>
<td>8.5</td>
<td>17.0</td>
</tr>
<tr>
<td>630 $&gt;\varnothing \geq 550$</td>
<td>7.25</td>
<td>14.8</td>
</tr>
<tr>
<td>550 $&gt;\varnothing \geq 470$</td>
<td>6.25</td>
<td>12.7</td>
</tr>
<tr>
<td>470 $&gt;\varnothing \geq 390$</td>
<td>5.25</td>
<td>10.5</td>
</tr>
<tr>
<td>390 $&gt;\varnothing \geq 330$</td>
<td>4.75</td>
<td>8.9</td>
</tr>
<tr>
<td>330 $&gt;\varnothing \geq 270$</td>
<td>3.5</td>
<td>7.3</td>
</tr>
<tr>
<td>270 $&gt;\varnothing \geq 210$</td>
<td>1.5</td>
<td>5.7</td>
</tr>
<tr>
<td>210 $&gt;\varnothing \geq 130$</td>
<td>1</td>
<td>3.5</td>
</tr>
</tbody>
</table>

d = worn rail wheel diameter limit (mm)

$\sigma_B$ = minimum resistance of the rail to tensile failure (N/mm$^2$)

$^a$ corresponds to rails, for example, 60 E 1 (UIC 60), 54 E 1 (S54) (880 N/mm$^2$)

$^b$ corresponds to rails, for example, 49 E 1 (S49) (680 N/mm$^2$)

G 5.5.1.1.2 A Rated Capacity Indicator (RCI) used, as set out in Section 9.7, is a load control device for the purposes of this section.

5.5.2 Wheel load on rail in travelling mode

5.5.2.1 The maximum static load per wheel, or roller, in travelling mode is set out in Table 1, column 2. The value of each wheel load shall be taken with all consumables full, with the machine in its fully laden condition, (this does not include lift and carry duties for cranes), and includes the operator and the maximum number of passengers. The tests shall be carried out on flat level track.

5.5.3 Wheel load on rail in working mode – general

5.5.3.1 Except for machines designed to bend rails, the maximum load exerted on the rails by any single rail wheel, or roller, in working mode shall not exceed those set out in 5.5.4 or 5.5.5. Verification of the manufacturer's calculations shall be made by tests for the first in class on flat level track and in worst case track conditions.
5.5.3.2  Where the load values exceed those in Table 1 column 4 or 6, the ECC shall be endorsed ‘Not to work on light rail systems’; this shall also be included in the instruction handbook, as set out in 10.1.2.2 c).

G 5.5.3.2.1 Where the machine has a separate working mode configuration, the load of a wheel is permitted to be greater than in the travelling mode. The values are set out in columns 3 to 6 of Table 1. Columns 3 and 4 are for machines without load control. A load control device is something that limits the load on an individual wheel, either directly by load sensing or by controlling the overturning moment. Therefore those machines fitted with an RCI (see section 9.7) do have load control. The figures given in columns 4 and 6 are for light rail sections (commonly found on tram and metro systems). The figures set out in columns 3 and 5 are for standard mainline rail and these loads are not to be exceeded, except where deliberately designed to do so.

5.5.3.3  The results of the first in class tests shall be recorded. Subsequent identical machines of the same type shall be tested on flat level track (or other comparable conditions) with the most adverse loads to check the individual wheel loads are within 5% of the values of the first in class machine.

G 5.5.3.3.1 The maximum wheel loads in working mode in the most adverse conditions, (ie the worst case loading and worst case track conditions set out in 5.3.1), needs to be calculated for the first in class machine. The calculations will then need to be verified by actual tests. The first in class machine needs to be tested on flat level track and then the tests repeated on each of the track conditions set out in 5.3.1, where necessary using a variety of load configurations to check the worst case scenario is used.

5.5.4  Wheel load on rail in working mode – machines without load control devices

5.5.4.1 In working mode, the maximum wheel loads \( Q_{\text{max}} \) of the rail wheels in relation to the diameter of the rail wheel and the rail material shall be calculated by the following equation:

\[
Q_{\text{max}} = 8.257 \times 10^{-7} \times \frac{d}{2} \left( \frac{\sigma_B}{v_{\text{head}}} \right)^2 \text{(kN)}
\]

where:

- \( v_{\text{head}} \) = 1.1
- \( d \) = worn rail wheel diameter limit (mm)
- \( \sigma_B \) = minimum resistance of the rail to tensile failure (N/mm\(^2\)).
5.5.5 Wheel load on rail in working mode – machines with load control devices

5.5.5.1 For machines on which the wheel loads of rail wheels are controlled in different work configurations by means of a device for limiting of overturning moment, which prevents the maximum value of the wheel load being exceeded, wheel loads shall be calculated by the following equation:

\[
Q_{\text{max}} = 10.52 \times 10^{-7} \times \frac{d}{2} \left( \frac{\sigma_B}{v_{\text{head}}} \right)^2 \text{(kN)}
\]

where:
- \( v_{\text{head}} = 1.1 \)
- \( d = \) worn rail wheel diameter limit (mm)
- \( \sigma_B = \) minimum resistance of the rail to tensile failure (N/mm²).

G 5.5.5.1.1 The maximum loads as a function of rail wheel diameter calculated for two common types of rail are set out in Table 1, columns 3 to 6.

G 5.5.5.1.2 Where a machine is intended to be used in unusual conditions, for example with different rail characteristics, the permissible wheel loads need to be specially calculated. For example, where the machine is designed to alter the sleeper spacing during its working mode this will need to be taken into account.

G 5.5.5.1.3 A manufacturer should consider the need to limit the nominal wheel load, in order to account for increases of wheel load encountered in operation such as:

- a) Specific activities (for example ballast ploughing).
- b) Swinging loads.
- c) The use of lifting accessories.
- d) Asymmetrical loading.

5.5.6 Wheel load and axle spacing

5.5.6.1 For machines in travelling mode with an axle load greater than 12 tonnes, the axle spacing shall be stated and a route availability (RA) and reduced railway light loading (RL) loading calculated for the intended use of the vehicle, as set out in GE/RT8006 and S1051. The RA and RL values shall be stated in the instruction handbook, as set out in 10.1.3.10, and shown on the ECC.

G 5.5.6.1.1 The use of machines in working mode will need to consider the wheel loads applied as a result of work. More information is given in M&EE COP0011.
5.6 Dynamic stability

5.6.1 Travelling mode

5.6.1.1 Except as set out in 5.6.1.2 or 5.6.1.3 a machine shall be capable of travelling at its maximum speed, as shown on the ECC and included in the instruction handbook, (as set out in 10.1.3.1 c)), in both unladen and fully laden condition, (this may include lift and travel duties but does not include working mode lift and carry duties), on the track conditions set out in 5.3.1.

G 5.6.1.1 The movement of OTP from the on tracking point to the work site, with attachments or a load secured in the bucket etc, can be considered as ‘lift and travel’ and be carried out at travelling mode speed. This is valid only if the machine and load are within loading gauge, components stowed and load secured while travelling. Where a machine has a stated ‘lift and travel’ capability, the loads imposed need to be taken into account when assessing the dynamic ride characteristics.

5.6.1.2 When a machine cannot be operated in travelling mode at maximum speed on switches and crossings or over raised check or guard rails, it shall have a speed or use restriction, which shall be shown on the ECC, included in the instruction handbook (as set out in 10.1.2.2 e)) and prominently displayed in the driving cab in travelling mode and on the outside of the machine on the data panels, where fitted (see Appendix C).

5.6.1.3 When a machine cannot be used in travelling mode on all specified track conditions, any limitations shall be shown on the ECC and included in the instruction handbook (as set out in 10.1.2.2 e)).

5.6.1.4 The minimum radius curve on which the machine is capable of travelling shall be displayed at the driving position, included in the instruction handbook (as set out in 10.1.3.1 b)) and displayed on the outside of the machine on the data panels, where fitted (see Appendix C).

5.6.2 Working mode

5.6.2.1 Except as set out in 5.6.2.2 a machine shall be capable of performing all working mode functional requirements (excluding on and off tracking) in unladen and all laden conditions on the track conditions set out in 5.3.1.

5.6.2.2 When a machine cannot be used in working mode under the most restrictive conditions, the limitations shall be shown on the ECC and included in the instruction handbook (as set out in 10.1.2.2 f)).

5.6.2.3 The maximum rail cant, gradient and minimum radius curve on which the machine is capable of working shall be displayed at the working position, shown on the ECC, included in the instruction handbook (as set out in 10.1.3.1 d)) and displayed on the data panels, where fitted (see Appendix C).

G 5.6.2.3.1 It is likely that some of these requirements can be demonstrated by stationary tests. Where a machine is permitted to move along the track in working mode, for example lift and carry duty for a crane, this will need to be demonstrated by additional dynamic testing. For dynamic testing, the track twist is a 20 mm dip, triangular in shape and a semi-span of 6 m (the form of the dip being the same as set out in Appendix A).

G 5.6.2.3.2 Consideration needs also to be given to the increased risk of derailment due to offloading of the rail wheel during excavations.
5.6.3 Testing for derailment of machines with maximum speed ≤ 37 mph (60 km/h)

5.6.3.1 Except as set out in 5.6.3.5 for machines limited to travelling at speeds up to and not exceeding 37 mph (60 km/h), the first in class machine shall have static ΔQ/Q tests undertaken in normal condition (nominal value) and in the most adversely loaded condition in both the travelling mode and working mode when moving along the track. Except as set out in 5.6.3.2, testing shall demonstrate that the vertical load on any rail wheel is not reduced by more than 50% (or 60% for bogie machines) from its nominal value.

G 5.6.3.1.1 The track conditions set out in 5.3.1 are simulated by vertically raising and / or lowering wheels of the static machine, as necessary. The loads on all rail wheels need to be monitored simultaneously. The worst case combination of track conditions should be simulated.

G 5.6.3.1.2 The value of Q is taken with the machine on flat level track; the change (ΔQ) is taken with the track condition in most adverse combination. The value of Q and hence ΔQ will vary depending on load and whether in travelling or working modes, and hence sufficient tests should be carried out to check the machine is compliant in all conditions. These tests should include (as applicable):

a) Unladen in travelling mode(s).
b) Fully laden in travelling mode(s).
c) Unladen in working mode, (where this has the ability to move along the track).
d) Where a machine has the ability to move along the track in working mode, has the capability to be loaded and is not fitted with an RCI, then tests should be carried out to check sufficient combinations have been measured to cater for each eventuality.

5.6.3.2 Where the vertical load, as set out in 5.6.3.1, on any rail wheel is reduced by more than 50% (or 60% for bogie machines) of its measured value prior to simulating movement, when in travelling or in working mode, there shall be an appropriate technical justification.

G 5.6.3.2.1 The technical justification should consider, as a minimum, the following aspects to check safety and safe interworking:

a) Degree of unloading.
b) Potential for flange climbing.
c) Permitted and actual speed range of the machine on-rail.
d) Dynamic forces experienced during travelling or when working.
e) Condition of track over which the machine will work (cant and track twist etc).
f) Risk of overturning.
g) Working loads.
h) Method of working.
The technical justification should include actual test results, where necessary, to demonstrate the wheel unloading is acceptable. For example, the propensity for flange climbing should be accompanied by actual side forces produced by the machine (Y force).

5.6.3.3 After the static $\Delta Q/Q$ tests set out in 5.6.3.1 and 5.6.3.2 have been successfully undertaken, the first in class of machine of a design not previously certificated, shall have actual track tests undertaken in the most adversely loaded condition in both the travelling mode and working mode when moving along the track at its maximum speed. These tests shall be deemed to be successful if the suspension is not detrimentally excited by a representative range of track conditions.

G 5.6.3.3.1 The test track to be used should be agreed with the manufacturer or machine owner beforehand as part of the testing process. The test tracks at both Wyvern Rail at Wirksworth and the Rail Innovation Development Centre at Tuxford, have already proved acceptable for these tests. However, other test facilities may be appropriate if they cover a range of the track conditions set out in 5.3.1, including as a minimum:

a) Jointed track with dipped joints.

b) A range of track twists.

c) Switches and crossings.

d) Raised check rail and / or guard rail, as set out in 5.3.1 f).

5.6.3.4 When undergoing reassessment, the first in class of machine shall have actual track tests undertaken, as set out in 5.6.3.3, unless:

a) The machine has or had an ECC (or Engineering Acceptance Certificate).

And

b) The machine type can demonstrate at least five years working on a representative sample of track conditions without a history of derailment problems.

And

c) The machine has not had engineering modifications that are likely to affect the stability of the machine since the history of safe running.

5.6.3.5 For machines which have a three point suspension in travelling mode and which have the capability of accommodating an additional 15 mm cross level variation beyond that required by the combinations of track conditions set out in 5.3.1, it is permissible for the $\Delta Q/Q$ tests to be proven by calculation rather than actual testing.

5.6.4 Testing for derailment of machines with maximum speeds > 37 mph (60 km/h)

5.6.4.1 First in class machines shall follow the acceptance procedure according to BS EN 15746-1:2010 + A1:2011 clause 5.6.2.
The load, if any, on a machine can normally be assumed to be evenly distributed for the purposes of dynamic stability tests. However, attention should be given to types of loading that may alter the centre of gravity significantly. The machine should be assessed to the load parameters known at the time of engineering assessment.

The possibility that the load could vary as the machine moves along the track should also be assessed. For example, a dump truck could discharge its load while moving along the track.

The first in class machine should have the test or calculations set out in 5.6.4 carried out in travelling mode in tare and laden condition, as well as, where applicable, in working mode while moving along the track in the most adversely loaded condition. No such test is normally required for subsequent identical machines.

5.6.5 Machines with different suspension arrangements for static operation and movement along the track

5.6.5.1 If a machine's suspension characteristics are changed to facilitate travelling along the track, it shall not be possible to move along the track with the suspension in static mode.

Where the suspension can be locked while the machine is not moving along the track, or any way deliberately altered to change its configuration from that used while moving, then the machine should not be allowed to move along the track until the suspension is in the configuration used for moving along the track.

It shall not be possible to leave one suspension arrangement for another if this would cause the machine to be unstable. It shall not be possible to change suspension arrangement while the machine is travelling unless it is specifically designed to do so.

This is particularly important to lifting machines, where the load allowed on a hook is likely to be greater in static lifting than in lift and carry duty.

The manufacturer should consider the implications of this in an emergency stop situation, where suspension arrangements may be interlinked with the 'emergency' brake such as the parking brake, or in the application of a 'working' (digging) brake. Locking the suspension while the machine is moving along the track is not considered acceptable.

5.6.6 Machine limitations

Any limitations that need to be placed on the operation of the machine, to enable safety and safe interworking, shall be clearly shown on the ECC and included in the instruction handbook (as set out in 10.1.2.1).
It may be that a load to be carried can have an effect on the stability. For example, it could be that discharging a loose load (for example sand or ballast) is acceptable but a single load (for example block of concrete) could cause instability when discharged from a tipper. Where a machine is not fitted with an RCI and the centre of gravity of the machine changes adversely during the use of the machine, the method of loading or discharging which causes the situation should be included in the instruction handbook. The machine could also be fitted with a stability indicator with an appropriate audible / visual alarm system.

5.7 OTP rail mode brakes

5.7.1 General requirement

5.7.1.1 All OTP shall have a braking system compliant with 5.7.2, 5.7.3 and 5.7.4, as appropriate. As set out in 5.7.4 all service brakes shall be fitted with air transmission medium between machines. If additional transmission mediums are fitted, the transmission medium between the machines shall be non-polluting if leaked to atmosphere. An exception is permitted for hydraulic connections and systems where the design shall:

a) Not allow spillage during use (including connection and disconnection) except during an emergency breakaway of the trailing load.

And

b) Where the brake is released by hydraulic pressure, there shall be a means of eliminating residual trapped pressure (above atmospheric) within the trailing machine after the coupling is disconnected.

And

c) Preclude the collection of oil in vented storage vessels where the oil is not automatically returned to the towing machine.

When coupling and uncoupling brake connections between machines, there should be no leakage of a polluting medium to atmosphere; thus mechanical, electrical or pneumatic systems are preferred. Air operated systems have proved satisfactory for conventional rail machines.

The couplings deemed suitable for transmission of oil should be commercially available drip-free self-sealing couplings. Industry good practice currently is ‘Faster’ type VFB for parking brake connections.

The compatibility between systems and the need to display working pressures is set out in 5.20.2.10 and 7.2.1j).

Tanks freely vented to atmosphere are not considered sufficient to meet the requirement of preventing spillage.

5.7.2 A powered machine shall have either:

a) A minimum of two separate and independent braking systems (one of which may be the parking brake, provided this is operated from the driving / operating position) each compliant with 5.7.2 and 5.7.3, as appropriate.
b) A single braking system that can be demonstrated to be failsafe (that is to say, a system where no single point failure leads to vehicle failure to meet the brake performance set out in 5.7.2 and 5.7.3, as appropriate).

5.7.1.3 Type 9B machines shall be fitted with service brakes and failsafe parking brakes on all rail wheels, such that they are not dependent on the road wheel / rail wheel interface for all rail braking.

5.7.1.4 The braked rail wheels of OTP shall either have a male 1” square drive in the centre of each wheel accessible from the outside (for measurement of torque), or the design of machine shall permit the testing of brakes of individual wheels / wheelset. The manufacturer shall state in the instruction handbook (as set out in 10.1.3.7) the minimum torque figure acceptable.

The manufacturer should state the minimum torque figure derived from the absolute required to stop the machine, as set out in 5.7.2 (for the service brake) and / or for the parking brake to hold the machine (as set out in 5.7.5) with an allowance for degradation and wear between tests, such that the absolute figure is never reached.

The 1” square drive is preferable to be a permanent feature; however, the manufacturer is able to design adaptor plates, as necessary, to provide the 1” square drive. This requirement is for all braked rail wheels, including trailers.

5.7.1.5 The design shall take into consideration all reasonably foreseeable damage that might occur to the braking assembly. The design shall be such that the system is protected against accidental damage.

5.7.1.6 Machines shall be designed to have a direct rail wheel dynamic (service) braking system capable of providing a target deceleration of 12% g.

The requirement set out in 5.7.1.6 is for design calculations only. All machines should still be tested as set out in 5.7.2.

5.7.1.7 The operation of the rail wheel brakes (or the operation to achieve sufficient retardation to achieve the required stopping distance) from the normal road driving position, shall be from the same human interfaces as the road wheel brakes.

5.7.1.8 Each brake system shall be capable of holding the fully laden and unladen machine on a 1 in 25 (40/00) gradient in all on and off tracking operations.

5.7.1.9 A machine that has air brakes, or a towing machine with the capability to control air service brakes, shall not be able to drive until it has sufficient air to fully apply the brakes on itself and / or the maximum number of trailers it is designed for.

On conventional railway machines this is known as 'a traction interlock'.

5.7.2 Braking performance – ≤ 35 mph

5.7.2.1 A powered machine and a powered machine / trailer combination shall be capable of stopping the fully laden machine and any permitted trailing load, on level track, in dry conditions, as set out in Table 2.
5.7.2.2 The design of the braking system, and the specified maintenance regime, shall take into account that the stopping distances set out in Table 2 are to be complied with at all times during the life of the machine.

5.7.2.3 The stopping distances shall be measured from the point of operation of the brake controls to the final stopping point.

<table>
<thead>
<tr>
<th>Machine speed (mph)</th>
<th>Maximum stopping distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤4</td>
<td>(6)</td>
</tr>
<tr>
<td>5</td>
<td>(8)</td>
</tr>
<tr>
<td>10</td>
<td>(16)</td>
</tr>
<tr>
<td>15</td>
<td>(24)</td>
</tr>
<tr>
<td>20</td>
<td>(32)</td>
</tr>
<tr>
<td>25</td>
<td>(40)</td>
</tr>
<tr>
<td>30</td>
<td>(48)</td>
</tr>
<tr>
<td>35</td>
<td>(56)</td>
</tr>
</tbody>
</table>

Table 2  Machine stopping distances for speeds ≤ 35 mph

5.7.3 Braking performance – machine with maximum speed > 35 mph (56 km/h)

5.7.3.1 The requirements for the minimum braking performance of either a single machine or machine and trailing / propelling load combination that travels above a speed of 35 mph (56 km/h) shall meet the minimum braking requirements defined by curve B1 of Figure 1 shown in GM/RT2042. The braking performance for 35 mph (56 km/h) and below shall comply with 5.7.2 of this document.

5.7.3.2 There shall be no step change in the machine brake performance while complying with the requirements of GM/RT2042 for speeds > 35 mph and this document for speeds ≤ 35 mph.

5.7.4 Braking requirement for machine and trailer combinations

5.7.4.1 Except as set out in 5.7.4.2 and 5.7.4.3, machines that are designed to tow trailers on rail shall be fitted with a braking system capable of controlling the air service brake on the trailers.

5.7.4.2 Machines less than 400 kg GVW are permitted to have an electric service brake where control on the towing machine simultaneously applies a brake on the towing machine and each trailer.
5.7.4.3 It is permissible not to fit a braking system capable of controlling the air service brake on trailers for towing machines that are designed only to couple to attachments meeting the requirements set out in 7.2.1 o).

G 5.7.4.3.1 It is permissible to manufacture machines with additional braking systems to that set out in 5.7.4.1 to be compatible with existing systems. However, such equipment (except as set out in 5.7.4.2 and 5.7.4.3) will be prohibited from 1 January 2017 and all additional braking equipment will have to be removed.

G 5.7.4.3.2 Towing machines should be capable of coupling together with trailers (which require service brakes, as set out in 7.2.1 d) with the service brake on all machines controlled by the operator.

G 5.7.4.3.3 Consideration should be given in the design process to check, as far as reasonably practicable, that machines cannot be coupled to other machines if this would lead to unsafe or incompatible braking.

5.7.4.4 Except for machines specifically designed for towing UIC air braked machines (as set out in 5.7.4.6), the connections shall be as set out in Appendix H.

5.7.4.5 Except for brakes, as set out in 5.7.4.7, the service brake system of the towing machine shall simultaneously control the service brakes on all towed machines. The parking brake system shall operate simultaneously on all towing and towed machines.

5.7.4.6 For machines fitted with UIC air brakes compatible with mainline trains, it is permissible for the controller in the towing machine to apply only the trailer brakes.

5.7.4.7 The manufacturer shall state in the instruction handbook (as set out in 10.1.3.1 p)), and shown on the ECC, the maximum number of trailing machines permitted so that:

a) The brake propagation allows the machine / trailers combination to meet the stopping distance requirements.

And

b) The system has sufficient capacity to permit a minimum of three consecutive full applications of the brakes with the engine at idling speed and that the brakes apply on all machines.

5.7.4.8 If there is insufficient air in the service brake system to apply the brakes, the trailer breakaway brake shall automatically apply and a warning shall be given to the operator.

5.7.5 Parking brake

5.7.5.1 A parking brake shall be fitted and be capable of holding any permitted combination of the fully laden or unladen machine and any trailing load, on a 1 in 25 (40%) gradient.

G 5.7.5.1.1 If the parking brake of the trailing load cannot be applied from the driving cab of the towing machine, then the brakes which can be applied from the driving cab should hold the machine and trailer on a 1 in 25 (40%) gradient while the operator leaves the driving cab to apply the parking brake of the trailing load. This should apply for the worst case combination of towing machine being in any loaded state and fully laden trailers (including assessment of worst case for load on hook in lift and carry duty).
A trailer or attachment that is designed such that it cannot move when not attached to a towing machine is deemed to meet the requirements set out in 5.7.5.1.

The parking brake control shall either be available from inside the machine, or available from both sides.

If the parking brake is of a screw design, the operator shall not need to exert a force greater than 500 N at the hand wheel or hand crank in order to apply the brake. The brake shall be applied by a clockwise movement of the control.

The same force should be used for lever type applications.

The manufacturer shall supply the minimum force figure required to pull the machine along flat level dry track with the parking brake applied in rail mode. The force required to commence movement shall be derived from the absolute required for the parking brake to hold the machine on a 1 in 25 (40/00) gradient with an allowance for degradation and wear between maintenance tests such that the absolute force figure is never reached. This force shall be recorded in the instruction handbook (see 10.1.3.7). Alternatively, where a wheel fitted with a parking brake has a 1” square drive, the torque figure for the parking brake is permitted to be declared.

Acceptance testing

The braking performance of the first in class machine shall be tested to verify compliance with this document. Each service brake system set out in 5.7.1.2 shall be tested in both forward and reverse directions at a minimum of three incremental speeds that shall include a minimum speed of 3 mph (5 km/h) and the maximum permitted speed for the machine. Where the maximum speed is greater than 20 mph (32 km/h), additional tests are required at approximately 10 mph (16 km/h) increments. Each service brake system shall be tested under the following conditions:

a) Machine only, in tare and fully laden conditions.

b) Machine in tare condition and maximum permitted trailing load.

c) Machine in fully laden condition and maximum permitted trailing load.

d) Machine in fully laden condition and the trailers in their tare condition.

Brake testing should be carried out using the methodology set out in section 2 of M&EE COP0025.

It is possible with some designs of braking system for the brakes to be affected by the change in load on the trailer. Consideration should be given to testing the brakes due to the loading and unloading of a trailer.

The test set out in 5.7.6.1d) is required to check that the unladen trailer is not over braked but compliant with the permitted stopping distance.
5.7.6.2 Except as set out in 5.7.6.3, subsequent identical machines to the first in class shall be tested at 3 mph (5 km/h), 10 mph (16 km/h) and the maximum permitted speed(s) for the machine in fully laden condition. The test result shall not be worse than 10% of the test results on the first in class set out in 5.7.6.1 a), providing this does not exceed the stopping distance set out in Table 2. The results of tests, as set out in 5.7.6.1, and the results of the tests in this clause shall be included in the instruction handbook (as set out in 10.1.3.8). The results shall state the control medium that was used in the test.

G 5.7.6.2.1 The requirements set out in 5.7.6.2 mean that testing is performed at the maximum permitted speed of the machine on its own and also at the maximum permitted speed of the machine trailer combination (which could be less than the maximum speeds of the individual machines).

G 5.7.6.2.2 These tests should be carried out for both brake systems if the option in 5.7.1.2 a) for two separate systems is used.

5.7.6.3 It is permissible to test subsequent identical trailers to the first in class trailer by resistance to movement by pull tests; the results achieved shall be the same or better than those of the first in class trailer for each independent braking system. A certificate shall be issued to demonstrate these tests have been carried out.

G 5.7.6.3.1 A certificate that can be used to satisfy 5.7.6.3 is shown in M&EE COP0014.

5.7.6.4 The machine trailer combination shall be type tested to demonstrate the effectiveness of the breakaway system, as set out in 5.20.2.7, to apply the brakes and bring all machines to a stand, in a failsafe manner, within the stopping distance set out in Table 2. There shall be a minimum of three separate tests undertaken to check that the brakes apply on the trailer successfully on each occasion.

G 5.7.6.4.1 These mandatory tests are for the first in class machine. There should be an indication to the operator that the breakaway has occurred, and this indication should be a failsafe system, as set out in 5.20.2.7.

G 5.7.6.4.2 Consideration should be given to testing combinations of loaded and unloaded trailers breaking away together. If the brakes do not apply on both trailers, testing needs to prove that the unloaded trailer is able to stop both itself and the loaded trailer.

G 5.7.6.4.3 It is preferable for the machines to be operable after the breakaway system has operated. However, it is permissible for individual components to be of a destructive design, providing the destruction takes place without risk to personnel. For hydraulic connections between machines, industry best practice has shown that a 90° elbow is normally required on the headstock (that is to say, the end of the trailer where the connection hoses are fitted) of a trailer.

5.7.6.5 To test the parking brake in rail mode, either the parking brake should be applied on flat level dry track and attempt to pull the machine along the track and check that the force derived in 5.7.5.4 is exceeded, or the machine placed on a slope at or exceeding 1 in 25 (400/00) and check that no movement occurs.
5.8 Movement limiting devices

5.8.1 General

5.8.1.1 Where required, movement limiting devices shall protect against any inadvertent exceedance of lateral and vertical limits of work. The manufacturer shall record in the instruction handbook (as set out in 10.1.3.9) and on the ECC (as shown in Appendix G if there are:

a) No movement limiting devices fitted.
b) Movement limiting devices fitted that are low performance.
c) Movement limiting devices that are high performance (see 5.8.2.2).

5.8.1.2 Where movement limiting devices are fitted, they shall be controlled with a key switch, or equivalent secure system, to prevent inadvertent overriding once initiated. Where used, the key switch shall be designed such that the key is removable when the movement limiting device is engaged.

5.8.1.3 The purpose and any limitations of the movement limiting devices shall be detailed on the ECC and included in the instruction handbook, as set out in 10.1.1.2 g).

5.8.2 Design of movement limiting devices

5.8.2.1 Movement limiting devices shall either permit the lateral and vertical limits to be variable or have one or more pre-set positions. Pre-set positions shall be shown as a limitation on the ECC and included in the instruction handbook, as set out in 10.1.1.2 h).

5.8.2.2 High performance movement limiting devices shall comply with the requirements set out in 5.11.6 and 5.8.3.

5.8.2.3 Movement limiting devices shall stop the movement when lateral and vertical limits are reached.

5.8.2.4 The movement limiting devices shall prevent movement commencing in an unsafe direction if the machine is stopped at its limit. The prevention of movement beyond the limit shall include when the machine is without power.

G 5.8.2.4.1 The requirement is that the limiting device stops the actual movement of the machine, including any inertia. The need is for any control system to not only request movement ceases but to actually prevent the machine encroaching the set limit.

G 5.8.2.4.2 Where the machine is intended for use with an adjacent line open to traffic movement, limiting devices are required by 5.2.2.4 and 5.2.2.5 in working mode. The design should also include the requirements set out in 5.8.3, 5.8.4 and 5.8.5, as appropriate.
5.8.2.5 Movement limiting devices shall be capable of resisting the foreseeable forces encountered as a result of their use. This includes proceeding beyond the selected limit point due to speed of approach.

G 5.8.2.5.1 These devices should be capable of resisting static forces (start-up force of the motion) where they are in the form of a lock, and dynamic forces where they are in the form of a stop.

5.8.2.6 The manufacturer shall design movement limiting devices so that, as far as reasonably practicable, the devices cannot be disabled by either simple wiring disconnections or tampering with sensors / limit switches or other mechanisms.

5.8.3 High performance movement limiting device

5.8.3.1 High performance movement limiting devices shall be designed so that there is no credible single point failure that would cause the system to fail to an unsafe condition. Electronically controlled and combinations of mechanical and electrical / electronic movement limiting devices shall comply with this clause as a system.

G 5.8.3.1.1 Where the movement limiting device system incorporates a control system supplied as a subsystem from a third party, the subsystem supplier should be included in the validation of the installation.

G 5.8.3.1.2 A common example of the motion described is slewing of an excavator upper structure. In that case the upper structure should be controlled so that when it enters the region described, slew speed is reduced as quickly as vehicle design allows to a value that ensures linear speed at the end of the boom at its current radius does not exceed 1 m/s.

5.8.3.2 Movement of structures towards the limit shall not exceed 2 m/s, for rotation of structures about a vertical axis; this includes the linear speed at any point on the rotating structure towards the limit.

G 5.8.3.2.1 It is permissible for the movement speed to be derestricted when the high performance movement limiting device is not in use.

5.8.3.3 The linear speed of a moving structure shall be limited to not exceed 1 m/s when any part of the moving structure moves beyond the stated machine gauge towards the limit.

G 5.8.3.3.1 It is permissible for linear speed to begin to reduce to 1 m/s as the structure enters the region set out in 5.8.3.3, so long as the reduction in speed takes place as quickly as vehicle design permits and normally at a target rate of 0.5 m/s².
G 5.8.3.3.2 A common example of the motion described is slewing of an excavator upper structure. In that case the upper structure should be controlled so that when it enters the region described, slew speed is reduced as quickly as vehicle design allows to a value that ensures linear speed at the end of the boom at its current radius does not exceed 1 m/s.

5.8.3.4 The movement limiting device shall be designed so that a failure of any component or system relating to speed management will cause the system to revert to the slower speed.

5.8.3.5 Mechanical movement limiting devices shall be designed so that it and no part of the machine will fail under fatigue loading for the foreseeable life of the machine as a result of the foreseeable loads imparted by the limiting device.

G 5.8.3.5.1 For fatigue calculations it may be assumed that ‘life’ is $1 \times 10^7$ cycles.

5.8.3.6 Lateral mechanical movement limiting devices shall be designed with a minimum safety factor of 5 calculated against the yield stress for all component parts and the complete assembly, for the worst case dynamic load.

5.8.3.7 Vertical mechanical limiting devices shall be designed with a minimum safety factor of 3 calculated against the yield stress for all component parts and the complete assembly, for the worst case dynamic load.

5.8.3.8 Electronically controlled movement limiting devices shall be designed so that any combination of events that lead to any part of the machine encroaching past the pre-set limit will not prevent the vehicle returning to within the pre-set limit.

5.8.4 High performance movement limiting devices – demonstration of compliance

5.8.4.1 For machines with a high performance movement limiting device fitted, the manufacturer shall physically demonstrate that the machine will prevent encroachment beyond the stop limit by using the maximum permitted load on the most adverse cant and gradient.

5.8.4.2 The manufacturer shall describe the maintenance necessary to retain the performance set out in 5.8.4.1.

5.8.5 Movement limiting devices – manually overriding the limit

5.8.5.1 Where a manual override is fitted, it shall meet the requirements of BS EN 15746-1:2010 + A1:2011 clause 5.2.3.2.2.5. The operation of any override shall be recorded on the data logger.

5.8.5.2 This manual override shall be independent of the operating control set out in 5.8.1.2.

5.8.6 Lateral limiting devices

5.8.6.1 Lateral limiting devices, as set out in 5.2.2.4, shall be continuously adjustable or adjustable in pre-set positions. Any non-mechanical lateral movement limiting device provided on the machine shall be failsafe under all operating conditions or be part of a system with an overall sufficient performance level, as set out in Table 3. Mechanical movement limiting devices shall be designed for a minimum factor of safety (FOS) of 5 and be type tested under worst case conditions of speed, load and adverse inclination of machine.

G 5.8.6.1.1 It is preferable that the lateral limit is infinitely adjustable to any dimension (thereby allowing the machine to be used to its maximum in any location); however, the only absolute requirement is that any limiter prevents the movement from going into the kinematic envelope of any vehicle on adjacent track on which movements take place.
The assessment of mechanical movement limiting devices relies on a number of assumptions that need to be made about the design. Calculation of inertial load for slew stops needs to account for the deceleration of the machine and load; the industry norm for deceleration time from contact to complete stop is 0.2 s.

5.8.6.2 Where the lateral limiting device is infinitely variable, there shall be a key switch to lock the lateral limit device in any position.

5.8.7 **Height limiting device**

5.8.7.1 The height at which the vertical limiting device is set shall be indicated visually to the operator.

5.8.7.2 Where an electrical height limiting device is provided for use under live OLE, it shall be set as default to the ‘ON’ position at a height limit of 3500 mm above rail head and, where adjustable, shall require a deliberate action (recorded on the data logger as a defined height) to move away from this default setting and any subsequent changes.

The indicated height is the maximum height of any part of the machine above rail level when in rail mode, noting that this is not the height above ground level when in road mode.

Where the height limit is variable, the actual figure should be displayed at the locking / operating position. Where the height is limited by a mechanical device such as a pin, the height set should be displayed adjacent to the locking position or at the operating position or both positions.

The height limiting device should be tested at the maximum operating speed to ensure it does not exceed the set limit.

5.9 **Personnel areas (where fitted)**

5.9.1 **Travelling mode**

5.9.1.1 The track and signals in the forward direction shall be visible from the driving position by direct line of sight when travelling. If such visibility is not achievable in reverse direction because of the physical design of the machine, then:

a) Space shall be provided for an assistant (provided with separate controls at that position to stop the movement of the machine, as set out in 5.7.2 or 5.7.3, as appropriate, and sound a warning, as set out in 5.15.2), where there is sufficient visibility, by direct line of sight, to be able to stop clear of any track obstruction or stop signal.

Or

b) Closed circuit television (CCTV) shall be provided at the driving position, meeting the requirements of Appendix M. The CCTV shall have a field of view both in the immediate vicinity of the rear of the machine and into the distance along the track sufficient to be able to stop clear of any track obstruction or stop signal when moving along the track at maximum travelling speed. The camera / screen shall provide a true rendition of the scene and be capable of distinguishing between white, red, yellow and green lights in all lighting conditions.

Or

c) Ground staff shall control reverse movements in conjunction with the operator.
5.9.1.2 In cases a), b) or c), the limitation shall be shown on the ECC and included in the instruction handbook, as set out in 10.1.2.5.

G 5.9.1.2.1 The three options set out in 5.9.1.1 a) b) and c) are in order of preference, remembering that, ideally, the operator should have direct line of sight as the preferred option.

G 5.9.1.2.2 Boom type MEWPs should be driven normally with the work platform at the leading end of the movement, wherever possible. Boom type MEWPs when being driven with the work platform stowed and trailing are considered to be reversing, and therefore the options in 5.9.1.1 a) to c) are applicable.

G 5.9.1.2.3 A way of always achieving vision in the forward direction is to have a turntable to enable the machine to be turned. The design of the turntable is set out in 5.19.2.

G 5.9.1.2.4 The minimum direct line of sight distance should be the braking distance at maximum speed on dry flat level track.

G 5.9.1.2.5 The maximum travelling speed could be reduced as a result of using any of the three options. It is likely that the maximum speed for b) would be 10 mph (16 km/h) and c) would be 3 mph (5 km/h), although these are only possibilities as each system would be assessed on its own merits.

G 5.9.1.2.6 Consideration should be given for personnel-carrying trailers that could be propelled and hence obscure the operator’s view.

G 5.9.1.2.7 Where the visibility is provided by CCTV the position of the display screen should be dictated using ergonomic principles as part of the design review.

5.9.1.3 RRV excavators, or other machines that require to be turned to achieve suitable vision in the opposite direction, shall either be fitted with a CCTV system (as set out in 5.9.1.1 b)) or the ECC shall be endorsed with the requirement that ‘the machine is to proceed at walking speed and ground staff control the movement in reverse until the superstructure can be slewed to face direction of travel’ and included in the instruction handbook, as set out in 10.1.1.3 l).

G 5.9.1.3.1 The requirement for CCTV is to enable the RRV excavator to be moved in a reverse direction safely where the machine is prohibited from slewling the superstructure around to provide clear unobstructed lines of site and in the direction of travel and to check visibility along a potential blind side.

G 5.9.1.3.2 Consideration should also be given to the fitment of CCTV to other machines where the driving cab could be rotated away from the direction of travel, or other moveable parts could potentially obstruct vision along the track in the direction of travel.

5.9.2 Working mode

5.9.2.1 In working mode the operator shall have a clear view of the work being undertaken and:

a) Sufficient visibility in the direction of movement by direct line of sight to be able to stop clear of any track obstruction or stop signal when moving along the track at maximum working mode speed.

Or
b) Space shall be provided for an assistant (provided with separate controls at that position to stop the movement of the machine, as set out in 5.7.2 or 5.7.3, as appropriate, and sound a warning, as set out in 5.15.2), where there is sufficient visibility in the direction of movement, by direct line of sight, to be able to stop clear of any track obstruction or stop signal when moving along the track at maximum working mode speed.

Or

c) CCTV (meeting the requirements of Appendix M) shall be provided at the operating position with field of view both in the immediate vicinity of the rear of the machine and into the distance along the track sufficient to be able to stop clear of any track obstruction or stop signal when moving along the track at maximum working mode speed. The camera / screen shall provide a true rendition of the scene and be capable of distinguishing between white, red and green lights in all lighting conditions.

Or

d) Ground staff shall control movement along the track in conjunction with the operator.

5.9.2.2 In cases b), c) or d) the limitation shall be shown on the ECC and included in the instruction handbook, as set out in 10.1.2.6.

G 5.9.2.2.1 The four options set out in 5.9.2.1a) b) c) and d) are in order of preference, remembering that, ideally, the operator should have direct line of sight as the preferred option.

5.9.3 Personnel safety

5.9.3.1 All personnel carried on OTP shall have either a fixed seat or standing position that provides adequate separation by means of a barrier from tools and materials. The ECC shall show the number of personnel that are permitted to be accommodated and any restrictions as to the type of tools or the load to be carried; the number of personnel and restrictions of tools or load shall also be included in the instruction handbook, as set out in 10.1.2.7.

5.9.3.2 Where fitted, a barrier shall be capable of withstanding the maximum load of tools and equipment at maximum acceleration and / or deceleration of 2 g longitudinally and 1 g laterally.

5.9.3.3 Where personnel are expected to stand, ergonomically designed handrails shall be provided.

G 5.9.3.3.1 The manufacturer should also consider the need to provide suitable handrails in other locations and make their use obvious, as set out in 5.22.5.

5.9.3.4 Such accommodation shall, as a minimum, contain personnel during normal movement of the machine and shall resist accelerations of 2 g longitudinally and vertically, and 1 g laterally. Except where requirements are contained within this standard, accommodation shall comply with the EN relevant to the host machine.

5.9.3.5 The provision of personnel accommodation areas shall not hinder the operator’s view along the track in the direction of travel.
5.9.3.6 Where personnel accommodation is removable from the machine, it shall comply with this section and also 5.24.

5.9.3.7 Where fitted, the seat for the operator shall be designed to minimise vibration to which the operator is subjected.

5.9.3.8 The seating position shall be ergonomically designed. For machines first certificated after 1 December 2012, as a minimum, there shall either be:

a) Sufficient legroom, headroom and body space to accommodate a 95th percentile male and 5th percentile female at each seating position.

Or

b) Where space is not sufficient to accommodate a 95th percentile male (usually based on the machine gauge restriction), a risk assessment and evaluation shall be conducted and documented, which demonstrates that the health of the person operating the machine and the ability for the machine to be safely operated is not compromised.

5.9.3.9 Where personnel are carried outside of the driving cab, there shall be a failsafe means of applying a brake in an emergency (which will stop the machine(s) in the required stopping distance, as set out in 5.7.2 or 5.7.3, as appropriate) located at the accommodation area.

5.9.3.10 Where personnel are carried outside of the driving cab of a machine, seat belts, or other suitable restraint systems, shall be provided. Seat belts (or other restraint systems) and their mountings shall provide the necessary level of restraint for the maximum speed of the machine to which they are fitted. Separate seat belts (or other restraint systems) shall be provided for each seating position and be suitable for use by all foreseeable personnel sizes.

5.9.4 Safe access and egress

5.9.4.1 For machines first certificated after 1 January 2016 the manufacturer shall review the ergonomics of access to, and egress from, all travelling and working positions. The review shall consider designing access and egress:

a) To suit 95th percentile male and 5th percentile female.

b) To comply with BS EN ISO 2867:2011, where reasonably practicable.

G 5.9.3.5.1 The requirements set out in 5.9.3.4 and 5.9.3.5 should take precedence over the requirements of such standards as the BS EN 474 series for earth moving machinery.

G 5.9.3.8.1 It is preferable that machines have a minimum of two permanent seats. BS EN 15746-1:2010 + A1:2001 requires RRVs with a maximum speed greater than 10 km/h to have two seats. Guidance for suitable seating is given in BS 6912-19:1996. Guidance for anthropometric data is given in BS EN ISO 3411:2007.

G 5.9.4.1.1 Guidance for access is given in BS EN 547-1.
5.9.4.2 Access to and egress from all travelling and working positions for all personnel shall accord with one of the following options:

a) Be from both sides of the machine.

Or

b) Directly into the ‘four foot’.

Or

c) Limited to one side, in which case the ECC shall be endorsed ‘The machine may only operate with the access adjacent to a cess or a line closed to all train movements or the documented safe system of work must take account of adequate safe clearances to adjacent lines’; this shall also be included in the use of plant safety plan, as set out in 10.1.5.4.

This list is in order of preference.

5.9.4.3 A method of restricting egress from the side of the machine open to traffic shall be provided. The method adopted shall be included in the instruction handbook, as set out in 10.1.3.1 q). Fixed warning signs to warn personnel of the dangers from passing traffic shall be fitted.

5.9.4.4 The manufacturer shall, where reasonably practicable, provide the operator with access and egress where the operating position could be slewed away from the travelling position (including emergency situations).

5.9.5 Controls

5.9.5.1 The design shall minimise the possibility to operate unintentionally switches or control devices.
5.10 Setting up and packing away

5.10.1 The machine design shall make it possible to unpack and pack the machine from:

a) Inside the cab or within the confines of the machine.

Or

b) Outside the machine from either side, and/or the ‘four-foot’, provided the necessary conditions are shown on the ECC and included in the instruction handbook, as set out in 10.1.1.1 e).

Or

c) Outside the machine from only one side, provided that the ECC stipulates that the control of the adjacent line to that side of the machine shall be under the control of the engineering supervisor responsible for controlling movements of the machine.

G 5.10.1.1 The three options are set out in order of preference.
G 5.10.1.2 The design could involve the three options being achieved in combination.

5.11 Other safety features

5.11.1 A notice shall be provided at the driving position(s) stating ‘This machine is not permitted outside a possession’.

G 5.11.1.1 This notice applies to the machine in its rail configuration.

5.11.2 Where infrastructure materials, plant or other loads are intended to be carried on a machine, suitable and sufficient securing systems shall be provided.

G 5.11.2.1 This might either be secure permanent storage areas or anchor points for attaching chains, straps etc.
G 5.11.2.2 It is recognised that all potential loads will not be definable; it is recommended that strength calculations similar to those set out in 5.24.1 and 5.24.2 are carried out for the machine maximum load.

5.11.3 Where an emergency stop button is fitted to a machine, the operation of the button shall:

a) Stop movement along the track, in accordance with the stopping distances set out in 5.7.2.

b) Stop movement of other machine components.

c) Prevent all further machine movements, including along the track.

G 5.11.3.1 Emergency stop buttons (normally red mushroom headed switches) are fitted to MEWPs and on the outside of certain other machines. Where they are fitted, the operation of the button should be tested to check that the brakes are applied in all configurations that the machine can be in, including during on and off tracking. It is acceptable for systems other than the brakes to bring the machine to a stop, for example a gearbox.
G 5.11.3.2 The operation of the emergency stop button should stop all machine movements, such as superstructure movement etc.

5.11.4 Where an emergency stop button is fitted to the machine exterior it shall be at a height of between 0.5 and 2.0 m above rail level, with the machine in rail mode.

G 5.11.4.1 The height of the emergency stop button should consider a person reaching for it, where, if positioned at a maximum permissible height of 2 m, could be excessive when in combination of height of rail and ballast shoulder sloping away. Where practicable, a maximum height of 1.5 m should be used.

5.11.5 The manufacturer shall provide a means of checking the road wheel tyre inflation for wheeled machines fitted with inflatable tyres. Provision shall also be made for inflation of tyres, including those on inner wheels of machines with twin wheels.

5.11.6 Safety-critical control systems shall meet the requirements of BS EN ISO 13849-1:2008. As a minimum, specific control systems shall achieve a performance level as set out in Table 3. The BS EN 61508:2010 series shall also be used in the review of the requirements against BS EN ISO 13849-1:2008.

G 5.11.6.1 The validation of the safety functions and categories in 5.11.6 are set out in BS EN ISO 13849-2:2008.

G 5.11.6.2 To demonstrate compliance with 5.11.6 the manufacturer should present an analysis that has been made for the safety related parts of the control system and overall control system safety performance; for example using failure modes and effects analysis (FMEA), failure modes, effects and criticality analysis (FMECA), decision tree etc, which could also be supported by physical testing, as appropriate. The PAB should check that such analysis has been undertaken and documented and take a professional view to be satisfied that the assessment is sensible, but it is not intended that the PAB would need to repeat or carry out additional analysis to verify accuracy and completeness.

G 5.11.6.3 The BS EN 61508:2010 series of standards demonstrate a more rigorous approach to the description of risks from failures in the functional safety of electrical, electronic and / or programmable electronic safety-related systems and a more complete methodology for defining these risks. BS EN ISO 13849-1:2008 is more complete in terms of its scope of application and therefore the BS EN 61508:2010 series should be used as the guiding standard for methodology and risk and BS EN ISO 13849-1:2008 for scope of application.

G 5.11.6.4 As part of the assessment, common cause failure modes should be assessed.
<table>
<thead>
<tr>
<th>Clause of standard</th>
<th>Safety system</th>
<th>Minimum required performance level as set out in BS EN ISO 13849-1</th>
<th>As per standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2.1.9</td>
<td>Inadvertent or unintended movement out of gauge in travelling mode</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.2.1.10</td>
<td>Securing devices for rail to road</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.2.2.4</td>
<td>Inadvertent or unintended lateral movement</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.2.2.5</td>
<td>Inadvertent or unintended vertical movement</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.3.2</td>
<td>Cant measurement / display</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Maximum permissible speed</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>5.7</td>
<td>Brakes</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.8.3</td>
<td>High performance movement limiting device control</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.8.4.1</td>
<td>Override of movement limiting device control (when applied to high performance limiting device)</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.8.6</td>
<td>Lateral limiting device</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.8.7</td>
<td>Height limiting device</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.11.3</td>
<td>Emergency stop</td>
<td>BS EN ISO 13850</td>
<td></td>
</tr>
<tr>
<td>5.11.13</td>
<td>Operator present and vigilance controls</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.12.2</td>
<td>Data logger operational</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>5.16.2</td>
<td>Warning horn(s)</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.19.1.1 c),d)</td>
<td>On / off tracking</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.19.2.1 a)</td>
<td>Turntables</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>5.19.2.3</td>
<td>Turntables stowed</td>
<td>b</td>
<td></td>
</tr>
<tr>
<td>5.24</td>
<td>Audible warning device (where fitted)</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>5.26</td>
<td>Wire-less control system</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>6.1.2</td>
<td>On / off tracking interlock</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>6.2.2.2</td>
<td>Inadvertent or unintended change of rail to road mode</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>6.3</td>
<td>Steering alignment</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.2.1.1</td>
<td>Cranes – general req.</td>
<td>BS EN 13000</td>
<td></td>
</tr>
<tr>
<td>9.2.2.1</td>
<td>Knuckle boom cranes</td>
<td>Latest BS EN 12999</td>
<td></td>
</tr>
<tr>
<td>9.3.1</td>
<td>MEWP – general</td>
<td>Latest BS EN 1280</td>
<td></td>
</tr>
<tr>
<td>9.5.6.6</td>
<td>Stabiliser retract</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.6.1.3</td>
<td>Duty change</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.7</td>
<td>RCI - for machines constructed after 1/1/16</td>
<td>d</td>
<td></td>
</tr>
<tr>
<td>9.7.1.5</td>
<td>Tandem lift on RCI</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.7.2.3</td>
<td>RCI override</td>
<td>Equal to or greater than safety function being overridden</td>
<td></td>
</tr>
</tbody>
</table>
### Clause of standard

<table>
<thead>
<tr>
<th>Safety system</th>
<th>Minimum required performance level according to BS EN ISO 13849-1</th>
<th>As per standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.7.4.1 RCI cease movement</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.7.4.2 RCI shall not allow movement</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.7.4.3 RCI shall not allow reduction in SWL</td>
<td>c</td>
<td></td>
</tr>
<tr>
<td>9.7.4.4 RCI shall allow safe movement</td>
<td>c</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 3: Performance levels for safety devices

5.11.7 All software and software systems shall be validated and documented. All software incorporated into a system with a performance level of d shall meet the requirements of a SIL 2 system as defined in BS EN 61508:2010.

G 5.11.7.1 The software validation should include checks that all foreseeable sequences of operations have been included and validated, as set out in BS EN ISO 13849-1:2008 clause 4.6 and part 3 of the BS EN 61508:2010 series of standards.

5.11.8 It shall only be possible to override a safety device set out in Table 3, in a safe manner, by using a separate safety function of equal or greater performance level or better.

5.11.9 Machines shall be provided with space for the conveyance of emergency equipment, as set out in section 11 of Module TW1 of the Rule Book.

5.11.10 OTP shall be equipped with a device in front of the leading rail wheels in either direction of movement to brush aside small obstacles from the rail head. The device shall be designed such that if it is subjected to any reasonably foreseeable load, it does not increase the risk of derailment of the machine.

G 5.11.10.1 This requirement is for all machines, including trailers, but excluding trolleys unless the manufacturer’s risk assessment identifies a need for the rail clearing device.

G 5.11.10.2 It is preferable that the device is non-metallic to avoid rail head damage. A common solution is to provide stiff rubber strips. They should be designed such that during all possible conditions of suspension movement and wheel wear, they are capable of being adjusted to maintain a clearance of less than 30 mm from the top of the rail.

G 5.11.10.3 In this context ‘small’ should be taken to mean an irregular shaped object, such as a stone, of approximately 0.5 kg. The device should be able to withstand collision with such objects at maximum machine speed, without permanent deformation.

5.11.11 In addition to the device set out in 5.11.10 there shall be an assessment to identify if a rail wheel poses a danger to the feet of personnel being trapped between the rotating wheel and rail. Where such a danger is identified, there shall be additional guards to prevent the trapping.
5.11.11.1 The device set out in 5.11.10 is designed for clearing the track of small obstacles. The requirement set out in 5.11.11 addresses a Machinery Directive requirement that there should be an assessment to mitigate against personnel being trapped by moving parts. A rail wheel is an example where, if it is not protected when it is in an exposed position, forward of the structure of the machine, it could trap a foot. The manufacturer should have carried out an assessment, as set out in BS EN 15746-2:2010 + A1:2011 clause 5.13, third paragraph.

5.11.12 There shall be a 12 V auxiliary power supply socket in accordance with BS EN ISO 4165:2003, at each operating position, available for use by the communication radio.

5.11.13 Controls for movement along the track shall be hold-to-run to retain power.

5.11.14 It shall be clear to the operator of a machine with rotatable superstructure which direction the machine will move when the forward or reverse directions are selected in the superstructure mounted cab on such a machine.

G 5.11.14.1 A way that the requirement could be achieved is by colour coding one end of the machine, and the associated control.

5.11.15 Guards shall be designed so that their use is encouraged; removal requires tools.

5.12 Data logging

5.12.1 Machines which are intended to undertake any lifting operations to which the Lifting Operations and Lifting Equipment Regulations (LOLER) apply (for example MEWPs, cranes, excavators) shall be provided with a data logging system which shall be capable of recording, as a minimum, the following information:

- The date and time of any occurrences shown in GMT and British date format.
- Overload occurrences during lifting operations.
- Except as set out in i) and ii) each incidence of the operation of the emergency control / override systems for recovery of equipment. This does not apply to:
  - Hand-pumps on hydraulic circuits.
  - In cases of complete electrical failure.
- Malfunction of active suspension system (as set out in 6.2.3.2), where fitted.
- Activation of RCI override systems (as set out in 9.7.2.4), where fitted.
- Activation of electrically or electro hydraulic controlled movement limiting device.
- Activation of movement limiter override systems (as set out in 5.8.5), where fitted.
- Malfunction of any electronic load monitoring system.

5.12.2 There shall be separate visual indications at the operator position to show that:

- The system is operational.
b) An exceedance, as set out in 5.12.1, has occurred. The indication shall remain illuminated until a data download has been completed.

5.12.3 The manufacturer shall include the following in the instruction handbook (as set out in 10.1.1.3 m)) 'Where a data logging system is found not to be operational then the machine shall not be used until the machine is repaired and fully confirmed as operational. This requirement applies irrespective of whether starting or part-way through an operation'.

5.12.4 The data logger shall be robust in design and mitigate against the effects of foreseeable derailment and collision incidents.

5.12.5 Where a data logger is fitted it shall be located in a secure area, capable of being downloaded when required, either remotely or via an accessible link in-situ.

5.12.6 Data loggers shall record data, as a minimum, throughout each occurrence, as set out in 5.12.1 b) to h), at 1 s intervals, for any change of the value of the exceedance / occurrence and shall store a minimum of 1000 events. Where available the measured value of overload required by 5.12.1 b) shall be recorded.

G 5.12.6.1 The requirement for 1000 events is for 1000 data sets, as set out in the list in 5.12.1, sampled at 1 s intervals.

5.12.7 The data logger shall be designed such that in the event of a host machine power failure all data currently stored on the data logger is retained. Data shall be protected against unauthorised amendment, deletion or corruption.

5.12.8 For machines with an RCI, in the event of any exceedance, the RCI shall be capable of recording and retaining a minimum of 1000 occurrences before overwriting. This data shall be security protected against tampering and unsolicited downloading or erasing. As a minimum, the data to be recorded for each occasion shall include:

a) Duty in use.

b) Load on hook *.

c) Radius *.

d) Height *.

e) Slew angle *.

f) Cant *.

g) Gradient *.

h) Speed (where RCI is displaying speed).

i) Personnel numbers, as set out in 5.12.9.

* Values as displayed by RCI.

G 5.12.8.1 The requirement for 1000 occurrences is for 1000 data sets, as set out in the list in 5.12.8, sampled at 1 s intervals while there is any change in exceedance.
5.12.9 For machines with an RCI, the RCI device shall be fitted with a key pad security system to provide a key code entry system for machine operators, machine / crane controllers and maintenance staff. This system shall be linked in to the data recording system set out in 5.12.8 and shall be capable of recording the key code entries from the staff concerned and the current RCI mode settings at the time of use, including all lifting / digging operations and system overrides undertaken. The system shall be capable of recording, as a minimum, an eight digit input code. Where practicable all data loggers shall be fitted with this key pad security system.

5.13 Failure recovery conditions

5.13.1 There shall be facilities to enable the machine to be towed from either end in the event of a failure. The following shall be provided on the machine:

a) Method of retracting and locking items to within gauge, as set out in 5.2.1.

b) Except for trailers, as set out in 7.2.2, and for small demountable machines approved for manual handling, towing connections at both ends for connection to a similar class of machine.

c) Tow bars, towing adaptors and brake hoses that are deemed necessary by the manufacturer (taking into account the length of overhanging jibs / booms). Tow bars and any necessary attachment provided shall be able to withstand the forces generated by the unbraked machine. The design of any tow bar system shall be shown to be fit for purpose by the use of theoretical analysis and practical assessment under worse case recovery conditions.

d) Instructions in the instruction handbook (as set out in 10.1.1 f)), including the description of the procedure for towing and the method of emergency coupling.

G 5.13.1.1 The design of the machine should facilitate a safe and practicable method of removing / re-railing a derailed machine.

G 5.13.1.2 If the method of emergency coupling requires personnel to be between machines, there should be sufficient space to accommodate the personnel required.

G 5.13.1.3 Consideration should be given to the possibility of the machine being in an unbraked position during the recovery and during the setting into the recovery position. Because this is an emergency condition it is permissible for the machine to be unbraked, but only if this has been highlighted and the recovery procedure mitigates against uncommanded movements.

5.13.2 The manufacturer shall consider the means necessary for removal of a failed machine from the railway line at a rail-road access point. The method shall be included in the instruction handbook, as set out in 10.1.1 k).

5.13.3 All emergency recovery control systems shall be provided with secure covers which shall be provided with a visible indication of tampering.

5.13.4 Where an auxiliary engine is used for recovery purposes the scope of use shall be clearly included in the instruction handbook, as set out in 10.1.1 k). The engine and its mounting position shall be accessible for use / maintenance. Where the engine cannot be started without requiring access to a platform higher than 1.4 m above rail level the machine shall not be suitable for use under live OLE, as set out in 5.18.1.1.

5.13.5 The running requirements of the auxiliary engine shall be included in the instruction handbook, for example maximum time of running on full load.
5.13.6 The machine shall be designed so that it is recoverable when a failure occurs. The manufacturer shall declare the estimated time for recovery for the typical foreseeable failure conditions in the instruction handbook, as set out in 10.1.1 g).

G 5.13.6.1 With any failure the machine should be capable of being moved clear of the railway line within two hours. For reasonably foreseeable failures of the electrical, hydraulic or pneumatic systems alone, the machine should be capable of returning to travelling mode gauge within 20 minutes.

G 5.13.6.2 There should be some redundancy incorporated into the design so that the more obvious faults have more than one potential recovery mechanism.

G 5.13.6.3 If electrical power is the sole means of recovery, then sufficient power should be available to return the machine to gauge from its maximum deployed state. Additionally, the ability to safely adapt additional charging should be considered.

5.14 Retention of components

5.14.1 For machines designed for travelling at speeds greater than 20 mph (32 km/h) the following shall apply:

a) Underframe hung components, which are secured by screwed fasteners, and which could fall to the track, shall be provided with a secondary locking device.

And

b) Underframe hung components with moving parts shall be provided with a device to prevent the component from falling to the track if it should become detached from its primary fixing.

G 5.14.1.1 The type of secondary locking device (for example tab washers, torque prevailing nuts, additional spring pins) should follow good engineering practice and be appropriate to the component. It should take into account the component mass, fastener size, the environment (particularly where vibration may be encountered) and access, both for ease of assembly and maintenance safety examination.

G 5.14.1.2 Any safety device should be designed to be secure in its own right, as set out in 5.14.1 a), but also needs to be of such strength that it can accommodate, without failure, the forces generated by the detached component (for example, cardan shaft).

5.15 Visibility and audibility

5.15.1 Rail mode lighting

5.15.1.1 OTP over 75 kg (gross weight) shall be fitted with two white marker lights and two red tail lights at each end, placed as far apart as the build of the machine allows. The machine shall always display white marker lights in the direction of movement along the track and red tail lights at the opposite end. During movement along the track it shall not be possible to display both red and white marker lights at the same time at the end of the machine.
The position of the lights should be as far apart as reasonably practicable permitted by the particular design of the machine. This does not necessarily mean that the lights are required at the extremities of the width of the machine. A further consideration of the location of the lights should be made to minimise the risk of their being obscured by equipment when the machine is in both travelling and working modes.

It is recommended that the red and white marker lights should be visible during daylight on the track from 50 m away.

Except for type 0D machines and trailers weighing ≤ 0.5 t, the colour displayed by the marker and tail lights shall be automatically direction-controlled.

Where possible, the automatic direction control should be linked to the gearbox arrangement or equivalent, so that potential direction of movement is indicated as soon as the direction is selected.

Self-propelled machines over 75 kg (gross weight) shall be fitted with a headlight for use in the direction of travel.

The exception for trailers not to have to fit headlights is set out in 7.2.1 n).

Where a headlight is fitted, with the machine at its maximum permitted travelling speed, it shall:

a) Be capable of illuminating retro-reflective signs.

b) Be capable of illuminating the track at least as far as the permitted stopping distance.

c) Be visible, on a clear night, by a person on the track in a position equal to the distance the machine could move if travelling at its maximum speed for 25 s.

Retro-reflective signs should be considered to be within 3 m of the edge of the running line and between 1 and 2 m high.

The maximum speed of the machine and the position / view of the operator should be part of the consideration of the headlight strength. When propelling multiple trailers or a long load, then additional portable headlamps and / or speed limitations should be specified, if appropriate.

Machines with headlamp fitted shall either have an indication at the driving position of a filament failure of headlamp, marker light or tail lamp, or the lamps shall be multi-element light emitting diode (LED).

With the exception of brake lights, dipped headlights and / or rear lights, all road machine lighting, including flashing beacons, shall be capable of being isolated or switched off to prevent use when the machine is operated on or near the line. It is permissible for dipped headlights and tail lights to be used to meet the requirement set out in 5.15.1.1 for marker lights.

OTP, when stationary, shall be capable of displaying two red lights at both ends of the machine. This facility shall also be available when the machine is left unattended.
The operator should have the option to control the lights, as set out in 5.15.1.7, as the safe system of work for a particular worksite may dictate.

Machines shall be fitted with a means of attaching temporary lights; this is permitted to take the form of lamp irons at each end of the machine such that temporary lights are able to illuminate along the track.

It is preferable for lamp irons to be fitted which should permit the temporary attachment of an emergency lamp facing along the track. Where it is impracticable to fit lamp irons, a suitable alternative is use of multi-element LED lighting.

The position of and means of attachment of temporary emergency lighting should provide unobstructed lighting facing along the track.

Where lamp irons are fitted, these should conform to the dimensions shown in Figure 11. The wide face should face forwards on the machine, with a minimum of 12 mm space behind the lamp iron to facilitate a lamp being placed on it.

![Figure 11 Lamp iron dimensions](image-url)
5.15.1.9 With the exception of the lighting required in this section, 5.15.1, and the blue lights set out in 9.7.1.5 and 9.7.2.1, all external indicator lights shall be disabled in rail mode.

G 5.15.1.9.1 This requirement is to avoid confusion about what indicator lights are showing. Only lighting that is called up in this document is allowed to be displayed, so that there is one national agreed list of exactly what and why an external visible indication is given by any machine.

G 5.15.1.9.2 The requirements set out in 5.15.1.9 are for indicator lights only. Lights provided for illumination of working areas should not be disabled.

G 5.15.1.9.3 The road machine lighting set out in 5.15.1.3 should not be included in the external indicator lights which are isolated.

5.15.2 Horns

5.15.2.1 Self-propelled machines greater than 75 kg shall be fitted with a warning horn(s) for use in both travelling and working modes, and shall be operable from all travelling and working positions, to warn persons of machine movement.

5.15.2.2 The warning horn(s) shall provide an increase of sound pressure level of at least 10 dB(A) greater than that produced by the machine, when measured at a distance of 1 m around the periphery of the machine and shall be in excess of 80 dB(A).

G 5.15.2.2.1 Measurement of the audibility of the warning horn should be taken with the machine in travelling mode configuration and any engine at mid speed. Readings should be taken at four positions: at 1 m from each side and to the front and rear of the body of the machine; all at 1.8 m above rail level. If a separate power source (additional diesel engine etc) is used in working mode, then the tests should be repeated using the additional engine.

G 5.15.2.2.2 The sound pressure level of the warning horn should be at least 10 dB(A) higher than the ambient machine level or 10 dB in 1/3rd octave within a range of 215 Hz to 2000 Hz, noting that the minimum requirement is 80 dB(A).
The warning horn should be of a totally different note to any other warning horn on the machine. If there are multiple horns to meet the requirements of this clause, then they should sound together.

5.15.3 Colour

5.15.3.1 Except as set out in 5.15.3.3, machines that do not have rotating superstructures shall have yellow ends.

G 5.15.3.1.1 The maximum possible area of yellow colour should be applied to the machine ends.

5.15.3.2 Except as set out in 5.15.3.3, all machines that have rotating superstructures shall have a predominantly yellow surface finish.

G 5.15.3.2.1 The extent of yellow colour should be as complete as reasonably practicable relative to the machine design and its manufacture, particularly in the case of conversions. The extent of the yellow colour on the machine sides should be greater than 50% and as close as possible to 100%. The machine should present predominantly yellow colour along the track, that is to say, all the sides of the rotating superstructure, the jib and the ends of any non-rotating part (for example, the chassis or rail gear) should be yellow in colour.

5.15.3.3 Where parts of the machine are designed to be in areas that are subject to abrasion, for example dozer blades and excavator buckets, the manufacturer is permitted to decide whether to colour these components yellow or leave them as bare metal.

5.15.3.4 The yellow colour shall be as specified by any of the following paint colours:

a) RAL 1003, RAL 1004, RAL 1018, RAL 1021, or RAL 1023 from the RAL Classic Colour Collection.

b) BS 4800 Item 08E51.

c) BR 81 Item 202.

d) NCS (natural colour system) target value 1080 - Y10R or 1475 - Y11R.

e) EC 222.69.79 in the Eurocolour table.

5.15.3.5 Conformance shall be assessed by confirmation that the particular colour has been applied using the manufacturer’s specification and applied using the manufacturer’s approved process. No measurement of the colour when applied to the machine is necessary.

5.15.3.6 Where vinyl and gel coats are used to achieve yellow colour, the colour shall be a reasonable match to the yellow colours set out above. Conformance shall be assessed by visual comparison. No measurement of the colour when applied to the machine is necessary.

G 5.15.3.6.1 The manufacturer should supply data to confirm that the yellow colour of vinyl or gel coats are equivalent to the colour set out in 5.15.3.4.
5.15.3.7 The specification for the colour application system, including preparation of surface metal, shall be either specified by the machine purchaser or decided by the manufacturer on the basis of an assessment of the intended duty cycle.

5.15.3.8 The visible positive locking elements of locking components shall be coloured in red.

G 5.15.3.8.1 All devices used for locking components in travelling configuration to keep the component within gauge (see also 5.2.1) should be red. Any component locked in working mode, for example pins used for height limiting, should also be red.

5.15.3.9 Specific component colours:

a) White: brake handwheels and levers, reservoir drain cocks, pneumatic system isolation cocks, steps and handrails.

b) Red: emergency brake levers, doorway barriers, grease nipple locations, areas around electrical safety bond connection points, locking securing components.

c) Orange: crane hook blocks, overhead warning line.

d) Blue: wheels and axles of insulated trolleys, road wheel rims of foam filled tyres.

5.16 Electrical equipment and electrical safety bonding

5.16.1 Requirements for electrical circuits above 28 V AC or DC

5.16.1.1 All control circuits shall be energised not exceeding 50 V AC or 120 V DC (ripple free) whether between conductors or to machine frame and bonded at source.

5.16.1.2 The system voltage shall not exceed 1000 V AC or 1500 V DC between conductors, or 600 V AC or 900 V DC between conductors and machine frame. The line to exposed conductive part voltage shall be minimised by using one of the following bonding methods, as appropriate:

a) 3 phase AC with the star point connected to the machine frame.

b) 1 phase AC and DC with the midpoint connected to the machine frame.

c) One supply rail of 50 V AC or 120 V DC (ripple free) is permitted to be bonded to the frame of the machine.

5.16.1.3 All electrical systems shall have overcurrent protection.

5.16.1.4 Each machine subsystem shall have separate overcurrent and residual current device (RCD) protection with discrimination to provide priority isolation.

5.16.1.5 Currents, including fault currents, originating from the supply and passing through the running rails shall not affect track circuits.

5.16.1.6 The supply to sockets for portable hand lamps and portable handheld tools which are to be used in a construction site environment shall be at either:

a) Not exceeding 50 V AC or 120 V DC (ripple free) whether between conductors or to machine frame.

Or
b) Nominal voltage of reduced low voltage circuits not exceeding 110 V rms AC between phases (three phase 63.5 V to machine frame connected neutral, single phase 55 V to machine frame connected midpoint).

5.16.1.7 All secondary circuits shall be electrically separate from their respective primary power supplies and bonded locally.

5.16.1.8 If two or more power sources are connected electrically to the same busline, measures shall be taken to prevent danger arising from non-matching power supply sources.

5.16.1.9 Provision shall be made to isolate the power source in case of emergency. This shall be positioned in the vicinity of the power source. Additional local emergency isolation for individual pieces of machinery may be necessary. Release of the isolating mechanism shall not automatically reset the power supply. The isolation devices shall be easily accessible from all anticipated working positions on or near the machines without the need to open doors, covers etc.

5.16.1.10 Isolation for safe working shall be provided for individual machines and coupled machines, as appropriate.

5.16.1.11 Conduit installations shall not be designed for use as handrails or footsteps. However, some conduit routings may result in its occasional use for support. In these circumstances the conduit shall be adequately supported and capable of withstanding the forces exerted.

5.16.2 Requirements for electrical circuits at 28 V AC or DC or below

5.16.2.1 All control circuits shall be to standard automotive practice or equivalent.

5.16.3 Overcurrent and RCD protection

5.16.3.1 On a two-wire centre tapped or three phase system the overcurrent protection shall be fitted to all poles of the supply. Under fault conditions all poles shall be disconnected from the supply.

5.16.3.2 Where it is necessary to use an RCD or a residual-current circuit breaker with overload protection (RCBO) for personnel protection, it shall have a residual current fault rating not exceeding 30 mA, 30 ms.

5.16.3.3 Where an RCD is used, the operating characteristics shall comply with BS EN 61008.

5.16.3.4 Where an RCBO is used, the operating characteristics shall comply with BS EN 61009.

5.16.3.5 Where RCDs or RCBOs are fitted they shall be subjected to periodic scheduled testing. To facilitate the use of standard RCD test equipment, for 240 V circuits, a 13 A three-pin test socket shall be provided, because the integral test buttons on RCDs do not provide a full test.

5.16.4 Inter-machine power supply connection greater than 28 V

5.16.4.1 Where electrical supplies are exported from the power supply machine to other machines in the consist, detachable and flexible inter-machine connectors shall be used.

5.16.4.2 All inter-machine cable coupler bodies shall be coloured in accordance with BS EN 60302-2:1998.

5.16.4.3 Inter-machine connectors shall not be compatible with connectors of different supply systems.

5.16.4.4 Pilot protection shall be provided where the voltage in the inter-machine connectors exceeds 50 V AC or 120 V DC (ripple free) whether between conductors or to machine frame. This pilot protection will help prevent arcing and exposure of live conductors when separating plugs and sockets.
5.16.4.5 It shall be demonstrated that a single point failure will not give rise to danger in the pilot system and its associated control equipment.

5.16.4.6 Re-energisation of the power supply shall not be possible by restoration of the inter-machine connectors only.

5.16.5 Requirements for equipotential bonding

5.16.5.1 The requirements for OTP and associated equipment is either:

a) Machines shall be equipotentially bonded in accordance with the requirements set out in GM/RT2111 clause 2.1.2.1.

Or

b) The machine shall be accepted for use with the operating limitation of not being allowed in any circumstance under OLE, or in a conductor rail area, unless an isolation and electrical safety bonding has been implemented. In this case, a permanent notice shall be provided in the operating positions to remind operators of this limitation, included in the instruction handbook, as set out in 10.1.2.2a) and 10.1.2.2j), and the data panels, where fitted (see Appendix C) suitably endorsed.

5.16.5.2 In all instances the design of OTP shall not incorporate insulation of the wheels / axles. It is permitted for specific trolleys to be fitted with insulated wheels / axles; such wheels / axles shall be painted blue.

G 5.16.5.2.1 Insulated trolleys should only be used where their deployment is agreed in advance by the infrastructure manager.

G 5.16.5.2.2 GM/GN2611 gives guidance for compliance with GM/RT2111 in this area. In addition, the following guidance for OTP in particular is given.

G 5.16.5.2.3 For bonding of road / rail vehicle main body structure to retractable rail gear, where stress considerations allow, a bonding stud assembly should be welded to a suitable position on the vehicle main body structure and on the retractable rail gear. However, where welding is not possible, a brass washer should be soldered to a suitable spot faced position. A hole should be drilled through this washer and the vehicle main body structure / retractable rail gear and tapped an appropriate size. To avoid the connecting set screw ‘bottoming out’ the hole should not be a blind hole. The bond should be connected using a suitable set screw and square section spring washer.

G 5.16.5.2.4 A bonding cable should be connected between the vehicle main body structure and the retractable rail gear connecting points.

G 5.16.5.2.5 The individual sections of MEWP scissor arm assemblies should be bonded at:

a) The outer ends of each pair of arms.

b) The lower fixed arm and the vehicle main body structure.

c) The upper fixed arm and the work platform.
Where stress considerations allow, a bonding stud should be welded to a suitable position on the scissor arm, vehicle main body structure, and work platform. However, where welding is not possible, a brass washer should be soldered to a suitable spot faced position. A hole should be drilled through this washer and the scissor arm / vehicle main body structure / work platform and tapped an appropriate size. To avoid the connecting set screw ‘bottoming out’ the hole should not be a blind hole. The bond should be connected using a suitable set screw and square section spring washer.

A bonding cable should be connected between the adjacent connecting points.

For bonding of OTP machine superstructures, elevating work, articulated arms and crane and excavator jibs, the main structural components of the articulated arms should be bonded together at each joint in the assembly in a similar manner to that given in G.5.16.5.2.6 and G.5.16.5.2.7.

The lower arm should be bonded to the vehicle main body structure, either:

a) By directly bonding the two components.

Or

b) If a slewing arrangement is used, by the use of a suitably rated slip ring.

The upper arm should be bonded to the work platform.

Non-metallic working platforms should be bonded by securing a copper strip to the work platform forming a continuous path around the top edge of the enclosure. A further copper strip should connect this strip to the metal base of the platform and to the anchor point of the top section of the articulated arms.

Any machine superstructure not included in the preceding two categories should be bonded so as to provide a continuous path from the top of the superstructure to the rail vehicle main body structure.

Where an MEWP basket has a changeover switch fitted to change between equipotential bonded and insulated, the switch shall be permanently removed and the basket confirmed to be bonded, as set out in 5.16.5.1.

Unless the machine is to be approved with limitations, as set out in 5.16.5.1 b), safety bond continuity tests shall be carried out on each machine to check a conductive path exists between all external conductive parts of the machine and each rail. The maximum impedance between any such part of the machine and each rail shall not exceed 0.15Ω.

The maximum impedance between any external conductive part of the machine and each rail should be such that no dangerous touch potentials exist in the event of either:

a) An electrical fault on the machine.

Or

b) A fault where either live OLE, or third rail equipment, comes into contact with the machine.
5.17 Electromagnetic compatibility

5.17.1 Emissions from machines

5.17.1.1 Except where a host machine is already stated to be compliant with European Automotive EMC Directive 2004/104/EC, machines shall meet the requirements of BS EN 13309:2000 or BS EN 50121-3-1:2015, clause 6.

5.17.1.2 Any electrical component that is added to a machine that has already been tested shall either be assessed as a component for its potential to affect railway signals, or the whole machine shall be reassessed.

5.17.1.3 Where a machine is designed and intended for use with an adjacent line open to traffic (ALO) on London Underground, it shall comply with LU standard S1193. If a machine is not declared compliant with S1193, with any assessments verified by a competent LU engineer, the ECC shall state 'Not suitable for ALO on LU'.

5.17.2 Immunity of machines from railway environment

5.17.2.1 Manufacturers shall assess the component parts of machines for their susceptibility and immunity to electro-magnetic induced currents. Each electrical or electronic circuit box shall be assessed for the effect they would have if the currents were induced. Any electrical or electronic circuit which is considered vulnerable to EMC shall comply with the requirements set out in EN 50121-3-2:2015, clause 8, Tables 4, 5 and 6, or equivalent, and furthermore include an additional assessment for frequencies below 9 kHz.

If electrical equipment is added to, or removed from, an electrical system of 28 V or less, then, providing this equipment has already been separately tested, a decision whether any further testing is required should be made by a competent engineer.

Where a previously untested machine exists with an electrical system of greater than 28 V, then the machine should be tested to railway machine EMC test BS EN 50121-3-1:2015.
G 5.17.2.1.6 If electrical equipment of greater than 28 V is to be added to an existing design, then the equipment to be added may either be independently tested to BS EN 50121-3-2:2015, or the complete machine tested to BS EN 50121-3-1:2015.

G 5.17.2.1.7 Demonstration of compliance with BS EN 50121-3-1:2015 or BS EN 50121-3-2:2015 may either be by testing, or a letter of compliance signed by a technically competent electromagnetic compatibility engineer.

5.17.3 Attachments
5.17.3.1 Where an attachment is electrically powered it shall comply with the requirements set out in 5.17.1 and 5.17.2 of this document.

5.18 Protection from overhead line equipment and / or conductor rails
5.18.1 General
5.18.1.1 Except as stated in 5.18.1.2, all fixed platforms or work surfaces where personnel might reasonably be present under OLE, which are higher than 1.4 m above rail level, including all normal and emergency access and egress routes, shall be covered by a metallic-framed roof. The roof cover is permitted to be a mesh or fibre-reinforced plastic. The mesh size shall be a maximum of 25 mm. It is permitted to have glass observation panels, as fitted to operating cabs.

G 5.18.1.1.1 All metallic components of the roof structure and covering should be suitably electrically bonded to running rail potential.

G 5.18.1.1.2 The mesh size should be a maximum of 25 mm, in order to prevent accidental hand / arm type protrusion through the mesh.

G 5.18.1.1.3 All translucent roofing materials should be shatterproof.

5.18.1.2 Exceptions to the requirement for platforms and surfaces to have a roof are permitted in respect of areas that are locked out of use, or have a locked physical barrier, during normal operation, and have OLE warning notices and display a notice forbidding access / use under live OLE.

5.18.1.3 Warning notice(s) shall be displayed at the access point to each platform or surface which is higher than 1.4 m above rail level. They shall be red lettering on a white background, stating ‘No access under live electric wires’, visible from a distance of 2 m.

5.18.1.4 Except as set out in 5.18.1.5, MEWPs which are precluded from having a roof fitted because of their intended use shall be fitted with OLE warning notice(s) and display a notice forbidding access / use under live OLE. The warning notice(s) shall be displayed at the access point to each elevating work platform. They shall be red lettering on a white background, stating ‘No access under live electric wires’, visible from a distance of 2 m.

5.18.1.5 MEWPs which are permitted to travel under live electric overhead lines while being controlled from the work platform shall have a work platform that is capable of being locked in a position below the 1.4 m floor height. In this case they shall be fitted with OLE warning notice(s) and notices displayed at the work platform access point and the operating position stating ‘The work platform must be locked in lowered position for travelling under live electric wires’. The latter notices shall be red lettering on a white background, visible from a distance of 2 m.
5.18.1.6 OLE warning notices shall be fixed adjacent to all access points to the superstructure, cab, platforms, work surfaces, foot boards and steps above a height of 1.4 m above rail level, and either side of breaks in the orange warning line, as set out in 5.18.2. Whenever the OLE warning line is terminated to avoid an obstruction, an OLE warning notice shall be fitted within 200 mm of each termination of the OLE warning line at the same level as the OLE warning line.

5.18.2 OLE warning lines

5.18.2.1 Machines shall, where the design allows, be marked with a warning line to indicate the upper limit below which it is safe to work in electrified areas without isolation of the OLE. The OLE warning line shall be 25 mm wide.

5.18.2.2 Except as set out below, the OLE warning line shall be orange coloured. Black or white lines are permitted where the livery in the area, or in close proximity, to where the OLE warning line is to be applied is itself orange, such that an orange line would not be clearly visible.

G 5.18.2.2.1 Black or white lines should not be substituted for orange merely because it gives a sharper contrast with the livery. Orange is widely recognised as the colour of the OLE warning line on machines and it should be used in all cases unless there is a problem of visibility of the OLE warning line, or of recognising it as an OLE warning line.

5.18.2.3 The OLE warning line shall be positioned as high as possible so that it is clearly visible when viewed from standing at rail level, normally within the range 3100 mm to 3300 mm above rail level.

G 5.18.2.3.1 Where practicable, the OLE warning line should be above body side doors and windows, machine end doors and windows, and horns etc. Where there are glazed areas, ventilators, grilles, rubber elements or other parts of the machine that cannot be liveried and which are of such a height that the line would be outside the dimensions, it is permissible to carry the OLE warning line below 3100 mm in cases where it can be positioned sufficiently high for it to be readily recognisable as an OLE warning line, or terminate the OLE warning line immediately either side of the obstruction.

5.18.3 Working and travelling under live overhead line

5.18.3.1 A machine fitted with a roof over the whole machine within W6a gauge, suitably bonded to running rail potential, shall be deemed suitable for use in working and travelling modes under live OLE. In this case the ECC and the instruction handbook, as set out in 10.1.1.3n), shall be endorsed ‘This machine is suitable for use under the live OLE when used in conjunction with a safe system of work’. The data panels, where fitted (see Appendix C) shall be endorsed for use under OLE.

G 5.18.3.1.1 The all-over roof should, as a minimum, cover the areas where personnel could foreseeably be present.

5.18.3.2 Where a machine is not fitted with an all-over roof, but is compliant with all of the following conditions, it shall be deemed suitable for use under live OLE. The ECC and the instruction handbook shall be endorsed as suitable for use (work and / or travel as applicable) under the live OLE when used in conjunction with a safe system of work. The data panels, where fitted (see Appendix C) shall be endorsed for use under OLE:
a) The machine is fitted with movement limiting devices (as set out in 5.8) to prevent any moveable part going into the area around the live OLE, or the boundaries of the machine under all conditions of use (excluding movement along the track in the travelling mode) are greater than 600 mm from the live parts of the OLE at all times.

b) The boundaries of the machine in the travelling mode are within W6a gauge.

c) All uncovered access points to the superstructure and cab, or to platforms, work surfaces, footboards or steps are at, or below, a height of 1.4 m above rail level.

5.18.3.3 The assessment to determine the suitability of a machine for working under live OLE shall be made assuming the lowest overhead wire height of 4.165 m. Where a machine is not compliant with the required conditions at this minimum height, the machine is not suitable for operation under live OLE, and this limitation shall be shown on the ECC, included in the instruction handbook, as set out in 10.1.2.2a) and the data panels, where fitted (see Appendix C) shall be suitably endorsed.

5.18.4 Travelling on track fitted with conductor rails

5.18.4.1 Except as set out in 5.2.1.6, machines are permitted to travel over live conductor rails, providing they meet with the requirements set out in GE/RT8025 in respect of static electrical clearance and passing electrical clearances (both terms are defined in GE/RT8025).

5.18.4.2 Machines not meeting the requirements set out in GE/RT8025 but meeting the requirements set out in 5.2.1.6 of this document are not permitted to travel over live conductor rails, but are permitted to travel over conductor rails isolated in accordance with Rule Book GE/RT/8000DC Module DC electrified lines provisions. This shall be shown as a limitation on the ECC, and the instruction handbook shall show this limitation, as set out in 10.1.2.2 j), and the data panels, where fitted (see Appendix C) suitably endorsed.

5.18.4.3 Machines not meeting the requirements set out in GE/RT8025 or 5.1.1.4 of this document are not permitted to travel over conductor rails, and the ECC and the instruction handbook, as set out in 10.1.2.2 j), shall show this limitation and the data panels, where fitted (see Appendix C) suitably endorsed.
5.18.5 Working on track with live conductor rails

5.18.5.1 Machines shall not be used in working mode on lines fitted with conductor rails with the conductor rail live, and the ECC and the instruction handbook, as set out in 10.1.2.2 j), shall be endorsed to this effect, and the data panels, where fitted (see Appendix C) suitably endorsed.

5.19 On and off tracking system

5.19.1 General

5.19.1.1 During on and off tracking, the machine shall:

a) Not damage the infrastructure.

b) Not short out the running rail to adjacent metalwork in conductor rail areas.

c) Be designed so that, at all times during the operation, it does not allow inadvertent movement of the machine.

d) At all times have, at a minimum, two braked wheels on one axle in contact with ground or rail, unless raised by a turntable (see 5.19.2).

e) Not damage itself.

In complying with 5.19.1.1 b) no part of the machine or its equipment should form an electrical path between the running rail and any proximity steelwork, for example bridge beams, overhead line structures and signal posts or gantries.

The requirement for braked wheels in contact with ground or rail, as set out in 5.19.1.1 d), does not apply when the wheels are not in contact with either, for example, when using a turntable or lifting a machine onto the track. In this case, the requirement for the wheel to be braked applies as soon as the wheel is in contact with the rail or ground.

5.19.1.2 The machine shall be capable of on and off tracking in tare and laden condition, or if it cannot, any limitation applied shall be shown on the ECC and in the instruction handbook.

5.19.1.3 The machine shall be capable of on and off tracking on:

a) A minimum cant of 100 mm.

And

b) A maximum gradient of 1 in 25 (40%).

Manufacturers are encouraged to provide machines capable of on and off tracking at greater than 100 mm cant to promote ease of use. Machines which are lifted onto rail (for example the majority of trailers) should be capable of on and off tracking at their maximum travelling cant.

5.19.1.4 The actual limiting value of cant for on and off tracking shall be displayed on the data panels, where fitted (see Appendix C) and shown on the ECC and included in the instruction handbook.

5.19.1.5 The first in class machine shall demonstrate the worst case for on and off tracking capabilities (as required by 5.19.1.3 and 5.19.1.4).
The design of the machine should be assessed such that at all times during the on / off tracking process it is possible for the machine to always be under control, stable, and there is no risk of running away. This should be demonstrated on the worst case of cant and gradient (both including track twist) permitted by the manufacturer.

The actual worst case value of both gradient and cant (excluding track twist) demonstrated for on and off tracking should be displayed on the data panel (if one is fitted) and on all occasions shown on the ECC and included in the instruction handbook.

A documented procedure shall be included in the instruction handbook as set out in 10.1.1.1 c), to describe the on and off tracking of the machine.

The manufacturer shall include a diagram as part of the documented on and off tracking procedure that illustrates the minimum physical size of the area to be used.

The documented procedure should also consider the requirements for adjacent lines to have train movements stopped during the on and off tracking process.

Movement from one line to another, known as cross tracking, shall be considered as a form of on and off tracking and shall comply with the applicable requirements set out in 5.19.

Turntables

Where fitted, turntables shall be designed to:

a) Be stable to prevent inadvertent movement.

b) Not damage the infrastructure.

c) Positively locate on the rails.

d) Not contact the sleepers.

When the turntable is in use it should be located in such a manner that the turntable will not move as the machine is raised or lowered.

Positive location on the rail should be taken to mean to inhibit lateral movement across the track, the turntable should not be clamped to the rail.

Verification of the stability of the turntable arrangement shall be established by calculation and test. The test shall take into account the most adversely loaded conditions of the machine.

The first in class machine should demonstrate the worst case use of the turntable, including the combination of cant and gradient.

Any equipment used for this purpose shall be capable of being positively locked in the stowed position when the turntable is not in use.
The turntable and its assemblies should be secured when in its stowed (raised) position; this locking should be by physical means such as pins, chains or failsafe powered check valves.

5.19.3 On and off tracking on track fitted with OLE

5.19.3.1 Where the machine vertically exceeds 3565 mm above rail head level during on and off tracking, either:

a) The ECC and the instruction handbook shall be endorsed ‘not to be on and off tracked under live OLE’.

Or

b) The ECC and the instruction handbook shall be endorsed ‘not to be on and off tracked under live OLE at a contact wire height of less than ***** mm’ (where ***** is 600 mm greater than the maximum height of machine during the on off tracking process).

The documented method of on and off tracking should remind the individual that the return conductor and autotransformer feed wires of overhead line equipment are not in a fixed design position. Machines built to Plant gauge are generally considered sufficient to access the track without being foul of the return conductor or autotransformer feed wire, but this cannot be guaranteed. Therefore a recommendation should be made for a site visit for each potential prepared access point for OTP (known as a ‘road-rail access point’ - RRAP) in the documented procedure for on and off tracking.

5.19.3.2 Except as set out in 5.19.3.3, where a machine is permitted to be on and off tracked or turned using a turntable under live OLE, the machine and turntable shall be capable of being bonded to the rail potential during the operation. Equipment needed shall be provided on the machine.

5.19.3.3 The requirement set out in 5.19.3.2 does not apply where the highest part of the machine accessible to personnel during the on and off tracking process, at maximum extension of the turntable, is less than 1.4 m above rail level.

The requirements set out in 5.16.5 and 5.19.3.2 are necessary to protect staff from the possibility of the machine body becoming energised by the OLE.

The requirements set out in 5.19.3.3 apply to any area such as steps, walkways, platforms or similar areas that personnel could have access to during the on and off tracking process. The 1.4 m height should be taken at maximum extension of the turntable.

5.19.4 On and off tracking on track fitted with conductor rails

5.19.4.1 Except as set out in 5.18.4 and 5.19.1.1 b), there are no particular machine design requirements for on and off tracking or turning at sites equipped with conductor rail, but the operation shall accord with the requirements of Handbook 15 of the Rule Book.

When the turntable is used for on and off tracking or turning the machine, consideration should be given to the clearance required to rotate over the conductor rail.
5.19.5 Testing

5.19.5.1 Each documented procedure used to place the machine on and off the track (see 5.19.1.6) shall be verified as a type test on the first in class machine.

5.20 Towing requirements

5.20.1 Towing machine requirements

5.20.1.1 Where OTP is designed for travelling coupled with other machines, the trailing machine shall meet the requirements of a trailer machine set out in 5.20.2 to 5.20.4.

5.20.2 Towing trailers and wagons

5.20.2.1 Where a machine is designed to tow trailer(s) on rail, the maximum towing weight (including load) of machines not fitted with a service brake shall be shown on the ECC, in the instruction handbook and prominently displayed on the machine data panels, where fitted (see Appendix C). This gross weight shall be such that the stopping distance of the machine and trailer machine(s) meets the requirements set out in 5.7. The ECC and the instruction handbook shall be endorsed with details of the braking system to be used on trailing machines.

G 5.20.2.1.1 The only trailers permitted not to be fitted with service brakes are two wheeled trailers, as set out in 7.2.2.

G 5.20.2.1.2 Propelling movements are potentially restricted by operational control measures. For example, propelling is only permitted outside a worksite with the agreement of Network Rail and is limited by visibility.

5.20.2.2 If towing a wagon registered on the Rolling Stock Library, then the combined machine and wagon brake systems shall comply with GM/RT2045.

G 5.20.2.2.1 This means the towing machine should be fitted with a control system compatible with the UIC air braking system.

5.20.2.3 Where the machine is designed to tow trailers on rail, the maximum towing weight(s), including load(s), shall be shown on the ECC, included in the instruction handbook and displayed on the data panels, where fitted (see Appendix C), for each alternative type of braking system fitted.

5.20.2.4 Where the machine is designed to tow trailers on rail, the maximum number of trailers permitted shall be shown on the ECC and included in the instruction handbook for each alternative type of braking system fitted.

G 5.20.2.4.1 The number of trailers will be specified by the manufacturer, as set out in 5.7.4.7.

5.20.2.5 The parking brake operating system shall be compatible between towing machine and trailer(s), enabling the consist to meet the requirements set out in 5.7.5.

G 5.20.2.5.1 The requirements set out in 5.7.5 are that either the parking brake of the trailer is applied from the operating position of the towing machine or that the towing machine can hold the fully laden trailers on maximum gradient while the trailer parking brakes are applied.
5.20.2.6 When controlled from a towing machine, the trailer(s) parking brake control(s) shall operate in conjunction with the towing machine parking brake control.

G 5.20.2.6.1 This means when the parking brake of the trailers is applied from the towing machine, then the same control lever should operate all parking brakes.

5.20.2.7 The method of connecting trailer machines shall be such that the operator is made aware of a breakaway of one or more trailers by a failsafe audible or visual indication. Trailer machine brakes shall automatically apply in the event of a breakaway.

G 5.20.2.7.1 Where the brakes are automatically applied on the towing (as well as towed) machines, this is deemed to be compliant with 5.20.2.8.

G 5.20.2.7.2 The requirements set out in 5.20.2.8 apply to a breakaway between any machines of a multi-machine formation.

G 5.20.2.7.3 The testing of this requirement is set out in 5.7.6.5, including guidance.

5.20.2.8 It shall not be possible to completely disconnect the trailer unless the parking brake is already applied, or the act of disconnection shall instantly apply the parking brake. This shall be verified by testing during acceptance.

5.20.2.9 The towing speeds mandated by this document or as otherwise shown on the ECC and included in the instruction handbook for each braking system / combination type shall be displayed on the machine on the data panels, where fitted (see Appendix C).

5.20.2.10 Brake connection systems shall be designed to prevent incompatible systems being coupled together. The maximum brake system pressure shall be indicated adjacent to each connection point on each machine.

5.20.3 Inter-machine mechanical couplings

5.20.3.1 The coupling system shall be designed to transmit, without suffering damage or permanent deformation, all the forces that arise between machines during their normal operation, including those due to traction, buffing, curving, braking, travelling, working, coupling and uncoupling. Couplings shall meet the requirements set out in Appendix J.

5.20.3.2 Machines that are intended to be coupled together shall have coupling systems that are mechanically compatible and compliant with all the relevant parts of this section.

G 5.20.3.2.1 Machines intended to tow trailers should be fitted with compatible couplings meeting the requirements set out in 7.2.1b).

5.20.3.3 The coupling system, with the exception of buffers (if fitted), shall engage positively with the coupling system of any rail machine (including trailers) to which it is intended to couple in a consist. Coupling and uncoupling shall be possible on the range of track features defined for the particular machines.

5.20.3.4 The coupling systems, with the exception of buffers (if fitted), shall remain positively engaged during all normal operations of the rail machines over the track features that they are designed to negotiate.
5.20.3.5 Any system that controls the operation of the coupling / uncoupling shall be protected from reasonably foreseeable interference that could result in the inadvertent operation of the system.

5.20.3.6 It shall be possible to determine that the coupling systems are positively engaged. It is permissible to achieve this directly or by a suitable system of indication.

5.20.3.7 Where the operator has direct line of sight of the coupling operation, or the operator has visibility of the coupling operation by a CCTV system (meeting the requirements of Appendix M), it is permissible for personnel to be between the machines. Where personnel are required to be between machines during the coupling operation, the design of the coupling system shall provide sufficient space for the person to stand and complete the coupling operation. Where the operator has no sight of the coupling operation, then personnel shall not be permitted between moving machines and the restriction recorded on the ECC and included in the instruction handbook, as set out in 10.1.1.1 b).

G 5.20.3.7.1 The track conditions are set out in 5.3.1.

5.20.3.8 The first in class machine shall be tested to demonstrate compliance to all the requirements set out in 5.20.3.

5.20.3.9 Any limitations on machine movement, arising from the use of the coupling system, shall be identified and shown on the ECC and included in the instruction handbook.

G 5.20.3.9.1 The track conditions are set out in 5.3.1.

G 5.20.3.9.2 Railway Group Standards GM/RT2100 and GM/RT2190 set out requirements that are relevant to train coupling systems. While OTP are outside the scope of these documents, they may provide guidance on the suitability of proposed coupling systems.

5.20.4 Inter-machine connections

5.20.4.1 Machines that are intended to be coupled together shall have connection systems that are mechanically and electrically compatible and compliant with all the relevant parts of this document. Air brake connections shall meet the requirements set out in Appendix H.

5.20.4.2 Connections shall be suitable for use in the railway environment.

G 5.20.4.2.1 Connections should be assessed for suitability against vibration found while in railway use; it is likely that a latching arrangement will be required to keep the connections together.

G 5.20.4.2.2 It is recommended that consideration is given to other connection arrangements that already exist. Where the control functions are the same as an existing design it is preferable to have the same connection. Where the functions are different, connection in error should be avoided by a different mechanical design of the connection.

5.20.4.3 If a combination includes a wagon registered on the Rolling Stock Library, then a compatible pneumatic connection for the continuous service brake shall be provided (of the automatic air brake type).
5.20.5 Instructions for coupling and uncoupling machines

5.20.5.1 The procedure to be used for connecting towing machine to trailer (and trailer to trailer or machine to machine, where applicable), including the brake test, shall be included in the instruction handbook.

5.20.5.2 The procedure to be used for uncoupling, including the brake test, shall be included in the instruction handbook, including details of how pressure is released or trapping of pressures is avoided.

G 5.20.5.2.1 This procedure is likely to include the actual order required to physically couple and uncouple the machines, the position and duties of personnel, and details of the brake test included in the instruction handbook – for further details see M&EE COP0014.

5.21 Rail wheels

5.21.1 General

5.21.1.1 Rail wheels shall be designed to operate under all normal conditions of wear, suspension condition, machine loading and speed.

G 5.21.1.1.1 All designs should take into account maximum wear and degradation of components.

5.21.2 Rail wheel function

5.21.2.1 The rail wheels and associated components shall give the machine positive rail guidance, achieved by:

a) Single wheels with diameters sufficient to negotiate switches and crossings for the permitted operational speed range of the machine.

Or

b) A design incorporating at least one bogie, classified as a bogie design. The minimum wheel diameter in this configuration shall be 330 mm.

Or

c) Twin stub axles fitted with small wheels (130 mm minimum diameter) at each rail guidance position. The twin stub axles shall be rigidly constrained to each other. The stub axles’ centres shall be at least 220 mm apart to provide satisfactory guidance for negotiation of switches and crossings.

G 5.21.2.1.1 Although wheel diameters less than 330 mm are permitted, it is preferable that the minimum wheel diameter is 330 mm.

5.21.3 Rail wheel profile

5.21.3.1 The following is applicable for all rail wheels:
a) The wheels shall be ferrous for all OTP over 1 tonne gross laden weight.

b) The wheels shall be capable of resisting the foreseeable encountered forces.

---

**G 5.21.3.1.1** Treads and flanges of wheels for machines of 1 tonne gross laden weight or under need not be ferrous, but the machine should still meet the electrical conducting requirements of wheels / axles set out in 5.16.5.

---

5.21.3.2 Except as set out below, rail wheel profiles on existing machines shall be one of the profiles set out in Table 4. It is permissible for existing type 0D machines to have a non-standard wheel profile.

5.21.3.3 On machines first certificated after 31 December 2006 the rail wheel profiles shall be P1 or S1002, as set out in Table 4.

---

**G 5.21.3.3.1** There is no known technical justification for a proliferation of wheel profiles on OTP. P1 has a successful history of use on these machines in Britain and S1002 is used extensively on European machines. However, manufacturers are permitted to apply for a deviation against this requirement, and provide an alternative wheel profile, providing this is accompanied by a detailed technical justification. This could also require demonstration of suitability for various requirements – such as grease transfer from flange to rail head.
### Table 4  Rail wheel profiles (** these figures vary depending on wheel diameter)**

<table>
<thead>
<tr>
<th>Tread profile</th>
<th>Drawing number / specification</th>
<th>Network Rail drawing number</th>
<th>Flange thickness details (mm) W</th>
<th>Flange height details (mm) Y</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>As new</td>
<td>Minimum (Worn)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>As new</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Maximum (Worn)</td>
</tr>
<tr>
<td>LT5</td>
<td>92667</td>
<td></td>
<td>26.5</td>
<td>25.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28.7</td>
<td>36.5</td>
</tr>
<tr>
<td>P1</td>
<td>S8-C2-8006234</td>
<td>RT-C3-2400401</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>36.5</td>
</tr>
<tr>
<td>P5</td>
<td>S8-C2-8003908</td>
<td>RT-C3-2400405</td>
<td>31.5</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>29</td>
<td>33</td>
</tr>
<tr>
<td>P6</td>
<td>S8-C2-8006238</td>
<td>RT-C3-2400406</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>36.5</td>
</tr>
<tr>
<td>P8</td>
<td>S8-C2-8006239</td>
<td>RT-C3-2400408</td>
<td>28.5</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>36.5</td>
</tr>
<tr>
<td>P9</td>
<td>S8-C2-8006240</td>
<td>RT-C3-2400409</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>36.5</td>
</tr>
<tr>
<td>P10</td>
<td>F-C-00234</td>
<td>RT-C3-2400410</td>
<td>31</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>P11</td>
<td>C1-C1-9016365</td>
<td>RT-C3-2400411</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>34</td>
</tr>
<tr>
<td>S1002</td>
<td>BS EN 13715:2006 +A1:2010</td>
<td>NA</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

5.21.3.4 Rail wheels shall be maintained within the limits set out in Table 4, Table 5 and Figure 13.

### Table 5  Wheel profile tolerances

<table>
<thead>
<tr>
<th>Manufactured / re-profiled</th>
<th>Maximum in service limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difference in wheel diameters across axle</td>
<td>≤ 0,5 mm</td>
</tr>
<tr>
<td>Back-to-back measurement</td>
<td>1 360 ± 2</td>
</tr>
<tr>
<td>Ei</td>
<td>Flat</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dimensions set out in Table 4 and Table 5 should be interpreted in accordance with Figure 13. The normal nomenclature for parts of the wheel is shown in Figure 14.

**Figure 13** Definition of dimensions in Tables 4 and 5

5.21.3.5 The maximum permissible rail wheel / tyre width, as shown in Figure 14, shall be 150 mm. The minimum permitted width shall be 127 mm.

5.21.4 Rail wheel flange back spacing

5.21.4.1 The flange back-to-back spacing, Ei, of the rail wheels shall be measured with the machine in maximum loaded condition standing on the track. The flange back-to-back spacing shall also be measured with the machine in unloaded condition standing on the track. Both values shall be within the dimensions given.

G 5.21.4.1.1 The wheels back-to-back measurement, as a minimum, should be taken at the top and bottom of the wheel, with the loading conditions set out in 5.21.4.1. The manufacturer should detail the method of taking these measurements in the maintenance documentation.
5.22 Doors, door handles, steps, handrails and railings

5.22.1 Where a machine is capable of working next to a line open to traffic, the opening of doors shall either not cause them to be out of gauge or, if this requirement is not possible, the door shall self-latch in the in-gauge position(s).

G 5.22.1.1 To comply with the requirement set out in 5.2.1.9 and 5.9.4.2 the operating handle for the door should have a reminder catch across, or an additional form of restraint for the door (for example a chain) should be provided.

5.22.2 It shall be possible to lock the doors to cabs externally. When in the locked position it shall be possible to open the doors from the inside without the use of a key or there shall be a readily accessible alternative means of escape.

5.22.3 The construction and position of the door handles shall make fast escape possible, but they shall not open unless intentionally operated.

5.22.4 Steps shall be designed for ease of use, shall not retain liquids and shall be non-slip.

G 5.22.4.1 Consideration should be given to the ease of access and egress of the machine for personnel. Attention should be given to the height of the steps and handrails when mounting or dismounting the machine. The custom has been to use the rail wheel as a step, which is fine when dry, but can be very slippery when wet. Consideration should be given to avoid the potential for personnel to slip through the steps.

5.22.5 Steps and handrails shall be coloured white.

5.23 Audible warning device (in working mode)

5.23.1 Where a siren warning system is to be fitted to warn of approaching trains, the following requirements shall apply:

a) The siren system shall be a totally different note from any other warning system situated on the machine.

b) The system shall give a warning to personnel on and at any position around the machine.

c) The system shall be operable should the main power source have failed.

d) The system shall be operable from positions on or around the machine from which a lookout is able to see the approach of trains and personnel he / she is warning.

e) The control of the system shall be at least 300 mm from any other control so that it is not confused with any other system.

f) The system shall be failsafe such that a failure of the system shall be indicated to the operators and lookouts, as appropriate, at each working and driving position.

g) The warning horn(s) shall provide an increase of sound pressure level of at least 10 dB(A) greater than that produced by the machine, when measured at a distance of 1 m around the periphery of the machine and shall be in excess of 80 dB(A).
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

G 5.23.1.1 Fitment of this type of warning system is not a mandatory requirement. If a system is fitted to warn personnel of the approach of trains, then it should comply with the requirements set out in 5.23.

5.24 Demountable modules

5.24.1 Where a machine is designed to carry demountable modules, the securing system shall be capable of withstanding the forces set out in 5.24.2. Where reasonably practicable these shall be of the metal locking type.

G 5.24.1.1 The preferred method of fixing is twistlocks. BS 3951-1:1989, section 1.1 refers to locations of the twistlocks, fitted at a 2259 ± 2 mm pitch. Where twistlocks are not used, the manufacturer should demonstrate that an equivalent level of security is offered.

5.24.2 Modules shall have fixing arrangements capable of withstanding accelerations on any component of 2 g longitudinally and vertically, and 1 g laterally.

G 5.24.2.1 There are two types of twistlocks available, fabricated and cast. The cast type have a higher load capacity, typically fabricated are 7000 kg vertical, 18300 kg longitudinal and 7600 kg lateral, where the cast type have 17500 kg vertical, 20500 kg longitudinal and 7600 kg lateral capacity.

5.24.3 Demountable modules, when fixed to the machine, become an integral part of the machine and shall meet every appropriate requirement of this document.

G 5.24.3.1 This allows OTP and any attached demountable module to be assessed as a combination.

5.24.4 The ECC of the machine and the instruction handbook shall show each type of demountable module accepted for use with that machine.

G 5.24.4.1 The potential for additional security should be considered. Where this is required the manufacturer should design additional engineering requirements (there are existing designs for secondary locking of twistlocks readily available) or operational rules to check their design is fit for purpose.

5.25 Windscreens and windows

5.25.1 Where a host machine has a windscreen and windows already compliant to Road Machine Legislation, no further assessment is required.

5.25.2 Except as set out in 5.25.3 where a machine does not comply with 5.25.1, then either:
a) Where machines have a maximum travelling and/or working speeds of 20 mph (32 km/h) or less, windscreens and windows, where fitted, shall, as a minimum, conform to the safety glass requirements of BS 857:1967 or equivalent European National Standards.

Or

b) Where machines have a maximum travelling and/or working speeds greater than 20 mph (32 km/h), any windscreens and windows for areas where personnel are carried shall conform to GM/RT2456.

5.25.3 It is permissible for the machine to be fitted with windscreens and windows of an alternative material to those set out in 5.25.2 where it is able to be demonstrated that the proposed material has the same characteristics (or better) as the material set out in 5.25.2.

G 5.25.3.1 Where an alternative material is proposed to those set out in 5.25.2, all physical characteristics of the proposed material (such as impact strength, durability, clarity etc) should be assessed to confirm that they are as good as, or better than, the specified materials.

5.26 Remote control systems

5.26.1 Remote control devices that are carried shall failsafe (stop all machine movements) when the device is dropped, the operator falls over, or the machine moves out of range.

5.26.2 If the person operating a remote control system is not on board the machine (that is to say, walking beside the machine) the speed of the machine shall be limited to not greater than 3 mph (5 km/h).

5.26.3 Wire-less control devices shall meet the requirements set out in EN 50121-3-2:2015.

5.26.4 Wired remote control devices (sometimes called 'wander leads') shall cause the machine to cease all movements and apply brakes if the wired cable is inadvertently disconnected or severed.

5.27 Noise emissions

5.27.1 The ambient sound pressure level at the ears of the operator(s) at personnel positions shall be less than 80dB(Ae8hrs), with no peak sound pressure level to exceed 85dB(A), excluding audible emergency warnings.

5.27.2 The manufacturer will have declared the values for noise at the personnel positions in accordance with the Machinery Directive. This information shall be included in the instruction handbook. For machines first certificated after 5 December 2009, the measurements shall be made, or verified, in accordance with Appendix K.

5.28 Vibration emissions

5.28.1 Positions intended for personnel to be present shall be designed so that the vibration level is as low as possible.

G 5.28.1.1 The manufacturer should design the machine to reduce whole body vibration levels, in areas that could have persons present. Further guidance for manufacturers on design to reduce whole body vibration is given in PD CEN/TR 15172-1:2005.
5.28.1.2 The manufacturer should design the machine to reduce vibration levels of handheld components. Further guidance for manufacturers on design to reduce hand-arm vibration is given in CR1030-1 (also known as PD 6585-1).

5.28.2 The manufacturer will have declared the values for vibration at the working positions in accordance with the Machinery Directive. This information shall be included in the instruction handbook. For machines first certificated after 5 December 2009, the measurements shall be made, or verified, in accordance with Appendix L.

5.29 Structural integrity

5.29.1 The body and running gear shall be sufficiently robust to withstand, without failure, including fatigue failure, the maximum stresses to which they are foreseeably subjected to during travelling and working modes. The structural integrity of the machine shall be demonstrated by either:

a) Evidence by calculation and / or measurement that the stress levels are acceptable for a minimum of 5000 hours normal operation and that due account has been taken of the dynamic stresses produced during travelling and working modes for lateral, longitudinal and vertical acceleration requirements for components.

Or

b) Written evidence that the stress levels are acceptable through the safety record of machines having a comparable design with the same or greater wheel loadings. It shall be based on a minimum of 1000 hours normal operation.

G 5.29.1.1 The designer of the machine, either in total or just to the extent of the conversion for rail use, should include calculations to show that the stress levels in structural components are compatible with the requirement of achieving a life free of failures. This information should form part of the technical file that is used to assess the design for compliance. In support, the manufacturer can also undertake stress measurements on components during service trials. The requirements set out in GM/RT2100 and the guidance given in GM/GN2686 does not apply to OTP but may be used as a source of information.

G 5.29.1.2 In the case of a new machine whose design incorporates the manufacturer's standard components, it is permissible to use evidence of their satisfactory service history from existing applications in support of the demonstration of compliance. To make use of such information and have confidence in the structural integrity, the established load / use limits of the existing application should not be exceeded.

G 5.29.1.3 When making comparison with existing design of 1000 hours, the minimum hour history for an individual machine should be included. If a fleet of 100 machines has each accumulated 10 hours of trouble-free operation, this is not a sufficient demonstration of acceptable fatigue life.

5.29.2 Demountable machine component design calculations shall use, as a minimum, a value of 2 g for longitudinal, 2 g for vertical and 1 g for lateral accelerations.
G 5.29.2.1 These accelerations should be considered individually for the majority of components unless a design risk assessment shows that the accelerations are likely to be experienced simultaneously. Unsprung components in contact with the rail are likely to experience significantly greater vertical accelerations; these will depend upon machine maximum speed.

5.30 Fire prevention

5.30.1 Control of ignition

5.30.1.1 The design of the machine and its equipment, located inside and outside the machine, shall reduce the risk of ignition to that which is reasonably achievable.

G 5.30.1.1.1 The design process should include an assessment of normal operation and failure modes to demonstrate that the potential for ignition has been minimised. Sources of high power densities, such as pressurised gas canisters, internal combustion engines, electrical power equipment (including DC current collection equipment), braking systems, diesel-fuelled heaters, cooking equipment and heaters, should be well spaced or separated by appropriate barriers from more readily flammable substances, such as fuel, hydraulic oil, lubricating oil and their associated tanks (or reservoirs) and pipework other than that unavoidably proximate to the equipment. If sparks are inherent to normal machine operation, shielding should be provided to prevent ignition of combustible materials by such sparks. Particular attention should be given to mechanical sources below the floor of the machine. Examples of such equipment include cast iron brake blocks, and rail grinding equipment.

5.30.2 Control of fire development

5.30.2.1 The design of the machine and installation of its systems shall eliminate, as far as is reasonably practicable, features that could encourage fire development. Consideration of the appropriate factors shall include:

   a) Layout of systems and equipment.
   b) Accumulation of flammable debris.
   c) Accumulation of flammable dust in ducting.
   d) Equipment and pipework containing flammable fluids.
   e) Fuel tanks and fuel pipelines serving on-board equipment. Fuel tanks shall be in a protected area or be of a puncture resistant design.
   f) Equipment cubicles and equipment cases.
   g) Penetrations through floors or fire barriers.
   h) Compressed air pipework and reservoirs (burst or ruptured compressed air lines are able to transform fires into very intense heat sources).
   i) Routing of electric power and control cables (cable failure is a significant initiator of a fire).
   j) Location and security of electrical connections (loose electrical connections can readily overheat resulting in an arcing fire).
5.30.2.2 All driving, operating cabs and other areas where personnel could be trapped shall be fitted with appropriate handheld fire extinguishers.

G 5.30.2.2.1 An assessment should be made to ascertain which areas should have extinguishers fitted. Enclosed cabins containing personnel are likely to require extinguishers, but open personnel areas, used rarely, are unlikely to require them.

G 5.30.2.2.2 An assessment should be made by the manufacturer to show that likely fire risks have been considered. Where not reasonably practicable to eliminate the fire risk, the assessment should consider whether an extinguisher capable of dealing with a likely fire needs to be fitted. For example, where the fire is potentially electrical or oil based, it is not sensible to fit a water extinguisher, and where considerable wood or paper is present it will need a larger extinguisher.

G 5.30.2.2.3 A handheld fire extinguisher should be mounted in a secure but accessible position in each of the defined locations. Requirements for the selection and specification of the extinguisher are set out in GM/RT2130 and the EN 3 series of standards; these do not apply to OTP but may be used as a source of information. It is recommended that AFFF extinguishers should be used which pass the 35 kV electrical conductivity test of EN 3.

5.30.2.3 Where an automatic extinguishing system is fitted, then the operation of the automatic system shall not stop the machine or its functions.

5.30.2.4 For machines, where a fire would not be easily seen by the operator and other personnel and / or there is a danger of being trapped, a fire detection system shall be fitted to give the operator an audible and visual warning of a fire.

5.31 Design requirements for machines intended for predominant use in enclosed locations

5.31.1 General requirements for enclosed locations

5.31.1.1 OTP intended for use in enclosed locations shall only incorporate internal combustion engines where the use of an alternative, cleaner power source is impracticable.

5.31.1.2 Where internal combustion engines are used in OTP they shall be diesel which are type-approved within the EEA countries.

G 5.31.1.2.1 Combustion engines used on machines should employ the best available technology to reduce toxic and other undesirable exhaust emissions.

G 5.31.1.2.2 Manufacturers supplying OTP incorporating diesel engines are responsible for providing evidence that the engines have been type approved by an accredited body in an EU member state. In the UK the accredited body is the Vehicle Certification Agency (VCA).

5.31.1.3 The limits of acceptability for the neat exhaust emissions from internal combustion engines incorporated into OTP intended for use in enclosed locations are as set out in Table 6.
Table 6 Neat exhaust emission limits for diesel engines

<table>
<thead>
<tr>
<th>Engine size</th>
<th>Carbon monoxide (ppm)</th>
<th>Oxides of nitrogen (ppm)</th>
<th>Nitrogen dioxide (ppm)</th>
<th>Bosch smoke number</th>
<th>Visual smoke</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>1500</td>
<td>500</td>
<td>n/a</td>
<td>0.5</td>
<td>Moderate</td>
</tr>
<tr>
<td>Over 750cc</td>
<td>800</td>
<td>700</td>
<td>70</td>
<td>0.5</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

G 5.31.1.3.1 Limits for exhaust emissions from internal combustion engines are defined in the European Directive for non-road mobile machinery, 97/68/EC amended, but these are not specifically intended for use in enclosed locations and therefore the need for the additional requirements set out in Table 6.

G 5.31.1.3.2 If the gaseous constituents are not stated by the manufacturer of the engine, an acceptable method of measuring the gaseous constituents of the neat exhaust is the use of CE conformant Drager tubes.

G 5.31.1.3.3 If the Bosch smoke number is not stated by the manufacturer of the engine, an acceptable method of measuring the level of smoke in the neat exhaust is by use of the Bosch ETD 020.50 instrument, or equivalent.

5.31.1.4 The exhaust gases from OTP intended for use in enclosed locations shall not be directed towards the catenary or towards any cables and pipes attached to the tunnel walls.

5.31.1.5 Diesel powered OTP that are intended for use in enclosed locations shall be designed to ensure that the air quality in all enclosed cabins and work stations occupied during travelling or working remains within acceptable limits.

G 5.31.1.5.1 Where diesel powered OTP are required to work in enclosed locations having uni-directional ventilation, the operating configuration of the machine in travelling and working modes should consider that no occupied cabin or work station is downstream of the engine exhaust, or that alternative arrangements are in place to provide acceptable air quality within the occupied cabin or work station.

5.31.1.6 The hydraulic fluid used in machines intended for use in enclosed locations shall comply with BS ISO 7745.

5.31.2 Fire precautions for enclosed locations

5.31.2.1 Machines intended for use in enclosed locations shall be designed for use either with materials specifically suitable for underground locations or a fire safety justification, as set out in 5.31.2.2, shall be made.

5.31.2.2 Where materials are not specifically suitable for underground locations an assessment of the fire load of the machine design shall be made. This assessment shall include an inventory of all materials with the quantity of use. The assessment will then need to include the likelihood of being exposed to a source of ignition and the mitigations for their location etc.

G 5.31.2.2.1 Further guidance on assessment of fire load is given in the BS 6853 and EN 45545 series.
G 5.31.2.2.2 Automatic fire extinguishing systems on vehicles used in confined spaces should be considered for their effect on the air quality for the operator or those working in the vicinity of the machine.

5.31.2.3 All areas within a machine that are permitted for staff shall have a minimum of two separate exits on sides of the machine 90° apart.

5.32 Owner identification
5.32.1 The owner's name and contact telephone number shall be displayed on the machine data panels, where fitted (see Appendix C).
Part 6 Road-Rail Vehicle Design Requirements

6.1 On and off tracking

6.1.1 The requirements set out in 6.1.2 to 6.1.5 are in addition to the requirements set out in 5.19, during on and off tracking.

6.1.2 Except for machines fitted with a turntable, as set out in 5.19.2, during the on and off tracking process RRVs shall at all times have at least two braked wheels on one axle (with the brakes applied during the road / rail transition phase), sufficient to hold the machine on the most adverse gradient on which it is able to be on and off tracked, in contact with either the rail or ground. This state shall be achieved by engineering means (for example an interlocking system) and not to be reliant on procedural controls. Any brake that is relied upon to meet the requirements of this clause shall not rely on a power source to apply.

6.1.3 Tracked (crawler) machines shall not damage the rail head. Tracked machines shall either:

a) Have tracks constructed completely from non-metallic material.

Or

b) Have tracks constructed such that metal parts are not exposed during all normal wear, and have specific maintenance requirements and limits shown in the maintenance instruction set out in Part 9.

Or

c) Carry, in a stowage facility on the machine, sufficient rail head protectors to enable the machine to be on and off tracked without damaging the rail head.

G 6.1.3.1 Bolt-on-pads fitted onto metallic tracks do not normally meet the requirements of clause b), which implies that metallic parts are embedded and should be obvious that wear is occurring before they are exposed.

6.1.4 The manufacturer shall provide a diagram as part of the documented on and off tracking procedure that illustrates the minimum physical size of the RRAP area to be used. The documented procedure shall state the maximum permitted angle of approach and the width of the RRAP either side of the track required to undertake the on and off tracking process.

6.2 Rail wheel systems

6.2.1 Rail wheel guidance

6.2.1.1 The rail wheels shall be loaded to provide guidance at all times when the machine is on rail. This shall be achieved by either the rail gear having a positively locked system (see 6.2.2) or an active suspension system (see 6.2.3).

G 6.2.1.1.1 The maximum and minimum rail wheel loading in both static and travelling modes should comply with the relevant parts of this document, in particular 5.4, 5.5, 9.5 and 9.6.

6.2.2 Positively locked guidance system

6.2.2.1 The rail gear shall be positively locked in both the stowed and rail mode. The locked state of the guidance system shall be maintained in the event of failure of the system.
6.2.2.2 It shall not be possible to inadvertently change mode from rail to road or vice-versa. The ability to leave a mode shall require a deliberate and positive act by two separate actions.

6.2.2.3 Rail gear held down with hydraulic cylinders shall have check valves on each cylinder to prevent against sudden loss of pressure (for example, due to hose failure).

6.2.2.4 The design of the controls shall be such that it is not possible for the operator to operate the rail gear, even momentarily, by accident.

G 6.2.2.4.1 In hydraulic circuits, pilot-operated control valves should be designed and installed so that the system in which they are installed fails safe (that is to say, stops the corresponding movement) in the event of failure.

6.2.2.5 Having turned a power source off, and allowed the various control systems to shut down, the various control systems shall retain the previous control state upon re-initiation of the power source, unless this results in an unsafe condition.

6.2.3 Active suspension systems

6.2.3.1 An active (or compensating) suspension system shall enable the RRV to be brought to rest safely following a sudden loss in pressure of the active medium, even when travelling at its maximum speed on any of the track conditions set out in 5.3.1.

6.2.3.2 There shall be a visual indication to the operator of the correct functioning and position of the system at the driving / control position. An alarm shall sound if the system malfunctions.

G 6.2.3.2.1 This clause means that the machine operator should be provided with an indication of the position of the rail wheels or rail gear in rail mode, together with an indication of its functioning at the correct system pressure(s). See also 6.2.4.

6.2.3.3 Following a failure of the active suspension system, there shall be a system to stop the machine rail movement, which is permitted to be initiated automatically, or by the operator following an alarm indication being given.

6.2.4 Ratio of wheel load on guiding wheels to road axle load for RRVs

6.2.4.1 Where road wheels share the load with the guiding rail wheels (that is to say, type 9C machines), in travelling mode and moving along the track in working mode, the ratio shall be set up so that the machine complies with the braking and dynamic stability requirements of this document with all permitted load variations.

6.2.4.2 Type 9C machines shall either:

a) Have the rail wheels deployment mechanically locked and not reliant upon any powered source.

Or

b) Have rail wheels held in position by trapped hydraulic pressure (or similar) and shall either:
i) Be held in place by devices such as failsafe powered check valves.

Or

ii) Have audible and visual warning devices to indicate an unsatisfactory wheel support force.

---

G 6.2.4.2.1 An example of the set-up for a shared load is shown in the graph in Figure 15. This displays the load on the road wheels compared against rail wheels, and is most suitable where maximum traction and braking is required. The 'y' axis shows the load on the rail wheels, and the 'x' axis the road wheels. The figures shown are for an axle; hence the wheel loads on each axle (or opposite each other on stub axles) should be added together. The comparison between road and rail wheels should be made for adjacent wheels.

G 6.2.4.2.2 The road wheel weights should be taken with the machine in road mode, then when in rail mode the rail wheel load adjusted to suit the figure in the graph in Figure 15.

G 6.2.4.2.3 With type 9C machines it is vital that the wheel loads are shared appropriately between the road and rail wheels to provide the correct amount of guidance from rail wheels and brake / traction from road wheels. On machines where the normal laden and tare weights do not vary significantly, for example excavators, MEWPs and Landrovers, the initial setting could be considered sufficient to provide adequate loading. Where the axle loads on the road wheels vary by a large ratio, for example between tare and laden conditions on lightweight machines, heavily laden machines such as water tankers etc, the load on the rail wheels needs to vary accordingly to meet the requirements of the graph. Consideration should also be given to the potential locations where the machine will be used, for example a means of retaining the rail wheel load will need to be fitted where rails are sunken into concrete or tarmac (docks / depots / tramways etc) and there is the potential for the road wheel to relieve the load on rail wheel.

G 6.2.4.2.4 It is also good practice to warn the operator of too much rail wheel loading.

---

6.2.4.3 Except as set out in 6.2.4.4, type 9C machines shall not be capable of raising any part of the machine road wheels once the rail guidance system has been lowered into position.

6.2.4.4 For type 9C machines it is permissible in travelling mode only for one rail axle to lower and lift one road axle at a time providing that all road or rail wheels have failsafe brakes. This function shall be interlocked to ensure that one road axle remains in full contact with the rail and that the brake meets the requirements set out in 5.6.

---

G 6.2.4.4.1 With type 9C machines, there should be no provision made to raise both road wheels during the time the RRV is in rail mode and with the rail gear fully deployed (that is to say, the use of such things as an ‘inducie button’ or equivalent is not permitted).
Wheelset support force of rail guide in relation to vehicle axle load

Wheelset support force [kN]
Axle load on road wheels [kN]

Wheelset support force
Max. wheelset support force
Min. wheelset support force
Warning

Figure 15  Ratio of wheel load on guiding wheels to road axle load

6.3  Steering

6.3.1  Except as set out in 6.3.2, there shall be a facility for the road steering wheels to be positively locked in the straight ahead position if the road steering wheels:

a)  Are in contact with the rail.

Or

b)  Are in contact with the rail wheels.

Or

c)  Have the potential to exceed the permitted gauge when the road-rail machine is rail mounted and the wheels are out of line.

6.3.2  For 6.3.1c) it is permissible to replace the locking of road wheels with an interlock in the drive such that, before the road wheels encroach into the permitted gauge, the traction power is removed and the brakes applied.
6.3.3 The locking device(s) shall be readily checked and accessible to the operator with the road wheels in line.

G 6.3.3.1 The device can be located at the driving position or local to the road steering wheels.

6.3.4 There shall be a label visible at each driving position stating 'When in rail mode ensure road wheels are aligned with track and the steering locked'.

6.4 Road vehicle conversions

6.4.1 If the machine or trailer is a converted road vehicle the structural strength shall not be compromised. Any work on the machine shall be approved by the original vehicle builder or other competent body.

G 6.4.1.1 Where the machine is to be used on the public highway any alterations / additions should not contravene the Road Machines (Construction and Use) Regulations 1986 and subsequent amendments.

G 6.4.1.2 In all cases, the manufacturer who converts the vehicle to a RRV, or the importer, is responsible for CE marking the RRV and issuing the declaration of conformance, as a requirement under the Machinery Directive.

G 6.4.1.3 It is expected that the manufacturer will assume that a finished standard automotive chassis used as a host for an RRV will offer an acceptable safety level for its basic functions, or the manufacturer should carry out an appropriate risk assessment. Where a risk assessment is required, the manufacturer should complete it for the complete machine, even where currently a harmonised standard does not exist for the machine in road configuration.
7.1 Trailer design

7.1.1 Trailers are permitted to take two forms. Either they are wagons registered on the Rolling Stock Library, or they will conform to the requirements set out in this section. In the latter case they shall be restricted to use in possessions.

G 7.1.1.1 Wagons registered on the Rolling Stock Library are conventional wagons permitted to be hauled outside of a possession and are fitted with conventional traction and rolling stock braking and drawgear (couplings).

7.2 Trailer general design requirements

7.2.1 Where the trailer is not a wagon registered on the Rolling Stock Library, the trailer shall meet all sections, where relevant, of this document with the following amendments:

a) Trailer frame strengths, tow points, couplings and tow bars shall, as a minimum, meet the maximum coupled loads of total consists (both towing and propelling). The ECC and the instruction handbook shall show the maximum number and total trailed weight of trailers that the manufacturer specifies can be safely coupled together.

b) The coupling type and height shall be as set out in Appendix J.

c) Tow bars shall meet the requirements set out in Appendix J.

d) Except as set out in 7.2.1e) and o) and 7.2.2, trailers shall have an air service brake fitted meeting the requirements of 5.7. The parking and service brake system shall be controlled by two separate air lines with brake pipe connection type and position as set out in Appendix H. Two-wheeled trailers and type 0D machines as set out in 7.2.2, which are incapable of moving along the track when disconnected from the towing machine, are exempt from this requirement. The exemption shall be shown on the ECC and included in the instruction handbook.

e) It is permissible for trailers, designed for towing by machines of less than 400 kg GVW, to have an electric service and parking brake where control on the towing machine simultaneously applies a brake on the towing machine and each trailer.

f) Trailers with a service brake shall be fitted with labels on either side stating ‘SERVICE BRAKE FITTED’, which shall be clearly visible from a distance of 2 m or, if fitted with a data panels (see Appendix C), the data panel shall be marked with the same phrase.

g) The trailer, in both fully laden and unladen condition, shall meet the stopping distances set out in 5.7.2 if it breaks away from the machine.

h) There is no requirement for two separate and independent braking systems, but the parking brake shall meet the requirements set out in 5.7.5 and 5.20.2.8.

i) The brake pressure range for each braking system shall be displayed adjacent to the brake pipework on the trailer headstock in letters / figures that are clearly legible from a distance of 2 m.

j) Where a trailer has a three point suspension system, the stable load carrying area shall be clearly and permanently marked on the floor of the trailer. The method of loading the trailer shall be included in the instruction handbook.
k) The trailer shall clearly display its tare weight, gross weight and carrying capacity, details of which shall be shown on the ECC and included in the instruction handbook. It is permissible to amend suitably the data panels, where fitted (see Appendix C).

l) Trailers shall have one space suitable to display the date of the next maintenance brake test due, in characters that are clearly visible from a distance of 2 m.

m) Trailers greater than 0.5 tonnes tare weight shall be capable of displaying two white marker lights only at the front when being propelled, and two red tail lights only at the rear when being towed. They shall also be capable of displaying two red tail lights at each end when detached from a towing machine and left on rail. Trailers that cannot be coupled in multiple, and are 0.5 tonnes or less, are permitted to have lamp irons, or some other suitable means of attaching the lights, as set out in 5.15.1.8.

n) Except where an operating or driving position is fitted, headlights and horns are not required.

o) It is permissible for attachments with two or more rail wheels not to be fitted with an air service brake system, where they fulfil all the following requirements:

i) They are non-load carrying attachments.

ii) They are incapable of being coupled to any other trailer.

iii) They are limited to use with one type of controlling machine with the attachment attached to the dipper arm.

iv) They are less than 20% of the gross weight of the controlling machine.

v) They comply with 7.3.4.1a).

G 7.2.1.1 It is recommended that automotive air-brake components are used on trailer brake systems.

7.2.2 Two wheeled trailers shall:

a) Be fitted with a coupling and connections at one end only.

b) Either be limited to coupling with specific type(s) of towing machine, or service brakes shall be fitted.

c) Be tested for conformance with 5.7.2.1 as the un-braked trailing load. Trailers shall be fitted at both ends of the towing machine simultaneously if the towing machine has the capability of coupling at both ends.

d) Either have a secondary retention system or be fitted with a breakaway brake, as set out in 5.7.6.5.

G 7.2.2.2 The ECC and the instruction handbook should show whether an attachment (type 0D trailer) is able to move along the track in either / both travelling and working modes when disconnected from the towing machine, which will define when service brake requirement can be exempted.

G 7.2.2.3 The instruction handbook and the ECC of the two wheeled trailer should have the specified towing machines described.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

7.2.3 Trailers, whose design obstructs the forward vision required by 5.9.1.1 if used in front of the towing machine, shall have a limitation shown on the ECC and in the instruction handbook ‘shall not be propelled’, and the data panel, where fitted (see Appendix C) marked ‘not to be propelled’.

7.2.4 The manufacturer shall provide any necessary fixed equipment for load retention and include the details of use in the instruction handbook.

7.2.5 Where loading ramps are provided, their use (including the stabilisation of the trailer during the loading operation) and the capacity, shall be included in the instruction handbook.

7.3 Brakes

7.3.1 Parking brake indication

7.3.1.1 Either:

a) A failsafe visual indication to show that the parking brake is in the ‘OFF’ or ‘ON’ position shall be provided on the outside of each machine and adjacent to all parking brake control points.

Or

b) It shall be easily possible to establish by sight whether the parking brake is applied or not.

G 7.3.1.1 It should be possible to see if the parking brake is on or off while standing outside the machine (but not necessarily from every position around the machine).

G 7.3.1.2 If a light system is used to indicate ‘ON’ or ‘OFF’, then either both states require a light indication, or the light should indicate the ‘ON’ state so that the indication is failsafe.

7.3.2 Hydraulic parking brake

7.3.2.1 Hydraulic released parking brakes shall be failsafe.

7.3.2.2 There shall be no self-contained systems for manual release.

G 7.3.2.1 Hand pumps, or accumulators for storing pressure which can be used to release the parking brake while the trailer is disconnected from its towing machine, should not be fitted.

7.3.3 Service brake indication

7.3.3.1 The manufacturer shall detail in the instruction handbook the instructions for demonstrating continuity of the service brake each time the trailer is coupled.

7.3.4 Miscellaneous machines and attachments

7.3.4.1 Miscellaneous machines and attachments with rail wheels (see 4.6) shall either:

a) Be fitted with a failsafe brake which automatically applies when not coupled or attached to the towing machine.

Or

b) The design of the machine or attachment prevents a run-away.
7.3.4.2 Where attachments are fitted with a braking system, the documented brake testing procedure shall form part of the maintenance procedures in the instruction handbook and shall meet the stopping distances set out in 5.7.2.

7.3.4.3 For non-load carrying attachments, with two or more rail wheels, that are limited to use with one type of controlling machine and where the attachment is less than 20% of the gross weight of the controlling machine, it is permissible for the attachment to comply with 7.3.3.1a) and not be fitted with a service brake system.

7.4 Jacking points for recovery

7.4.1 For trailers with tare weight greater than 1 tonne, jacking points shall be provided such that the trailer can be safely supported by jacking at one end and / or jacking at both ends simultaneously.
8.1 General

8.1.1 All trolleys shall meet the requirements of BS EN 13977:2011, except as set out below:

a) Electrical power supplies shall be limited to 110 V AC and DC, not as set out in BS EN 13977:2011 section 5.6.1.

b) Trolleys permitted to be used outside of a possession shall comply with the requirements for the electrical resistance across rails set out in BS EN 13977:2011 section 5.12.1. Portable and transportable Plant that is limited to be used only within a possession shall have an electrical resistance between rail wheels of <0.01 Ω, measured across wheel tread surface on wheels on opposite rails (normally on the same axle alignment). See also 8.2.1.

c) The gauge profile set out in BS EN 13977:2011 section 5.17 is permitted in the second paragraph to be more restrictive on some infrastructures. The gauge profile of trolleys for use on Network Rail managed infrastructure shall either be compliant with W6a gauge, as defined in Appendix A of GE/RT8073, or the trolley shall be restricted for use within a possession only. It is permissible for the gauge to be exceeded in the area around the wheelset, as shown in Figure 16 and Figure 17, depending on the weight of the trolley. The ECC shall be endorsed 'Not for use on switches and crossings with a raised check rail' when Figure 17 is used.

G 8.1.1.2 The use of the profile shown in Figure 17 could cause a conflict at switches and crossings with check rails above rail level; this is the reason for the endorsement.

Figure 16 Exceedance allowed at lower gauge (up to 1000 mm above rail level) for railborne portable and transportable Plant over 20 kg
Figure 17  Exceedance allowed at lower gauge (up to 1000 mm above rail level) for railborne portable and transportable Plant 20 kg and less

G 8.1.1.3  The manufacturer should take into account the maximum allowable wear on wheels and suspension equipment to ensure clearances are achieved throughout the life of the trolley.

G 8.1.1.4  The profile shown in Figure 17 includes no allowance for raised check rail to 60 mm above rail head level. The ECC should be endorsed with any restrictions.

8.1.2 Where the trolley is considered likely to be left on the track, there shall be the provision to attach a lamp at both ends of the trolley.

G 8.1.2.1  A trolley used as described in Handbook 10 (GE/RT8000 – HB10) should display either a red flag or red light (Handbook 10 clause 3).

G 8.1.2.2  A bracket acceptable for attaching a lamp is shown in Figure 11.

8.2 Rail wheels

8.2.1 The electrical resistance between rail wheels on one axle (or the equivalent if stub axles are fitted) shall be measured and stated. The resistance shall either be less than 0.01 Ω or greater than 10 M Ω (in which case the wheel shall be painted blue, as set out in 5.15.3.9 d)).
G 8.2.1.1 BS EN 13977:2011 section 5.3 sets out requirements for the trolley in its worst case operating condition to ride successfully on a range of track configurations. The track configurations shown in BS EN 13977:2011 should be augmented with a track twist test equivalent to a slope of 1 in 150 of one rail up to a maximum of 20 mm.

G 8.2.1.2 Additionally, the trolley should be tested and assessed to ensure it does not exhibit the propensity to derail on all track conditions at 3 mph (5 km/h). This should include switches, crossings, dipped joints, track twists, curves and canted track under all operational modes.

8.3 Brake system

8.3.1 The braking system of trolleys shall be designed to meet the stopping distance performance set out in EN 13977:2011 5.4 with an overload of twice the permitted load. The maintenance instruction shall include instructions to retain this capability. The performance shall be demonstrated to meet the stopping distance dynamically at 6 km/h with twice the stated permitted maximum load, and at 10 km/h with the maximum permitted payload.

G 8.3.1.1 The manufacturer should provide instructions in the maintenance instruction to maintain the braking system during its working life.

G 8.3.1.2 It would also be advantageous to have an engineering control of load limiting, but this is not mandated.

G 8.3.1.3 In addition to overloading, there is also a risk of an adverse effect on the braking performance caused by over-speeding of trolleys. The maximum speed of a trolley is 3 mph (as set out in RIS-1700-PLT). The speed is controlled by staff discipline; it would be advantageous to have an engineering means to limit speed, but this is not mandated.

8.3.2 Trolley brakes shall be designed assuming a dynamic use on a downward slope and shall demonstrate the ability to accommodate the wear in the braking components.

8.3.3 Trolleys shall, as far as reasonably practicable, be designed to prevent interference and damage to any mechanisms and actuators used in the operation of the brake, which could subsequently impede or reduce the effectiveness of the operation of the brake.

8.3.4 Each braked rail wheel shall have capability of measurement of the dynamic torque figure of the braked wheel, with an adaptor, as necessary, to a torque wrench or other suitable device.

G 8.3.4.1 The method of maintenance and use testing of brakes for trolleys is set out in M&EE COP0018

8.3.5 Where trolleys are capable of coupling together, the coupling action shall not automatically release the brake on either of the trolleys.

8.4 Manual propulsion

8.4.1 The design of trolleys shall take into account the capabilities of the people required to propel (pull or push) it.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

G 8.4.1.1 When deciding the maximum weight of the trolley and any permitted load, consideration should be given to the manpower required to propel it along the track. Advice on the number of persons normally required to push wheeled vehicles is given in M&EE code of practice COP0018.

G 8.4.1.2 Additional advice for design considerations regarding the handling and operation of trolleys can be obtained from Network Rail’s Ergonomics & Human Factors Specialist Team.

8.5 Dynamic stability

8.5.1 The design of trolleys shall either be stable on all track conditions set out in 5.3.1 or the value of cant and gradient shall be continuously measured and indicated. The maximum value of cant and gradient (and any other restriction) that the trolley is permitted shall be displayed on the side of the trolley and detailed in the instruction handbook, as set out in 10.1.2.2 i).
Part 9 Machines with Moveable Parts Affecting Stability

9.1 General requirements

9.1.1 Moveable parts

9.1.1.1 A machine with moveable parts shall not be used with adjacent lines open to traffic (adjacent line is defined as a line where the kinematic gauge of the machines using the line could be fouled by the moveable part) unless either:

a) Limiting devices, as set out in 5.8, capable of stopping the slewing action of the superstructure (both front and rear) in all operating conditions are fitted.

Or

b) The machine is permitted to be operated with adjacent lines open to traffic and the limitations of operation are clearly shown on the ECC and included in the instruction handbook.

9.1.2 Moveable superstructure dimensions

9.1.2.1 For machines with a moveable superstructure which is able to move beyond the Plant gauge, the lateral distance by which the tail swing exceeds the gauge shall be shown on the ECC, included in the instruction handbook and on the data panels, where fitted (see Appendix C).

9.1.2.2 The minimum height from rail level to the underside of the rotating part beyond the gauge line shall be shown on the ECC, included in the instruction handbook and on the data panels, where fitted (see Appendix C).

G 9.1.2.2.1 This clearance is required to enable the planner and site staff to determine if the superstructure is able to slew over adjacent lineside equipment, platforms etc.

G 9.1.2.2.2 This clearance will not be required where the tail swing, or front of the machine where the superstructure extends beyond the width of the carriage, remains completely within the gauge in all conditions.

G 9.1.2.2.3 Historically, a minimum height of tail swing of 1300 mm has been found sufficient to clear the majority of lineside equipment, platforms etc.

9.1.3 Label

9.1.3.1 Where a machine has moveable superstructure, a warning label shall be provided on both sides of the superstructure. This label shall be black on yellow. It shall be fixed in the location set out in Appendix D.

G 9.1.3.1.1 An example of an acceptable label is shown in Figure 18. The dimensions of this label are 175 mm x 335 mm.
Figure 18  Example label for warning of moveable superstructure

G 9.1.3.1.2  These notices are generally only fitted on the tail swing area of rotating superstructures; however, it is expected that manufacturers will examine the whole machine to determine if additional notices are needed in other areas as well.

9.2  Cranes (including excavators / loaders used as cranes)

9.2.1  Cranes – general requirements

9.2.1.1  Other than knuckle boom cranes, cranes shall comply with the requirements set out in EN 13000:2004.

G 9.2.1.1.1  The crane itself should comply with BS EN 13000:2004. The attachment of rail wheels to the machine and the effect this has on the crane, especially the safe working loads (SWL), is covered by this document. The conversion of the original machine to an item of OTP will require a recertification, similar to the guidance given in G.6.4.1.2. Manufacturers are reminded that, if the theoretical maximum load on the machine is greater in rail mode, then consideration should be given to the ability of the crane structure to withstand the additional load.

9.2.2  Incorporation of knuckle boom cranes

9.2.2.1  The design, construction and testing of knuckle boom cranes (formerly known as lorry loader crane units) shall conform to the requirements set out in BS EN 12999:2011.

G 9.2.2.1.1  The knuckle boom crane itself should comply with BS EN 12999:2011. The attachment to the machine and the effect of the crane on the machine is set out in this document.

9.3  Mobile elevating work platforms

9.3.1  New or newly converted machines

9.3.1.1  Except as set out in 9.3.1.2, machines fitted with MEWPs shall meet the requirements of the latest issue of BS EN 280:2001.
The manufacturer should demonstrate proof of compliance with BS EN 280:2001, by one of the following:

a) Assessment by a Notified Body (NoBo) registered by a member state of the European Union to carry out such assessments, and certificated by the NoBo.

Or

b) Certification by a NoBo that they have checked the manufacturers' calculations and tests.

Or

c) Self-certification by the manufacturer as compliant to BS EN 280:2001 with the technical file held by a NoBo.

Except for wheel loads (for which the requirements are set out in 9.6), annual brake test stopping distances (as set out in 10.2.9), and rail clamps (as set out in 9.5.4.1), where there is a conflict between this document, RIS-1530-PLT, and BS EN 280:2001, the latter shall prevail.

A guard rail, or other suitable device, shall be fitted over the operating controls on the work platform of a MEWP to prevent the operator inadvertently activating controls by leaning on them (or being pushed into them).

Where the MEWP (including machines fitted with MEWP attachments) is fitted with a separate driving cab, as well as the controls in the work platform, and the MEWP is in working mode (that is to say, the work platform is out of the stowed position), it shall not be possible to drive or operate the MEWP from the driving cab.

The MEWP shall be provided with a system for the work platform to be retained in the stowed position while in travelling mode. The system shall include an interlock to limit the MEWP to being moved along the track at working mode speed when the work platform is not in the stowed position.

Emergency recovery labels shall be visible with the machine in rail mode, standing at sleeper level.

Several types of MEWPs are manufactured where the emergency recovery labels are attached to a sloping surface that can only be clearly read when viewed from above. The additional height of the machine in rail mode, combined with standing on a ballast shoulder, can cause some of these labels to be obscured or not visible.

With the machine in rail mode the PAB should assess whether the emergency recovery labels / signage is visible to someone standing on the ballast. If the existing labels / signs cannot be clearly seen and understood when viewed as set out above, then the requirement set out in 9.3.1.6 is that additional identical labels / signs are fitted such that they are clearly visible from the ballast.

Recertification of machines

Machines which are being recertificated to this document and fitted with MEWPs shall meet the requirements set out in BS EN 280:2001 or later (depending on the date of original CE declaration) at the date of recertification.
9.3.3 Work restraint anchor points fitted to MEWPs

9.3.3.1 Work restraint anchor points shall be fitted to MEWPs which shall be dedicated points within the work platform (for example rails or fixed points).

9.3.3.2 Anchor points shall be attached only to permanent parts of the work platform unless designed for specific movable components of the work platform.

9.3.3.3 The anchor points shall be designed to accept any required personal protective equipment.

9.3.3.4 The number of anchor points provided shall be sufficient to accommodate the maximum number of personnel allowed in the work platform.

9.3.3.5 Work restraint anchor points in the work platform shall be clearly identified and marked for work restraint.

9.3.3.6 Work restraint anchor points in the work platform shall be clearly marked with the number of persons for which they are rated.

9.3.3.7 Testing of work restraint anchor points shall be carried out using a load of 750 N per person. There shall be no resultant permanent deformation when the load is applied in the least favourable condition. The test shall be made following initial fitment and following any structural repair.

9.4 Attachments

9.4.1 Attachments affecting machine stability

9.4.1.1 Attachments intended for use in rail mode without an RCI (or with the RCI switched off) and which adversely affect machine stability shall be identified by make and model number and be shown on the ECC and included in the instruction handbook of each applicable machine.

9.4.1.2 An attachment intended for use on a specific machine shall be shown on that machine’s ECC and included in the instruction handbook.

9.4.1.3 The ECC and the instruction handbook shall be endorsed ‘Where an attachment is known to have a significant adverse effect on stability the RCI shall always be in “Lift Mode” when using the attachment’.

G 9.4.1.3.1 Where an attachment is used that adversely affects stability and / or dynamic performance and the make and model number is not shown on the ECC, it is essential, when in service, that the RCI is operational. The recommended course of action, where practicable, is always to use the machine with the RCI operational that is to treat the attachment as a load.

G 9.4.1.3.2 Common attachments and components which can be fixed to the machine such as various size buckets, which are not identified by individual model or serial numbers, should be identified by capacity or size.

9.4.2 Attachments for raising and lowering personnel

9.4.2.1 Attachments or adaptations for raising and lowering personnel shall be treated as MEWPs and shall meet the requirements set out in 9.3. There shall be an endorsement on the ECC and in the instruction handbook, as set out in 9.4.1.1.

G 9.4.2.1.1 The attachment and specific machine should be assessed together for compliance to BS EN 280:2001.
9.4.3 Quick Hitches

9.4.3.1 Machines shall not be fitted with semi-automatic Quick Hitches.

| G 9.4.3.1.1 | A semi-automatic Quick Hitch is one that requires the operator to manually insert a retaining bar in the hitch after the Quick Hitch latch has been operated. |

9.4.3.2 The auxiliary lifting point fitted on Quick Hitches shall comply with 9.10.

9.4.3.3 Quick Hitches that are designed to be used to undertake lifting operations through the Quick Hitch jaws shall be rated, tested and examined in accordance with the requirements of LOLER.

9.4.3.4 Quick Hitches approved for lifting shall either be:

   a) Permanently fitted to the machine, in which case they are considered to be part of the item of lifting equipment, as defined by LOLER. The Quick Hitch body and adaptor plate shall be considered part of the machine for the purpose of producing the RCI load / radius tables. In this case the RCI load / radius tables shall be endorsed to the effect that the Quick Hitch is part of the machine and not an additional load.

   Or

   b) Considered as a lifting accessory as defined by LOLER and not permanently fitted.

9.4.3.5 Permanently fitted Quick Hitches, as endorsed on the RCI load / radius table, shall be attached by nuts and bolts or split / cotter / roll pins or other permanent fixings that require tools to disconnect.

| G 9.4.3.5.1 | Quick Hitches with mounting pins that are retained by fixings such as ‘R’ clips, Lynch pins and / or French keys are not considered to be permanently fitted, and the RCI load / radius table will not be endorsed with the Quick Hitch details. |

| G 9.4.3.5.2 | Quick Hitches that are not permanently fitted should be attached to the machine after the stability testing has been undertaken and the RCI load / radius tables produced. |

9.4.3.6 Where a permanently fitted Quick Hitch does not carry the necessary rating / testing and certification to undertake lifting operations either via an auxiliary lifting point on the body or the Quick Hitch jaws, the Certificate of Engineering Acceptance shall be endorsed ‘Quick Hitch not suitable for undertaking lifting operations’.

9.4.3.7 Maintenance instructions shall include all appropriate maintenance requirements of any permanently fitted Quick Hitches.

9.5 Static stability

9.5.1 Proof of stability against overturning, machine stationary, general

9.5.1.1 If a machine has a structure that is able to move and affect the static stability, then the proof of stability shall be established by calculation and by testing.

9.5.1.2 If the machine is of a design that arrives on site in several pieces, which are then assembled, the assembly operation shall be assessed to check stability under all rail conditions.
In considering the stability of a machine, the tests and calculations should be considered for the machine during assembly and not limited to the stability of any individual component or sub assembly of the machine.

A machine is considered stable if, in the most unfavourable structural position, loading, track conditions and wind loading, the centre of gravity does not cross the tipping lines. Guidance for wind loading is given in BS EN 280:2001 and BS EN 13000:2004 which can be used for all machines for this aspect.

9.5.2 Calculation for static stability

9.5.2.1 The calculations shall be made for the first in class machines only.

It is permissible to use the definition of static stability in G 9.5.1.2.2 for calculation purposes. Testing requirements are set out in 9.5.6 and refer to one and two rail wheels leaving the rail, which is accepted as occurring before the case given in G 9.5.1.2.2.

Guidance on the tipping line can be found in ISO 4305:1991 and ISO 10567:1992. It should be borne in mind that the tipping lines set out in these documents are for road wheels and these will be affected by the substitution of rail wheels.

9.5.3 Load cases for calculating stability

9.5.3.1 For machines with moveable parts, which may therefore have their centre of gravity displaced or where the wheels can be unloaded, overturning stability shall be calculated. The calculations shall be made with the machine on the worst case combination of track cant, twist and gradient set out in 5.3.1.

9.5.3.2 Where the machine cannot achieve the required stability on the worst case track conditions, then a limitation of gradient and / or cant is permitted to be applied so that the required stability can be achieved. This limitation shall be shown on the ECC and in the instruction handbook, as set out in 5.6.1.3 and 5.6.6.1.

9.5.3.3 The calculations shall be made in accordance with:

\( a \) BS EN 280:2001 for a MEWP.

\( b \) BS EN 12999:2011 for a knuckle boom crane.

\( c \) BS EN 13000:2004 for a mobile crane.

\( d \) All other machines shall be calculated in accordance with Table 7.

<table>
<thead>
<tr>
<th>Working mode</th>
<th>Use of machine</th>
<th>Maximum overturning load</th>
</tr>
</thead>
<tbody>
<tr>
<td>With stabilisers</td>
<td>On track</td>
<td>1.25P + 0.1F</td>
</tr>
<tr>
<td>Without stabilisers</td>
<td>On track</td>
<td>1.33P + 0.1F</td>
</tr>
</tbody>
</table>

Parameters \( P \) and \( F \) in accordance with ISO 4305:1991 and ISO 4310:1981

\( P \) = Load, including lifting accessories, where appropriate

\( F \) = Equivalent force of jib or arm / boom(s)

Table 7 Load cases for calculating stability
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

G 9.5.3.3.1 The equivalent force (weight) of the jib ‘F’ is the downward force component of the jib in any particular jib position. A more detailed explanation is set out in ISO 4310:1981.

G 9.5.3.3.2 The stabilisers referred to are the outrigger type. Locking of the suspension is not considered a stabiliser within this meaning.

9.5.4 Rail clamps and stabilisers

9.5.4.1 Rail clamps which could be used to assist in the prevention of overturning shall not be fitted.

9.5.4.2 Overturning stability shall be achieved without the use of any stabilisers coming into contact with the sleepers or rails. The feet of the stabilisers shall be suitable for the types of surface on which they will be expected to operate.

9.5.4.3 The use of stabilisers shall be included in the instruction handbook and shown on the ECC.

G 9.5.4.3.1 If fitted, stabilisers should be designed so that they do not impinge upon sleepers, either on the track being used for the machine or an adjacent track. Because of varying track dimensions this requirement is imprecise, but as guidance the stabiliser should normally descend into the ‘six foot’ area between two running lines. It is permissible for the design or use of stabilisers to be made for specific jobs, purposes or locations.

9.5.5 Stability of machines when digging or grabbing

9.5.5.1 For use in digging and grabbing, overturning stability shall be calculated in accordance with Table 8.

<table>
<thead>
<tr>
<th>Working mode</th>
<th>Duty</th>
<th>Standard</th>
<th>Maximum overturning load</th>
</tr>
</thead>
<tbody>
<tr>
<td>With or without stabilisers</td>
<td>Digging or grabbing</td>
<td>ISO 4305:1991</td>
<td>2 P</td>
</tr>
<tr>
<td>( P ) = Load, including bucket or grab, and contents</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8 Load cases for calculating stability of excavators used in digging or grabbing configuration

9.5.5.2 Where the load cannot be shown by an RCI during digging, the calculation shall show the prevention of overturning in this mode. Use of the machine for lifting with a grabbing attachment shall be with an operational RCI. It is permissible for this duty to be a separate duty on the RCI.

G 9.5.5.2.1 Digging is where an open bucket is being used to push into the ground. Grabbing is where a clam shell type bucket is picking up a loose material load (for example ballast). There are many combinations of this type of activity, but the common factor is the combination of reverse loads and potential high transient forces.

G 9.5.5.2.2 The load \( P \) includes the contents of the bucket or grab.

G 9.5.5.2.3 Due regard should be made to worst case scenarios for load in bucket and resistance to lifting, for example contacting a solid block while scraping soft topsoil.
Consideration should also be given to the increased risk of derailment due to off-loading of the rail wheel during digging.

9.5.6 Requirement for testing – proof of stability by test

9.5.6.1 Stability shall be proved by tests as part of acceptance. All foreseeable unfavourable configurations of the machine and load, and the worst combination of track cant, twist and gradient set out in 5.3.1 shall be considered. The worst combination shall be taken as the maximum working cant + a simulated track twist of 20 mm on a 1 in 25 (40/000) gradient.

9.5.6.2 For multi-piece jib cranes (such as excavators) the first in class machine shall be tested for heights, radii, track conditions and boom/jib configurations, with the suspension in static configuration. As a minimum, either the following shall be undertaken, or the manufacturer shall demonstrate that sufficient tests are undertaken to demonstrate the verification set out in 9.5.6.3:

a) Testing shall be completed on flat level track (that is to say, without gradient, cant or twist) at 10° intervals around the machine, with the main boom in mid position.

b) Testing shall be completed on track with a combination of maximum gradient, twist and cant at 10° intervals around the machine in the worst case, with the main boom in mid position.

c) At the worst angular position per duty sector, the tests shall be repeated on track conditions (a) and (b) above) at three radii (maximum, minimum and mid-point), at three heights (maximum, minimum and mid-point) with the main boom as far back as possible and then as far forward as possible. The maximum height is permitted to be limited in certain positions by the necessity to maintain backward stability. Where the RCI does not have duty sectors the additional testing shall be carried out at 10° intervals.

d) In addition to level rail and maximum cant, the tests shall be repeated for at least one intermediate cant value.

e) Where the machine is to be restricted to a lesser value of gradient or cant (as permitted by 9.5.6.3), the tests in a) to d) above shall be undertaken with these lesser values and combination of lesser values.

9.5.6.3 The results obtained in 9.5.6.2 shall be compared with the calculated results. Where there is correlation to within 5%, then no further testing is required. Where there are differences between calculated and actual results, further testing shall be carried out in the specific area of the discrepancy to verify the test results obtained.

G 9.5.6.3.1 For single piece jib cranes, the testing set out in 9.5.6.2 is recommended but without the different heights; the load should be kept as low to the ground as possible during these tests.

G 9.5.6.3.2 It is not essential that specific radii or heights are tested; it is important that an accurate value of radius or height is measured and sufficient values are tested. For example, when testing at various radii it does not have to be at 5.00 m and 6.00 m; other values such as 4.91 m and 6.13 m are acceptable.
G 9.5.6.3.3 Subsequent identical machine are allowed to be tested on flat level track, directly over each end and at the worst angular position as shown by the first in class machine. The tests are permitted to consist of maximum, minimum and mid radii at maximum, minimum and mid height. Providing the tip test results obtained are within 5% of the values of the first in class machines, no further testing is required.

9.5.6.4 The testing shall be carried out in accordance with:

a) BS EN 280:2001 for a mobile elevating work platform.

b) BS EN 12999:2011 for a knuckle boom crane.

c) BS EN 13000:2004 for a mobile crane.

d) All other machines shall be tested in accordance with Table 9.

9.5.6.5 If the maximum overturning load set out in Tables 6 and 8 cannot be achieved on the worst case track conditions, it is permissible to use more favourable values of track cant and gradient. In this case a notice shall be displayed on the machine indicating the maximum cant and gradient on which the machine is permitted to be used; this shall be displayed on the data panels, where fitted (see Appendix C). Such limitations that need to be placed on the operation of the machine to enable safety and stability shall be clearly shown on the ECC and in the instruction handbook.

<table>
<thead>
<tr>
<th>Working mode</th>
<th>Load condition</th>
<th>Maximum safe working load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without stabilisers</td>
<td>Static in working mode</td>
<td>SWL = 90% of load that causes first rail wheel to leave the rail or 75% of the load that causes the second rail wheel to leave the track, whichever is the less. For machines with an RCI fitted the SWL shall never be less than 500 kg.</td>
</tr>
<tr>
<td>With stabilisers</td>
<td>Static in working mode</td>
<td>As per manufacturer’s specification. As a minimum this shall verify the calculated result from Table 8.</td>
</tr>
</tbody>
</table>

‘Leave the rail’ is defined as the point at which the rail wheel unloads completely

Table 9 Static stability

G 9.5.6.5.1 All the tests set out in 9.5.6.1 to 9.5.6.3 should be carried out by continuing to lift increasingly heavy loads, or applying heavier loads, as appropriate, until the first rail wheel is completely unloaded.

G 9.5.6.5.2 There is no defined means for detecting when the wheel is unloaded but a simple method is to have a thin steel shim between wheel and rail; when the shim can be pulled out is the point the wheel is unloaded. Having noted the load for the first wheel to be unloaded, continue lifting until a second rail wheel becomes unloaded. The method of determining the SWL by test for a machine with stabilisers in use cannot be specified because of the variety of designs and potential radii. The manufacturer should demonstrate that the tests completed demonstrate the theoretical calculations set out in 9.5.3.3 and are comparable with similar tests for the machine without stabilisers.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

G 9.5.6.5.3 Where the SWL in the tests set out in 9.5.6.4 is found to be greater than the value of \( P \) used in the calculations set out in 9.5.3.3, the calculations should be repeated using the higher value of \( P \).

9.5.6.6 When changing from stabilisers 'used' to 'not used', it shall not be possible to change from one configuration to the other if this would cause the load moment to reach or exceed the safe working load (SWL) for the new configuration.

G 9.5.6.6.1 Where powered stabilisers are used, the controlling switch should be inhibited where the load would be greater than that allowed without stabilisers.

9.5.7 Backward stability

9.5.7.1 In working mode it shall not be possible for any rail wheel of the machine to become completely unloaded. For machines exceeding 5 tonnes gross machine weight, the minimum wheel loading shall not be less than 500 kg. The wheel load shall be controlled at all times during working operations unless the design of machine shall make unloading impossible.

9.5.7.2 All subsequent machines of the same type shall be tested on the worst case values of track cant, gradient and twist, with the most adverse boom position, to check the minimum wheel load is within 5% of the value of the first in class machine with the identical main boom angle setting.

G 9.5.7.2.1 The first in class machine should be tested on flat level track and then the tests repeated on each of the track conditions set out in 5.3.1, using all possible boom configurations to check the worst case scenario is used. This normally results in a main boom angle being discovered, which should not be exceeded.

G 9.5.7.2.2 Where backward stability is constantly monitored by a load sensing device it is permissible for the main boom angle to vary, but there should be a system in place to prevent sudden reductions in load causing the machine to become backwardly unstable.

G 9.5.7.2.3 Backward stability tests should be carried out with nothing attached to the boom, for example no lifting accessories or even a quick hitch (unless permanently attached to the machine and shown as such on the ECC and in the instruction handbook). See also the requirements for consumables set out in 9.8.

9.6 Dynamic stability

9.6.1 Prevention of derailment during travelling and when moving along the track in working configuration – general

9.6.1.1 When moving along the track in travelling and working modes a machine shall have all wheels loaded sufficiently to avoid derailment.

G 9.6.1.1.1 This requirement is to be considered in conjunction with the requirements set out in 5.6. The requirement in 9.6.1.1 is for machines that can move along the track while having rotating components in a potentially unfavourable position. The most common example of this is lift and carry duties of cranes.
9.6.1.2 It shall not be possible to change configuration if this would cause the load moment to reach or exceed the SWL for the new configuration.

9.6.1.3 The system or device which provides compliance with 9.6.1.2 shall be failsafe.

9.6.2 Verification of prevention of derailment

9.6.2.1 The safety against derailment shall be proven for rail movement with the geometrical threshold parameters corresponding to the machine. The track twist is set out in Appendix A.

9.6.2.2 The proof of resistance to derailment shall be achieved by the following methods:

a) Stationary tests taking into account the work configurations, as set out in 9.6.3.

b) And one of the following:

i) Calculation of derailment using a track twist, as set out in Appendix A. The corresponding moments, forces and limiting conditions arising from the work configurations shall be taken into account.

Or

ii) A simulation whereby the twist parameters (such as guiding forces, wheel relief, torsional resistance of the machine etc) characteristically measured during the stationary derailment tests constitutes the basis of the calculation. The corresponding moments, forces and limiting conditions arising from the working modes shall be taken into account.

Or

iii) Dynamic test on a level track without cant, at maximum speed with the track twist of 20 mm, the relative unloading of any rail wheel of the machine is ≤ 20%.

9.6.3 Load cases for prevention of derailment while moving along the track

For prevention of derailment when moving along the track, wheel unloading shall be proven by static tests. With all the possible unfavourable positions of the machine and load, and worst combination of track cant, gradient and twist, as set out in 5.3.1, no rail wheel shall leave the rail when the load used to obtain the maximum SWL load set out in Table 10 is applied.

<table>
<thead>
<tr>
<th>Load case</th>
<th>Use of machine</th>
<th>Maximum safe working load</th>
</tr>
</thead>
</table>

G 9.6.2.2.1 The running behaviour is permitted to be proven by simulation when there is a proven model of the machine. A model of a machine's suspension for simulation of running characteristics is proven by comparing the model results against the results of running tests when the same input of track characteristics is used. Therefore a proven model is a simulation model that has been verified by an actual running test that excites the suspension sufficiently and where there is a close correlation between the results of the running test and the predictions from the simulation model over the same test track. A recognised machines dynamics software modelling package should be used.
Free on wheels | On track | SWL = 67% of load that causes first rail wheel to leave rail
---|---|---
Leave rail is the point at which the rail wheel unloads completely

### Table 10 Load cases for testing stability

9.6.3.2 The SWL is 67% of the load that causes the first rail wheel to lift. For machines fitted with RCIs, the SWL shall never be less than 500 kg.

G 9.6.3.2.1 For multi-jib cranes (such as excavators) the first in class machine should be tested for all heights, radii, track conditions and boom/jib configurations, with the suspension in its travelling configuration. It is recommended that testing be completed on flat level track at 0.5 m interval radii, at 1 m interval heights, at 10° intervals around the machine, with the main boom as far back as possible, as far forward as possible and in mid position where the two extremes are reasonably far apart. Where the rotating component is in its most unfavourable angular position, tests should be repeated 5° either side of worst angles. These tests should be repeated for each track condition as set out in 5.3.1.

G 9.6.3.2.2 For single piece jib cranes, the testing given in G 9.6.3.2.1 is recommended but without the different heights; the load should be kept as low to the ground as possible when testing with a single piece jib.

G 9.6.3.2.3 It is not essential that specific radii or heights are tested. It is important that an accurate value of radius or height is measured and sufficient values are tested. For example, when testing at various radii it does not have to be at 5.00 m and 6.00 m; other values, such as 4.91 m and 6.13 m, are acceptable.

G 9.6.3.2.4 All the tests should be carried out by continuing to lift increasingly heavy loads, or applying heavier loads, as appropriate, until the first rail wheel is completely unloaded. There is no defined means for detecting when the wheel is unloaded, but a simple method is to have a thin steel shim between wheel and rail; when the shim can be pulled out is the point the wheel is unloaded.

G 9.6.3.2.5 Subsequent identical machines may be tested only on flat level track, directly over each end and at the worst angular position, as shown by the first in class machine. The tests are permitted to consist of maximum, minimum and mid radii at maximum, minimum and mid height. Providing the results obtained are within 5% of the values of the first in class machine, no further testing is required.

### 9.7 Rated Capacity Indicator (RCI)

#### 9.7.1 General

9.7.1.1 Machines that have the capability to be used as cranes or lifting machines shall be fitted with an RCI unless:

a) The machine is designed for raising or lifting persons compliant with BS EN 280:2001.

Or

b) The machine is incapable of lifting more than the overturning moment and the overturning moment is less than 40,000 Nm.
9.7.1.2 The functionality of the RCI shall comply with the requirements set out in BS EN 12077-2:1998 and the indication to the operator shall comply with the requirements set out in BS 7262:1990.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

G 9.7.1.2.1 The requirements for the RCI in this document actually combine the requirements for RCI and RCL as set out in EN 12077-2. The UK standard RCI is actually a combined RCI/RCL unit.

9.7.1.3 The RCI shall continuously receive information about any variable that could cause variation of the SWL and shall respond to the changes, for example the angular position of the machine (cant and gradient).

G 9.7.1.3.1 The RCI, a device formerly known as a safe load indicator (SLI), should be capable of calculating the overturning and restoring moments in all possible potential positions of the machine. It is usually the case for OTP that the RCI is used for more than just a load indicator, for example it may also monitor backward stability in all modes.

G 9.7.1.3.2 There should be a display to the operator of the machine giving the current information of position and weight of load. It is not a requirement that the RCI device should accurately give weight of load, as it is recognised that different lifting accessories may be used at various times, which could affect the overturning moment. It is important that accuracy is maintained for the moments.

9.7.1.4 The RCI shall either be provided with a tandem lift operation mode giving a reduced SWL of 67% of the individual lifting duties, or the ECC and the instruction handbook shall be endorsed ‘This machine shall not be used for tandem lifting operations’. Whether a tandem lift facility is provided or not shall be shown on the data panels, where fitted (see Appendix C).

G 9.7.1.4.1 Further details of the tandem lift operation are set out in M&EE Code of Practice COP0008.

9.7.1.5 The tandem lift duty shall be controlled by a switch. The switch shall also control any combination of RCI duties. When the RCI is switched into tandem lift duty, the blue light called up in 9.7.2.1 shall blink off and on at a rate of 2 s on and 2 s off.

G 9.7.1.5.1 The RCI duties include non-lift and lifting modes.

9.7.1.6 Excavators not fitted with an RCI shall not be used for lifting operations. They shall be fitted with a label on each side of the machine boom visible from the ground at a minimum distance of 5 m. The label shall have blue lettering on a white background stating ‘Not approved for lifting operations’. The ECC and the instruction handbook shall be endorsed accordingly.

G 9.7.1.6.1 As part of the acceptance testing, the accuracy of the RCI should be checked after it has been installed onto the machine.
9.7.2 Indication of the state of the RCI

9.7.2.1 If fitted, the RCI shall either be permanently in lifting mode or switched into this mode when the machine is in lifting configuration. When the machine is switched on, the RCI shall either automatically be activated and default to lift mode, or the machine shall be incapable of use until the RCI is switched on in lift mode. Also, the change from road to rail mode or vice versa shall also automatically default the RCI to lift mode. There shall be a continuous blue light fitted externally to the machine, visible to site personnel under all foreseeable lighting conditions and illuminated when the RCI is in lifting mode.

G 9.7.2.1.1 The blue light should be visible externally from the machine from 10 m. Therefore a blue light in the cab window is unlikely to be sufficient. It is not mandatory that the light is visible from every conceivable position around the machine, but that it should be obvious from a distance and easily seen when looked for in the correct position close up to the machine. The position should enable the light to be visible to the crane controller. It is against road traffic regulations to fit a blue lamp that imitates an emergency beacon while the machine is on the public highway. Therefore, either the machine should be transported between sites on another road machine, or the light should be removed when not in rail mode, or the blue light is visually not obviously an emergency beacon.

9.7.2.2 During initial switch-on sequence of the RCI, the audible alarm, as set out in 9.7.3.2, shall operate until acknowledged by the operator. If the acknowledgement is not given, the RCI shall, as a minimum, give a visual warning to the operator.

9.7.2.3 Manual override of the RCI control system shall be possible only by means of a key switch which shall be located in a small translucent fronted container with a secure cover that is fitted with a discrete external seal. The maintenance instruction shall include a regular check on the condition of the key enclosure and the integrity / effectiveness of its seal.

9.7.2.4 When any RCI override system has been activated, the blue light, set out in 9.7.2.1, shall not illuminate and the audible alarm, set out in 9.7.3.3, shall sound continuously.

9.7.3 Warning of the RCI load status

9.7.3.1 There shall be a clear and continuous audible warning to the operator to indicate the approach to the SWL. The warning shall commence at not less than 90% and not more than 97.5% of the SWL. The warning shall continue until the load again reduces to below the figure at which the warning initiated.

9.7.3.2 There shall be a clear and continuous audible warning to the operator to indicate overload. The warning shall commence at not less than 100% and not more than 110% of the SWL. The warning shall continue until the load again reduces to below the figure at which the warning initiated. The warning shall be of a different and more strident nature to the approach warning.

9.7.3.3 There shall be an external audible warning to indicate the overload condition, as set out in 9.7.3.2. The external warning shall provide an increase of sound pressure level of at least 10 dB(A) greater than that produced by the working machine, when measured at a distance of 1 m around the periphery of the machine and shall be in any case in excess of 80 dB(A).
9.7.3.3.1 Measurement of the audibility of the RCI audible warning should be taken on the first in class machine with any engine at mid speed. Readings should be taken at four positions: at 1 m from each side and to the front and rear of the superstructure (body) of the machine; all at 1.8 m above rail level. If a separate power source (additional diesel engine etc) is used during lifting operation, then the tests should be repeated using the additional engine. Subsequent machines should be verified to demonstrate that the sounders provided are operational.

9.7.4 Machine control function of the RCI

9.7.4.1 The machine shall cease any movement or movements which are causing an increase in overturning moment when the RCI indicates the overload, as set out in 9.7.3.2.

9.7.4.2 The system shall not allow the commencement of any movement which would cause an increase in overturning moment when the RCI indicates the overload, as set out in 9.7.3.2.

9.7.4.3 The system shall not allow the commencement of any movement which would cause a reduction in SWL when the RCI indicates the overload, as set out in 9.7.3.2.

9.7.4.4 The system shall allow the commencement of any safe movement which would cause an increase in SWL, or a reduction in overturning moment, when the RCI indicates the overload, as set out in 9.7.3.2, without the control system being overridden.

9.7.4.4.1 The inhibition of further movement between 100 – 110% should always allow movement to bring the machine back to the required stability.

9.7.4.4.2 The RCI does not have to receive information relating to gradient or respond to changes if the machine is equipped to deal with maximum possible gradient without ‘adjustment’. Similarly with cant, if the machine is set up with only one configuration which handles all acceptable (certificated) cants.

9.7.4.4.3 The RCI device is unlikely to be able to predict changes in track condition (although any such device would be welcome). Therefore as the machine encounters changes in track geometry the RCI should react immediately and give warning if the overturning moment reaches between 90 – 97.5% of the SWL, or safely bring the movement to a halt if the overturning moment reaches between 100 – 110% of SWL. The reference to ‘safely bring movement to a halt’ means the stop should not be instantaneous where this would cause violent load swings. As with all such requirements in this document the machine should still be able to move in a direction that reduces the overload.

9.8 Condition of variables during calculation and testing

9.8.1 For all machines, overturning stability and prevention of derailment calculations shall assume that all tanks containing consumable fluids are in their least favourable condition, and all moveable components are in their least favourable position. This shall also apply to testing.

9.8.1.1 Consumables mean such commodities as fuel tanks, windscreen wash bottles, sand boxes etc. Moveable components are items such as cab doors, sliding windscreens etc. Where the machine has provision for carriage of personnel, consideration should also be given to potential eccentric loads caused by personnel.
9.9 Burst protection

9.9.1 Any part of the hydraulic circuitry for which failure during lifting operations could cause unsafe movement shall be protected against failure of the hydraulic pressure, to prevent uncontrolled movement.

9.9.2 Unless used exclusively for excavation, each section of boom, including any bucket crowd cylinder shall be fitted with burst hose protection devices. If limited to excavation this shall be made clear in the instruction manual, as set out in 10.1.2.2k).

G 9.9.2.1 Where lock valves are fitted they should close automatically to prevent fluid leaving the cylinders until they are opened by an external force.

G 9.9.2.2 Burst hose protection devices should rely upon controlled servo pressure to release the valve and not main system pressure.

G 9.9.2.3 The position of the burst hose protection device should be considered for its vulnerability during routine operation of the machine. If necessary, protection should be provided for the device to avoid mechanical damage.

9.9.3 The manufacturer shall provide any necessary instruction for testing of burst hose protection devices in the maintenance instruction.

G 9.9.3.1 The manufacturer should provide any necessary test facility on the machine.

9.10 Load lifting points

9.10.1 All load lifting points used on the machine shall either be approved by the manufacturer or, where the manufacturer is no longer available, it is permissible for any additional load lifting points to be assessed by a competent body.

G 9.10.1.1 The manufacturer is either the original machine builder or the converter of the host machine to rail use where this is appropriate.

9.10.2 The position and rating of each load lifting point shall be shown on the ECC and in the instruction handbook, as set out in 10.1.3.2 b) ix).

9.10.3 Where an additional load lifting point is added to a machine a new ECC shall be obtained and the information added to the instruction handbook.

G 9.10.3.1 Additional load lifting points, including those on any attachments which did not come with the machine, should only be added by, or with agreement from, the manufacturer.

9.10.4 Load lifting points shall take into account the forces from the variety of angles that the suspended load could take up relative to the lifting equipment.

G 9.10.4.1 It should be demonstrated that consideration has been given to the potential angle that the load could adopt and that the lifting point is capable of accommodating this angle. A fixed hook does not normally meet this requirement.
9.10.5 Load lifting points shall be designed to have a safety factor of a minimum of 5:1 to yield.

9.10.6 All load lifting points on the first in class machine shall be proof load tested to a minimum of 150% of the specified SWL of that load lifting point.

9.10.7 All load lifting points added as a modification to an existing machine shall be proof load tested to a minimum of 150% of the specified SWL of that load lifting point.

G 9.10.7.1 Testing should be undertaken so that it does not damage the main structure or destabilise the machine. This could involve additional support to the structure while testing is taking place.

G 9.10.7.2 The proof load test is to demonstrate build conformance of modifications.

9.10.8 All load lifting points shall be marked as a load lifting point, and labelled with maximum SWL and periodicity of use if not intended to be used continuously.

G 9.10.8.1 Labelling the load lifting point does not infer that the machine can itself be lifted at this point.

G 9.10.8.2 Every load lifting point should be clearly labelled on the machine: red on white for permanent load lifting points and white on red for load lifting points that have restrictions applied. Suggestions for labels are shown in Figure 19. Each machine owner should decide how often the labels are maintained.

Figure 19 Load lifting point labels

LOAD LIFTING POINT
SWL 5 tonne
Not suitable for continuous use
recommend not more than once in 4 hours

G 9.10.8.3 The manufacturer should also supply information, possibly in the form of a label on the side of the boom, of all of the load lifting points on a machine.

G 9.10.8.4 When providing load lifting points the manufacturer should consider the potential use that may be made of them in the railway environment. It might be necessary to strengthen some existing points where their use is likely to increase. For example, some hydraulic excavators have a load lifting point suitable for picking up empty buckets once per shift. This lifting point is therefore not suitable for continuous use.

9.10.9 All load lifting points shall have duty charts showing the machine configuration to which it applies for each duty. The serial number of the duty chart(s) for the machine shall be shown on the ECC and in the instruction handbook.

9.10.10 Only lifts that are physically possible shall be shown on duty charts.
G 9.10.10.1 Duty charts are required for each authorised load lifting point on the machine. The statutory charts, as set out for example in ISO 10567:1992, should be kept with the machine technical data.

G 9.10.10.2 It is recommended that additional duty charts be provided for each load lifting point, specifically tailored for railway industry use. The value of cant and gradient should be shown, as required, noting that track twist is an additional factor which should be included in the testing regime (as set out in 9.5.6.1) but not be included within the declared cant (and gradient) figure on the duty chart. These charts should be provided for each duty, including tandem lifting, where applicable, for example:

1. 0 – 50 mm cant, travelling mode, 350° - 10°.
2. 0 – 50 mm cant, static mode, 350° - 10°.
3. 0 – 50 mm cant, static tandem lift mode, 350° - 10°.
4. 50 – 100 mm cant, travelling mode, 350° - 10°.
5. 50 – 100 mm cant, static mode, 350° - 10°.

Etc

38. 100 – 150 mm cant, static mode, 170° - 190°.
39. 150 – 200 mm cant, travelling mode, 170° - 190°.
40. 150 – 200 mm cant, static mode, 170° - 190°.

This list is shown as an example and is not intended to infer a recommendation that this number of duty charts is required.

G 9.10.10.3 The information on the railway specific duty chart should show the lifting load at various heights and radii for each duty, an example is shown in Figure 20. The lifting load for a rigid jib crane is the SWL, as set out in 9.5 or 9.6 (as appropriate). Where a machine has a multi-jib facility, for example a hydraulic excavator, the same radius and height can be achieved with various jib configurations, which can greatly affect the SWL. Therefore the lifting load of a multi-jib crane should be, for example:

a) For heights below 4 m the main jib should be as far back as possible without going above 4 m (above rail level). The lifting load is the SWL, as set out in 9.5 or 9.6 (as appropriate) with the jib in this position.

b) For heights at or above 4 m the main boom should be as far back as the backward stability with no load allows. The lifting load is the SWL, as set out in 9.5 or 9.6 (as appropriate) with the boom in this position.
RAILWAY PLANNERS LIFTING DUTY CHART FOR MACHINE 99709 948011-0

<table>
<thead>
<tr>
<th>Load lifting point A</th>
</tr>
</thead>
<tbody>
<tr>
<td>First in class number 99709 908010-0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radius (m)</th>
<th>Maximum lift (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>-1</td>
<td>7</td>
</tr>
<tr>
<td>-2</td>
<td>7</td>
</tr>
<tr>
<td>-3</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Figure 20 Example of a duty chart

G 9.10.10.4 Lifts that are limited by the hydraulic limit of the machine, rather than stability, should be shown on the railway specific duty chart in italics.
Part 10  Information for Users

10.1  Instruction handbook

10.1.1  Operating instructions

10.1.1.1 The instruction handbook shall include operating instructions for:

a) Stopping the machine and the means for doing so, in particular instruction of the staff on normal and emergency stopping devices; that their access shall be kept free from obstacles and their function is to be periodically controlled;

b) Safe system of work for coupling and uncoupling, as set out in 5.20.3.7.

c) Safe system of work for on and off tracking (where the machine exceeds the stated gauge), as set out in 5.19.1.6.

d) Safe system of work for changing the mode of the machine. The instruction handbook shall describe the work necessary to put the machine from one mode into any other mode (for travelling and working), with the associated minimum times, in the following cases:

i) In the normal work situation.

ii) In the case of loss or breakdown affecting a part or tool of the machine to return the machine to travelling and / or running mode.

iii) The instruction handbook shall also indicate the number of persons required to carry out this work.

e) System of work for setting up and packing away, as set out in 5.10.

f) System of work for coupling in emergency, as set out in 5.13.1 d).

g) Time estimates for recovery of failures, as set out in 5.13.6.

h) Safety instructions for lifting the machine, parts of the machine and attachments.

i) Safety instructions for stabling.

j) Safety instructions on precautions to minimise possible chemical hazards during operation, maintenance and disposal.

k) Safe system of work for removing the failed machine, as set out in 5.13.2, including use of auxiliary engine, as set out in 5.13.4.

10.1.1.2 The instruction handbook shall include:

a) Specification of personal protective equipment required when the machine is working and the risks for which the equipment is required.

b) Information for cleaning the machine.

c) Details for restarting the machine after an emergency or accidental stop.

d) Information about function checks of the safety devices carried out before the beginning of working.

e) Information about adjustment of the operators’ seats in relation to height and weight of the operator.
f) Information about the necessary safety measurements when removing and replacing parts of the machine.

g) Information about design and adjustment of the limiting devices, as set out in 5.8.1.3.

h) Where the lateral limiting device is fixed steps the exact positions, as set out in 5.8.2.1.

i) Instructions on the position of the control to lower attachments and release residual pressure and how they should be used.

j) Indicate the occasions where an RCI (if fitted) is permitted to be isolated (for example during emergency recovery or while an excavator is in digging configuration). The information shall reinforce the importance that the RCI is operational during lifting operations.

k) Instructions for lowering equipment in the event of emergency stop activation (see 5.11.3).

l) The method of locking tools and equipment into the travelling mode shall be described in the instruction handbook.

m) The location and use of work places outside of the machine gauge shall be described in the instruction handbook. It shall also be indicated in which direction to evacuate these working places in case of dangers generated by railway operations.

10.1.1.3 The instruction handbook shall include instruction that:

a) Only authorised staff may start, operate or interfere with the machine.

b) That emergency stopping devices shall not be used for stopping normally and full description of functions inhibited by operation of the emergency stopping device.

c) That the user of the machine shall only operate the machine under normal conditions and avoid overloading.

d) That the user shall take due care when making changes to the machine to ensure the safety level is not compromised (it is recommended that the user should not make changes without having consulted the manufacturer or their representative).

e) Instruction to use only the suitable and permissible places for driving on the machine.

f) Advice that the operator and other personnel fully acquaint themselves with the operation manual before operating the machine.

g) If access is only available from one side of the machine an instruction shall be made that the machine is not allowed beside a line open to rail traffic on that side without other operational instruction.

h) Safety barriers designed to prevent exiting to a side of the operating track shall be described in the instruction handbook and their use mandated.

i) Warning systems shall be tested for audibility and visibility in the working conditions.

j) Where the machine exceeds the lower sector gauge, as set out in 5.2.1.9, the instruction handbook shall state ‘This has the potential to strike some platforms and underbridge girders. A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use’.
k) Where the machine encroaches below rail head level, as set out in 5.2.1.10, the instruction handbook shall state ‘A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use’.

l) For machines with rotating superstructures the instruction handbook shall state ‘the machine is to proceed at walking speed and ground staff control the movement in reverse until the superstructure can be slewed to face direction of travel’, as set out in 5.9.1.3.

m) As set out in 5.12.3, ‘Where a data logging system is found not to be operational then the machine shall not be used until the machine is repaired and fully confirmed as operational. This requirement applies irrespective of whether starting or part-way through an operation’.

n) As set out in 5.18.3.1, ‘This machine is suitable for use under the live OLE when used in conjunction with a safe system of work determined and authorised in accordance with the requirements of GE/RT8024’.

o) Braking systems set out in 5.7.6.5 shall have instruction that, ‘Where the components are of a destructive design, the vehicle shall not be moved on rail until the damaged components have been replaced and the affected system(s) proved to be operating correctly’.

10.1.1.4 The instruction handbook shall equally draw attention to the user of their obligation to take precautions given by the railway infrastructure manager concerned.

10.1.2 Operating restrictions

10.1.2.1 The instructions in the instruction handbook for using the machine shall also indicate the ways in which the machine shall not be used, and include detailed information of any necessary limitation of use, as set out in 5.6.6.1.

10.1.2.2 The instruction handbook shall include the restrictions of use (where appropriate):

a) Not for use under live catenary, as set out in 5.16.5.1, and 5.18.3.3.

b) Speed restrictions on check rails, or other track features.

c) Not suitable for use on light rail, as set out in in 5.5.3.2.

d) Not suitable for operation of spring loaded points, as set out in 5.5.1.1.

e) Speed restrictions necessary in travelling mode for specific track conditions, as set out in 5.6.1.2 and 5.6.1.3.

f) Speed restrictions necessary in working mode for specific track conditions, as set out in 5.6.2.2.

g) Speed restrictions necessary in working mode for movement along the track at night-time.

h) Personnel not permitted between moving machines.

i) Any restrictions on working mode to ensure machine does not derail, as set out in 8.5.1.

j) Not for use on live third / fourth rail areas, as set out in 5.16.5.1, 5.18.4.2, 5.18.4.3 and 5.18.5.1.

k) Not for use for lifting, as set out in 9.9.2.
10.1.2.3 The instruction handbook shall give detailed information on restrictions of use of the machine in accordance with the requirements of this document; as a minimum this shall include:

a) That the machine is not intended for passenger or freight transport.

b) That the machine may not circulate freely or work without restriction on switches, level crossings or other installations.

c) If particular measures shall be taken under OLE.

10.1.2.4 The instruction handbook shall highlight that the machine does not have a travelling mode, as set out in 5.2.1.14.

10.1.2.5 The instruction handbook shall highlight that the machine does not have direct view in reverse in travelling mode, as set out in 5.9.1.2.

10.1.2.6 The instruction handbook shall highlight that the machine does not have direct view in reverse in working mode, as set out in 5.9.2.2.

10.1.2.7 The instruction handbook shall detail any restrictions on personnel and load, as set out in 5.9.3.1.

10.1.3 Technical details

10.1.3.1 The following information shall be provided in the instruction handbook:

a) Functional description of the working devices.

b) Minimum permissible radius of curvature to be negotiated in all modes, as set out in 5.6.1.4.

c) Maximum speed in all modes, as set out in 5.4.1 and 5.4.3.

d) Maximum track conditions in working mode, as set out in 5.6.2.3.

e) Description of instrumentation and operators’ controls.

f) The range of temperature in which the machine is intended to operate and be stabled.

g) Intended use for towing, for example the type of hauled machines / vehicles and maximum number of hauled machines / vehicles allowed.

h) Maximum stresses generated by devices for levelling, lining or other operations.

i) Description of movement limiting devices, and a reminder to reset when using attachments.

j) Mass of the machine in all modes.

k) The distribution of the mass by wheel in the different foreseen machine working modes.

l) Category of line.

m) Safety relevant technical data, including noise emission values guidance for the selection of the ventilation filter element.

n) The load exerted on rail level infrastructure, as set out in 5.2.1.8.

o) Tail swing, as set out in 5.2.2.2.
p) The maximum number of trailed machines, as set out in 5.7.4.7.
q) The method of preventing egress to running railway, as set out in 5.9.4.3.
r) The intended use and identified / considered hazards, as set out in 5.1.2.

10.1.3.2 The instruction handbook shall include the following diagrams:
a) Outline diagram showing principal dimensions and position of the centres of gravity.
b) Assembly drawing showing:
   i) Principal dimensions, in road and rail modes, including the critical points near
      limit of gauge.
   ii) Position of the centre(s) of gravity.
   iii) Position of the powered and unpowered axles marked with the indication of the
        maximum permissible load.
   iv) Showing machine in travelling mode, as set out in 5.2.1.15.
   v) Positions of exhaust outlets.
   vi) Work positions, including those that are beyond the loading gauge.
   vii) Position of lights.
   viii) Position of optical and acoustic warning devices.
   ix) Details of lifting and jacking points, where fitted, as set out in 7.4.1 and 9.10.2.

c) Detailed drawings indicating the following:
   i) The maximum distances of working parts beyond the swept envelope.
   ii) The maximum lateral exceedance allowed on curves.

d) Detailed drawings with the following indications:
   i) Devices that can be in contact with the rails.
   ii) Tools that may bear on the ballast.

e) Diagram giving details of stowed position of components in travelling mode, as set out
   in 5.2.1.5.

10.1.3.3 The instruction handbook shall detail any exceedance from the Plant gauge, as set out in
5.2.1.4.

10.1.3.4 The instruction handbook shall detail exceedance for RRV tyres from the OTP gauge, as
set out in 5.2.1.6.

10.1.3.5 The instruction handbook shall state the predicted loads onto the infrastructure by non-
metallic parts, as set out in 5.2.1.8.

10.1.3.6 The instruction handbook shall detail any exceedance from the travelling gauge when the
machine is in working mode, as set out in 5.2.2.1.

10.1.3.7 The instruction handbook shall state the brake torque figures required for each wheel, as
set out in 5.7.1.4 and the parking brake derived force, as set out in 5.7.5.4.
10.1.3.8 The instruction handbook shall detail all brake test actual results achieved for each machine, as set out in 5.7.6.2.

10.1.3.9 The instruction handbook shall state the type of lateral limit of work device, as set out in 5.8.1.1.

10.1.3.10 The instruction handbook shall state the RA and RL values, as set out in 5.5.6.1.

10.1.3.11 The instruction handbook shall describe the installed warning systems.

10.1.3.12 The instruction handbook shall indicate that the warning systems provided are based on the assumption that staff on and around the machine have periodical medical checks to ensure normal hearing ability.

10.1.3.13 Description of hydraulic or pneumatic circuit for the rail wheels suspension and locking system when the machine is in rail mode.

10.1.3.14 Minimum duration of gauge infringement by working tools during different phases of work.

10.1.3.15 Locking devices for working components that can go out of the swept envelope.

10.1.4 Generic safety requirements – training and competence

10.1.4.1 The manufacturer shall state in the instruction handbook the competence requirements for each operation the machine is designed and intended to be used.

10.1.4.2 The manufacturer shall state in the instruction handbook the training requirements for each operation that the machine is designed and intended to be used.

10.1.5 Specific safety requirements – safe use

10.1.5.1 The manufacturer shall state how to use the machine for the purpose it was intended for, as set out in 10.1.1, and then shall consider if the machine is specifically designed for a specific infrastructure manager or environment specific.

10.1.5.2 The residual risks left after the design assessment carried out to comply with 5.1.1 shall be stated, together with the mitigation the manufacturer considers necessary.

G 10.1.5.2.1 For example, the manufacturer should show the personal protective equipment (PPE) that could be considered necessary after the hazards have been reduced by the design review process.

G 10.1.5.2.2 The Use of Plant Safety Plan, at this stage, is a generic document for the machine in its designed use. It is likely that the individual infrastructure manager will enhance this plan for use on the specific railway infrastructure. The individual plant operating company will add further detail for each specific use and location of the intended use of the machine.

10.1.5.3 Where the machine is capable of using attachments, as set out in 5.2.2.3, the Use of Plant Safety Plan shall state ‘If adjacent lines are open to traffic, this machine shall be used only if a safe system of work has been adopted to take account of the extra gauge exceedance caused by attachments’.

10.1.5.4 Where access is limited to the machine, as set out in 5.9.4.2c), the Use of Plant Safety Plan shall state ‘The machine may only operate with the access adjacent to a cess or a line closed to all train movements or the documented safe system of work must take account of adequate safe clearances to adjacent lines’.
10.2 **Maintenance**

10.2.1 **Maintenance instructions**

10.2.1.1 Each machine shall have an approved maintenance instruction.

G 10.2.1.1 The maintenance instruction should cover all the requirements of this document. It is unlikely that a composite maintenance instruction covering every machine in a disparate fleet will comply with 10.2.1.3.

10.2.1.2 The maintenance instruction shall be designed so that the machine and any associated equipment are kept in compliance with this document throughout the intended service life.

10.2.1.3 The maintenance instruction shall be designed so that it is practical and achievable.

10.2.1.4 The maintenance instruction shall be designed to enable users to understand quickly and easily what they have to do and when, what acceptance criteria to apply, and on safety-critical systems the remedial action to be taken when defects are found.

10.2.1.5 The maintenance instruction shall include the requirement to retain auditable records of maintenance attention to safety-critical systems and components.

G 10.2.1.5.1 The auditable records should provide traceability to the machine concerned, date, location and personnel who carried out the maintenance.

10.2.2 **Documentation**

10.2.2.1 The maintenance instruction shall be a controlled document.

G 10.2.2.1.1 Controlled documents should be contained within the machine owner’s quality system, and should include:

a) A title, unique identification number, issue and / or revision number, and date.

b) Approval and authorisation by appropriate persons.

c) A revision / amendment record page.

d) All sections, including job descriptions, to be numbered to facilitate referencing.

e) A numbered list of contents.

f) Pages identified so that it is obvious if any are missing or out of date.

G 10.2.2.1.2 An example of some good practice documentation is set out in Appendix E.

10.2.2.2 The maintenance instruction shall include the requirement to update the machine log book with the date and examination type of the last maintenance carried out.

10.2.2.3 The maintenance instruction shall include the requirement to record the results of any measurements taken, such as results of brake tests, rail wheel dimensional checks, tyre pressure / condition.
10.2.3 Content of the maintenance instruction – competence

10.2.3.1 The maintenance instruction shall include a statement of the minimum level of competence of personnel responsible for the maintenance.

G 10.2.3.1.1 It is recommended that the maintenance instruction details what level of competency is required for each safety-critical task, in order to avoid confusion (for example between operator, maintenance fitter and/or electronics technician).

G 10.2.3.1.2 It is not the intention of this requirement to be specific. The maintenance instruction should indicate the anticipated competency requirements. It is the machine owner’s responsibility to define, control, assess and record the competency for each maintenance task undertaken on their machines.

10.2.4 Content of the maintenance instruction – facilities

10.2.4.1 The maintenance instruction shall include a statement of the minimum maintenance facilities needed for the implementation of the instruction.

G 10.2.4.1.1 The statement should include the following or similar clauses: ‘In order to carry out this maintenance instruction, the following minimum level of facilities is required, appropriate to the jobs being undertaken:

   a) Clean, dry, covered accommodation for dealing with wheelsets, bearings, mechanical hydraulic and electrical components etc.

   b) Adequate illumination for inspection of components, bogies and underframes.

   c) Cleaning facilities which will not cause damage to the components.

   d) Handling facilities for removal and refitting of components such as rail bogies and engines.

   e) Protection from the weather of vulnerable areas of the machines and its components.

   f) Any specific requirements additional to those listed are identified on the applicable job description.

   g) A suitable length of straight level rail track for carrying out brake tests’.

10.2.4.2 The maintenance instruction shall include details of special tools and accessories necessary for maintenance.

10.2.5 Content of the maintenance instruction – host machine

10.2.5.1 Where the machine is based on a host machine and the maintenance requirements of the host machine are not included in the maintenance instruction, the relevant document(s) shall be referenced.

10.2.5.2 Maintenance instructions for various component parts of a machine (for example the host machine, auxiliary engine and rail conversion) shall be combined to form a unified instruction with consistent interval frequencies.
In the case of a machine that is a conversion or derived from a non-rail machine, then the manufacturer’s instruction handbook for the base machine should form part of the maintenance instruction. If it is not practical to include the content of the document, then it should be referenced in the maintenance instruction. Wherever possible the location of the relevant sections of the base machine instruction handbook should be given in the appropriate parts of the maintenance instruction.

10.2.6 Content of the maintenance instruction – maintenance frequency

10.2.6.1 The maintenance instruction shall include a statement of the intervals at which each scheduled maintenance activity is to be carried out.

G 10.2.6.1.1 Good practice is to identify each examination by means of a code (letter, number or colour) and clearly specify the limits which apply. An example follows:

‘The machines are to be examined at frequencies no greater than the limits set out below:

Exam code A - Daily or pre-use.
Exam code B - Pre-hire or monthly when on continuous hire.
Exam code C - 6 monthly.
Exam code D - 12 monthly’.

G 10.2.6.1.2 The periodicity could be based on different parameters, for example calendar dates, engine hours, days used, shifts used, and / or distance travelled unless required otherwise in this document.

10.2.7 Content of the maintenance instruction – defined maintenance terms

10.2.7.1 Each maintenance instruction shall include a list of defined maintenance terms that shall be used in the maintenance instruction.

10.2.7.2 The defined maintenance terms set out in Table 11 shall be used where appropriate. Any deviation from these terms shall be clearly identified to make them unambiguously different.

<table>
<thead>
<tr>
<th>Term</th>
<th>Action required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjust</td>
<td>Correct to defined limits</td>
</tr>
<tr>
<td>Change</td>
<td>Remove the original and fit a new or overhauled part or assembly in its place</td>
</tr>
<tr>
<td>Check</td>
<td>Determine a particular nominated condition before, during, or after repair, for example completeness, security, position</td>
</tr>
<tr>
<td>Clean</td>
<td>Remove all dirt and deposits</td>
</tr>
<tr>
<td>Defective</td>
<td>Any fault or faults in a component or assembly, for example structural fractures or weld fractures, which may prevent the component or assembly from fulfilling its designed purpose</td>
</tr>
<tr>
<td>Dismantle</td>
<td>Take to pieces</td>
</tr>
<tr>
<td>Examine</td>
<td>Determine general condition before repair, for example wear, cracks, splits, leaks, scoring, erosion, breaks, distortion, looseness</td>
</tr>
<tr>
<td>Term</td>
<td>Action required</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Gauge</td>
<td>Determine a nominated dimension by using suitable measuring equipment, for example ruler, micrometer, callipers, feeler gauges or Go / No-Go gauge</td>
</tr>
<tr>
<td>Inspect</td>
<td>Determine general condition after repair and attention, that is to say, conformity to required standards</td>
</tr>
<tr>
<td>Lubricate</td>
<td>Apply lubricant</td>
</tr>
<tr>
<td>Overhaul</td>
<td>Do what is necessary to make an assembly or sub-assembly reusable, that is to say, dismantle, strip, clean, examine, fit new parts, repair, reassemble, test and inspect, as required</td>
</tr>
<tr>
<td>Paint</td>
<td>To impart colour to a surface</td>
</tr>
<tr>
<td>Re-assemble</td>
<td>Put together</td>
</tr>
<tr>
<td>Record</td>
<td>Put down in writing a finding from examination, test, inspection or special checks</td>
</tr>
<tr>
<td>Rectify</td>
<td>To set right</td>
</tr>
<tr>
<td>Refit</td>
<td>Put back and reconnect</td>
</tr>
<tr>
<td>Remove</td>
<td>Disconnect and take off</td>
</tr>
<tr>
<td>Renew</td>
<td>Remove, scrap the original part and put a new part in its place</td>
</tr>
<tr>
<td>Repair</td>
<td>Restore an original part to the required condition by hand tooling, machining, build-up, welding, patching, bending, setting, heat-treating, re-securing etc</td>
</tr>
<tr>
<td>Strip</td>
<td>Remove covering, that is to say, paint, polish, fabric</td>
</tr>
<tr>
<td>Test</td>
<td>Prove correct operation by trial</td>
</tr>
</tbody>
</table>

**Table 11** Definition of terms in maintenance instructions

G 10.2.7.2.1 The defined words should be used rigorously to minimise the number of words used, and maximise the clarity of the document.

### 10.2.8 Content of the maintenance instruction – task descriptions

10.2.8.1 The maintenance instruction shall include a statement or task description for each component, group of components or system which requires attention.

10.2.8.2 The task descriptions in the maintenance instruction shall describe the safety instructions for maintenance, including energy supply disconnection, measures against re-connection, neutralisation of residual energy and testing of zero energy state. The safety requirements for maintenance that are only possible to be undertaken with the engine running shall be described.

10.2.8.3 Where appropriate, each task description shall include:

a) Acceptance criteria and wear limits.

b) Method statements, especially for brake testing and wheel examination and gauging.

c) Illustrations to clarify the above, and show locations of components and safety labels.
The maintenance instruction should cover the component, group of components and systems of the machine concerned. As well as the control, power and transmission systems, an example of the type of components and systems to be included is set out in Table 12 (which is not exhaustive).

<table>
<thead>
<tr>
<th>Component</th>
<th>Activity</th>
<th>Examination code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail marker lights</td>
<td>Test</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Clean</td>
<td>✓</td>
</tr>
<tr>
<td>Wipers</td>
<td>Test</td>
<td>✓</td>
</tr>
<tr>
<td>Safety labelling</td>
<td>Examine</td>
<td>✓</td>
</tr>
<tr>
<td>Leaks of flammable fluids</td>
<td>Beneath machine</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Each system</td>
<td>✓</td>
</tr>
<tr>
<td>Underframe and structural components</td>
<td>Check for obvious defects</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Examine</td>
<td>✓</td>
</tr>
<tr>
<td>Bogies and rail guidance systems</td>
<td>Check for obvious defects</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Examine</td>
<td>✓</td>
</tr>
<tr>
<td>Yellow panels</td>
<td>Clean</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Check for deterioration</td>
<td>✓</td>
</tr>
<tr>
<td>Brake systems</td>
<td>Simple checks</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Stopping distance test</td>
<td>✓</td>
</tr>
<tr>
<td>Rail wheels and axles</td>
<td>Check for obvious defects</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Examine and gauge</td>
<td>✓</td>
</tr>
<tr>
<td>Rail wheel bearings</td>
<td>Check for rumble / play</td>
<td>✓</td>
</tr>
<tr>
<td>Road tyres on friction drive</td>
<td>Examine</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Check pressure</td>
<td>✓</td>
</tr>
<tr>
<td>Rail gear check valves</td>
<td>Test</td>
<td>✓</td>
</tr>
<tr>
<td>Emergency recovery system</td>
<td>Test</td>
<td>✓</td>
</tr>
<tr>
<td>Engine and transmission mountings</td>
<td>Check security</td>
<td>✓</td>
</tr>
<tr>
<td>Lifting equipment</td>
<td>LOLER exam</td>
<td>✓</td>
</tr>
<tr>
<td>Hydraulic and pneumatic systems</td>
<td>Examine</td>
<td>✓</td>
</tr>
<tr>
<td>Horns and sirens</td>
<td>Check</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Test sound level</td>
<td>✓</td>
</tr>
<tr>
<td>Safety stops</td>
<td>Test</td>
<td>✓</td>
</tr>
<tr>
<td>Security systems, for example slew locks</td>
<td>Examine</td>
<td>✓</td>
</tr>
</tbody>
</table>
Component | Activity | Examination code | A | B | C | D
---|---|---|---|---|---|---
Rated capacity indicators | Check | ✔ | ✔ | | | |
 | Test | | | ✔ | ✔ | ✔ |
Fire equipment | Check presence | ✔ | ✔ | ✔ | | |
 | Exam / date check | | | | | ✔ |
Inter machine couplings | Examine | ✔ | ✔ | ✔ | | |
Speed indicators and limiters | Test | | | | | ✔ |
Equipment for limiting interference | Test | | | | | |
Safety systems | Test | ✔ | ✔ | ✔ | | |
Guards | Check in place | ✔ | ✔ | ✔ | | |

Table 12 Examples of maintenance activities and intervals

G 10.2.8.3.2 Good practice is to identify each task or job by means of a number and title, which clearly defines the components or system covered, and the intent of the task or job. The intent is usually one of the defined maintenance terms (see 9.3.5). An example of a star chart is set out in Table 13.

| Job | Job title | Exam code |
| --- | --- | --- | --- | --- | --- |
| | | A | B | C | D |

BRAKES

B01 Brakes – check * * *  
B06 Brake fluid level – check * * *  
B07 Brake system hoses and pipework – examine * *  
B08 Air tanks – drain * * *  
B10 Parking brake – test *  
B11 Footbrake – test *  
B12 Brake linings – check *  

CAB AND SUPERSTRUCTURE

C01 Windscreen wipers – check * * * *  
C03 Cab door security – check * * *  
C04 Access panel security – check * * *  
C05 Yellow paintwork – check * * *  
C06 Safety labels – check * * *  
C11 Screen wash bottle – refill * * *  
C15 Machine general condition – check *  

Amendments to this document can be found on the RSSB Standards Catalogue - http://www.rssb.co.uk/railway-group-standards
## Table 13  
Maintenance summary (star chart) (selected sections only)

<table>
<thead>
<tr>
<th>Job</th>
<th>Job title</th>
<th>Exam code</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E01</td>
<td>Battery – check</td>
<td></td>
</tr>
<tr>
<td>E02</td>
<td>Road and rail lights – check and clean</td>
<td></td>
</tr>
<tr>
<td>E03</td>
<td>Work lights – check and clean</td>
<td></td>
</tr>
<tr>
<td>E04</td>
<td>Warning horn – check</td>
<td></td>
</tr>
<tr>
<td>E05</td>
<td>Electrical wiring, plugs and sockets – examine</td>
<td></td>
</tr>
<tr>
<td>E06</td>
<td>Emergency stop system – test</td>
<td></td>
</tr>
<tr>
<td>E07</td>
<td>Trailer brake away siren – test</td>
<td></td>
</tr>
<tr>
<td>E11</td>
<td>Battery – examine</td>
<td></td>
</tr>
<tr>
<td>E16</td>
<td>Starter and alternator – examine</td>
<td></td>
</tr>
<tr>
<td>E**</td>
<td>Bonding – check</td>
<td></td>
</tr>
<tr>
<td>E**</td>
<td>Bonding – test</td>
<td></td>
</tr>
<tr>
<td><strong>UNDERFRAME</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U01</td>
<td>Rail bogies – check</td>
<td></td>
</tr>
<tr>
<td>U02</td>
<td>Underframe – examine</td>
<td></td>
</tr>
<tr>
<td>U03</td>
<td>Ballast weight – check security</td>
<td></td>
</tr>
<tr>
<td>U04</td>
<td>Retaining bolts and pins – check</td>
<td></td>
</tr>
<tr>
<td>U05</td>
<td>Coupling and tow bar – examine</td>
<td></td>
</tr>
<tr>
<td>U11</td>
<td>Rail bogies – examine</td>
<td></td>
</tr>
<tr>
<td>U12</td>
<td>Rail bogies and underframe – clean</td>
<td></td>
</tr>
<tr>
<td><strong>WHEELS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W01</td>
<td>Road wheel nuts and tyres – check</td>
<td></td>
</tr>
<tr>
<td>W02</td>
<td>Rail wheels – check</td>
<td></td>
</tr>
<tr>
<td>W12</td>
<td>Rail wheels and bearings – examine</td>
<td></td>
</tr>
<tr>
<td>W21</td>
<td>Road wheels and tyres – examine</td>
<td></td>
</tr>
<tr>
<td>W22</td>
<td>Rail wheels back-to-back – gauge</td>
<td></td>
</tr>
</tbody>
</table>

**The star chart gives a summary of the tasks to be performed and when. The actual detail of what is to be performed should be set out elsewhere in the maintenance documentation.**

### 10.2.9  
**Particular requirements – brakes**

#### 10.2.9.1  
The maintenance instruction shall include a statement of the brake test procedure. The brake test procedure shall be assessed as part of the engineering acceptance process.

#### 10.2.9.2  
As a minimum, there shall be an annual brake test, which shall detail the requirements for all the brake systems fitted.
The manufacturer should initially state in the maintenance instruction the frequency for a brake test which, as a minimum, should be annually. Some machine types, for example MEWPs, and some designs of brake system, could require more frequent testing. The instruction is able to be amended as subsequent service experience is gained (see also 3.4.1.7c)).

A machine capable of towing other machines shall have brake pressures tested at the intermachine connecting point, and figures recorded at least annually.

It is recommended that, in addition to ensuring that a machine stops within the required distance, or the brake force is correct, a statement should be included to the effect that, if the stopping distance increases, or force decreases, by more than 10% over previous results, the reasons should be investigated and corrected.

For trolleys, the manufacturer shall state the minimum torque figure acceptable for the rail wheel brake.

More detail of trolley brake testing is set out in M&EE COP 0018.

For RRV with rail wheel braking, the manufacturer shall state the minimum torque figure required at the prescribed maintenance interval using the 1" square drive set out in 5.7.1.4.

Parking brakes on trailers should either be tested by use of the 1" square drive on the rail wheel, where fitted, or by applying a pulling or pushing force and checking that the wheels do not rotate; for most 10 mph (16 km/h) trailers this force is equivalent to 6% of the total weight of the loaded trailer.

Parking brakes on towing machines should be tested as instructed by the manufacturer. It is permissible for this to be a pull test if the manufacturer states that this is sufficient.

Each maintenance instruction shall include a statement of the maintenance requirements for wheels. This shall include the limits set out in Tables 4 and 5, and shown in Figures 12 and 13.

Wheels shall be maintained so that they are safe to operate under all normal conditions of wear, suspension condition, machine loading and speed, and that the geometry of the wheel is compatible at all times with the standard rail and track geometry.

The manufacturer may set tighter limits than those set out in Tables 4 and 5, but the maintenance instruction should be designed to not allow an exceedance of the figures in the tables.

It is recommended that information is provided to enable readers to understand the various forms of wheel defects. For example, the result of metal migration down the flange can be similar in appearance to a structural crack. Migration does not affect the integrity of the wheel, whereas a crack does.
10.2.11 Particular requirements – road wheels and tracks

10.2.11.1 Each maintenance instruction shall include a statement of the maintenance requirements for road wheel tyres, where fitted. As a minimum, this shall include requirements to check tyre pressure, wear and condition, road tyre to rail wheel / rail head contact pressure and compatibility between tyre types.

G 10.2.11.1.1 This is important for 9C machines, as it has been demonstrated that poor tyre condition and incorrect pressure can have a significant effect on braking performance. On both 9B and 9C machines, tyre condition will also affect the traction capability. Tyre type mix, excessive tread wear, appreciable variations in tread wear between tyres driving the rail wheels and excessive tread damage, are all significant factors.

10.2.11.2 The maintenance instruction shall detail the permitted tyre types and tyre type combinations, and the requirements / adjustments needed following tyre change. The information included in the instruction shall, as a minimum, include the following, where applicable:

a) Squash – limits and method of measuring.
b) Tyre pressures.
c) Tyre wear limits.
d) Tyre identification and acceptable alternative requirements.
e) Matching replacement tyres across machine with tyres already fitted.

G 10.2.11.2.1 It is recommended that, following a tyre change, a functional brake test is carried out immediately before further use, and a brake stopping distance test at the earliest opportunity.

10.2.11.3 The maintenance instruction shall detail the permitted wear limits of tracks, as required by 6.1.4b).

10.2.11.4 The maintenance instruction shall include the detail and frequency for checking the security of road wheels.

10.2.12 Particular requirements – load lifting

10.2.12.1 Where machines are fitted with one or more load lifting points, the maintenance instruction shall detail the examination and testing in accordance with the requirements of LOLER.

10.2.12.2 Where machines are fitted with hydraulic burst hose protection devices that are capable of test, the maintenance instruction shall detail the testing required.

10.2.13 Particular requirements – MEWPs

10.2.13.1 The examination of all load bearing structures and components shall be detailed, with the method of testing as required.

10.2.13.2 The maintenance instruction shall detail the examination and testing in accordance with the requirements of LOLER.
10.2.14 Particular requirements – RCI

10.2.14.1 Where fitted with a RCI the maintenance instructions shall detail the requirements for frequency of checking for function and accuracy. There shall also be a procedure to be followed post any repair to the RCI or associated components.

10.2.15 Particular requirements – towing equipment

10.2.15.1 The maintenance instruction shall include all appropriate maintenance requirements for towing couplings and tow bars, both general and recovery types.

10.2.16 Particular requirements – data logger

10.2.16.1 Where fitted with a data logger, the maintenance instructions shall detail the requirements for down loading at regular intervals.

10.2.16.2 The manufacturer shall state in the maintenance instruction the frequency required for testing the accuracy of the data logger.

10.2.17 Particular requirements – hydraulic system

10.2.17.1 Where a machine has a hydraulic supply, the maintenance instruction shall detail the hydraulic pump or system pressure and flow rates. The maintenance instruction shall specify the periodicity of checks that shall be undertaken.

10.2.18 Particular requirements – equipotential bonding

10.2.18.1 Where a machine is intended for use under live OLE, the maintenance instruction shall detail the checks necessary to maintain the required impedance. The maintenance instruction shall specify the periodicity of checks that shall be undertaken.

10.2.19 Document review

10.2.19.1 The maintenance instruction shall state the periodicity of review. The instruction shall include the following instructions:

a) A process for it to be regularly reviewed for potential to improve its effectiveness.

b) A process for a record to be kept of decisions taken at each review.

c) A process for the maintenance instruction to also be reviewed in the light of the following:

i) In process reviews of maintenance activities.

ii) Performance of the machines and components covered by the instruction, including relevant national incident reports.

iii) Changes in the pattern of use and operating environment.

iv) Manufacturer’s advice.

v) Network Rail directives.

vi) As part of the seven-year review of the machine.

vii) Fault logs and GE/RT8250 NIRs.
A key element in the development of a successful maintenance instruction is a commitment to review regularly both the frequency and content of each job description. A nominated competent engineer identified by the owner should review the maintenance instruction, as a minimum, every 12 months, and the records retained for audit purposes.

Each component failure should be assessed to establish if there is a failure of maintenance that either caused or contributed to the failure. The maintenance instruction should then be amended to reflect the lessons learnt.

Regular reviews of the performance of the machine, reviews of maintenance activities, changes of use or frequency of use of the machine, and external information, could all lead to changes in the instruction.

Each change of the instruction should be authorised by a nominated competent engineer and, where reasonably practicable, the change should be agreed by the OEM. The amended instruction needs to be recertificated. It is recommended that the instruction is kept as a live document, with each change authorised by the competent engineer, who should decide if the amendment is serious (and requires recertification immediately), or whether several changes can be bundled together and recertificated at an annual review.

The users of the maintenance instruction should be encouraged to contribute to the review process.

Examples of some good practice documentation are set out in Appendix E.
Appendix A  Track Twist Geometry

ϕ₁ = Long wavelength track twist angle between running rails = 1:300.

ϕ₂ = Short wavelength track twist angle between running rails = 1:150.

T = Semi-span of short wavelength discontinuity = 6 m.

Figure 21  Track twist geometry diagram

A.1.1 The short wavelength discontinuity can occur at any position relative to the machine as the machine moves over it.

G A.1.1.1 Track twist is where one wheel is effectively in a dip, as shown in Figure 21.

G A.1.1.2 Most OTP have a wheel base of less than 6 m, in which case the amount of the twist is a simple calculation:

\[ \text{Twist (mm)} = \frac{\text{wheelbase (mm)}}{150} \]

G A.1.1.3 Where the machine has a wheel base greater than 6 m, the amount of the twist is calculated:

\[ \text{Twist (mm)} = \left[ \frac{(\text{wheelbase (mm)} - 6000)}{300} \right] + 40 \]
### Appendix B  Machine Number

#### GB numbering system – demountable machine

<table>
<thead>
<tr>
<th>Special vehicle</th>
<th>Registered in UK</th>
<th>Special</th>
<th>Sequence number</th>
</tr>
</thead>
<tbody>
<tr>
<td>99 70 9</td>
<td>a b c d e f X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- a – b = 90 \( \text{demountable machine} \)

- c = 0  \( \text{crane} \)
- c = 1  \( \text{man carrier} \)
- c = 2  \( \text{MEWP's / access boom} \)
- c = 3  \( \text{S&C carrier} \)
- c = 4  \( \text{test / inspection machine} \)
- c = 6  \( \text{sleeper conditioner} \)
- c = 7  \( \text{rail conditioner} \)
- c = 8  \( \text{trackbed conditioner} \)
- c = 9  \( \text{miscellaneous} \)

#### GB numbering system – RRV

<table>
<thead>
<tr>
<th>Special vehicle</th>
<th>Registered in UK</th>
<th>Special</th>
<th>Sequence number</th>
</tr>
</thead>
<tbody>
<tr>
<td>99 70 9</td>
<td>a b c d e f X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- a – b = 91, 92, 93 \( \text{Type 9A machine} \)
- a – b = 94, 95, 96 \( \text{Type 9B machine} \)
- a – b = 97, 98, 99 \( \text{Type 9C machine} \)

- c = 0  \( \text{360° excavator – wheeled} \)
- c = 1  \( \text{360° excavator – tracked} \)
- c = 2  \( \text{MEWP's / access boom} \)
- c = 3  \( \text{dumper} \)
- c = 4  \( \text{bulldozer} \)
- c = 5  \( \text{tractor / buggie} \)
- c = 6  \( \text{van / land rover} \)
- c = 7  \( \text{open back lorry} \)
- c = 8  \( \text{box lorry} \)
- c = 9  \( \text{miscellaneous} \)
## GB numbering system – wheeled attachments

<table>
<thead>
<tr>
<th>9</th>
<th>9</th>
<th>7</th>
<th>0</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special vehicle</td>
<td>Registered in UK</td>
<td>Special</td>
<td>Sequence number</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- \(a - b = 00\) wheeled attachment

- \(c = 0\) brushbox
- \(c = 1\) clipper machines
- \(c = 2\) sleeper conditioner
- \(c = 3\) trackbed conditioner
- \(c = 4\)
- \(c = 5\)
- \(c = 6\)
- \(c = 7\)
- \(c = 8\)
- \(c = 9\) miscellaneous

### Check digit
- the digits in even positions of number are taken at their own decimal value
- the digits in odd positions of number are multiplied by two
- add together all the digits formed by the two processes
- retain the units digit of this sum
- the complement required to bring the unit digit to 10 is the check digit
- NB. If unit digit is 0 the check digit is 0

## GB numbering system – trailers

<table>
<thead>
<tr>
<th>9</th>
<th>9</th>
<th>7</th>
<th>0</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special vehicle</td>
<td>Registered in UK</td>
<td>Special</td>
<td>Sequence number</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- \(a - b = 01, 02, 03\) Type 0A machine
- \(a - b = 04, 05, 06\) Type 0B machine
- \(a - b = 07, 08, 09\) Type 0C machine

### Check digit
- the digits in even positions of number are taken at their own decimal value
- the digits in odd positions of number are multiplied by two
- add together all the digits formed by the two processes
- retain the units digit of this sum
- the complement required to bring the unit digit to 10 is the check digit
- NB. If unit digit is 0 the check digit is 0
### Appendix C Data Panel

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philquote GmbH</td>
<td>Hydmee Trackside</td>
</tr>
<tr>
<td>012 345 6789</td>
<td>01357 246890</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum travelling speed</td>
<td>$nn$ mph</td>
</tr>
<tr>
<td>Maximum working speed</td>
<td>$nn$ mph</td>
</tr>
<tr>
<td>Maximum cant</td>
<td>$nnn$ mm</td>
</tr>
<tr>
<td>Maximum working gradient</td>
<td>$1 : nn$</td>
</tr>
<tr>
<td>Minimum travelling radius</td>
<td>$nn$ m</td>
</tr>
<tr>
<td>Minimum working radius</td>
<td>$nn$ m</td>
</tr>
<tr>
<td>Maximum service braked towed load</td>
<td>$nnn$ t</td>
</tr>
<tr>
<td>Maximum on / off track cant</td>
<td>$nnnn$ mm</td>
</tr>
<tr>
<td>May be used under LIVE overhead lines</td>
<td>YES</td>
</tr>
<tr>
<td>May travel on LIVE 3 or 4 rail lines</td>
<td>NO</td>
</tr>
<tr>
<td>May be used on isolated and bonded 3/4 rail lines</td>
<td>YES</td>
</tr>
<tr>
<td>Maximum height of tail swing above rail level</td>
<td>$nnn$ mm</td>
</tr>
<tr>
<td>RCI does NOT have a tandem lift mode</td>
<td></td>
</tr>
<tr>
<td>NOT PERMITTED OUTSIDE A POSSESSION</td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 22** Powered machine
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Owner</th>
<th>Manufacturer</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philquote GmbH</td>
<td>012 345 6789</td>
<td>Hydmee Trackside</td>
<td>01357 246890</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum speed</td>
<td>(nn) mph</td>
<td>Maximum on / off track cant</td>
<td>(nnn) mm</td>
</tr>
<tr>
<td>Maximum speed through S&amp;C</td>
<td>(nn) mph</td>
<td>May travel on LIVE 3 or 4 rail lines</td>
<td>NO</td>
</tr>
<tr>
<td>Maximum speed through raised check rails</td>
<td>(nn) mph</td>
<td>May be used on ISOLATED 3/4 rail lines</td>
<td>YES</td>
</tr>
<tr>
<td>Minimum radius</td>
<td>(nn) m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tare weight</td>
<td>(n) t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross vehicle weight</td>
<td>(nn) t</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum load</td>
<td>(nn) t</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOT PERMITTED OUTSIDE A POSSESSION**

*Figure 23  Trailer machine*

G C.1.1.1 To facilitate fitment on the side of the machine, this table can be split into two or more parts, side by side, if required.
Appendix D  Labelling Guidance Diagram

- OLE warning line 5.17.2
- OLE warning notice 5.17.1.6
- OLE warning notice 5.17.1.3
- Lifting point notice 8.10.8
- Data panel Appendix C
- Movement warning notice 8.1.3
- Data panel Appendix C

Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

Appendix C

OLE warning notice
5.17.1.6

OLE warning notice
5.17.1.3

Lifting point notice
8.10.8

Data panel
Appendix C

Movement warning notice
8.1.3

OLE warning line
5.17.2
Appendix E  Example of Good Practice Maintenance Instruction Documentation

Job description for examination of rail axles

This job description has separate texts for Arising Work where the step numbers correspond with those of scheduled work.

<table>
<thead>
<tr>
<th>MAINTENANCE INSTRUCTION</th>
<th>Doc no: MJ-MP-003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Issue: 1</td>
</tr>
<tr>
<td></td>
<td>Rev: A</td>
</tr>
<tr>
<td></td>
<td>Section: 7</td>
</tr>
<tr>
<td></td>
<td>Date: Oct 2004</td>
</tr>
<tr>
<td></td>
<td>Page: 1 of 3</td>
</tr>
</tbody>
</table>

Rail Bogies – Examine  
Job No U11

Safety Condition: SCI and SCR

SCHEDULED WORK

a) Examine each bogie structure, particularly welded joints for signs of cracks and deformation. (See Figures 1 and 2.)

Figure 1  Floating axle

2. Examine visible parts of each bush and pin, checking that the locking devices are undamaged and secure.
3. Examine the bogie securing bolts as follows:
   3.1 Check that all fasteners are present.
   3.2 Visually check for signs of looseness, as follows:
       a) Evidence of fastener rotation such as corrosion, dust or disturbance of debris.
       b) Relative movement between nuts, bolts and washers.
       c) Gaps between any components.
   3.3 Check that any fasteners, packers or washers cannot be rotated by hand.
SCHEDULED WORK (Cont’d)

4. Start the engine and operate the hydraulics to change the machine to rail mode.
   If rail track is not available place suitable wooden packing on ground to prevent damage to rail wheels.

5. During step 4 check that there are no signs of slackness, noise or vibration as each bogie is lowered and raised in turn.

6. Check that there is evidence of surplus grease escaping from all lubricated pins and bushes.

ARISING WORK

1. Renew any damaged component, or repair in accordance with the procedure produced by a competent body.

2. Renew defective components. Renew any locking devices such as tab washers.

3. Renew any missing or damaged fastener. If any found loose or missing renew all in group.

5. Investigate symptom and renew defective components.

6. When carrying out greasing, check that grease escapes from joints where concern exists. If grease is not pumped through correctly, renew grease nipple. If still not satisfactory, then report to supervisor.
Job description for rail wheels and bearings

This job description has separate texts for Arising Work where the step numbers correspond with those of Scheduled Work

<table>
<thead>
<tr>
<th>MAINTENANCE INSTRUCTION</th>
<th>Doc no: MJ-MP-003</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOR ROAD-RAIL MACHINES</td>
<td>Issue: 1</td>
</tr>
<tr>
<td></td>
<td>Rev: A</td>
</tr>
<tr>
<td></td>
<td>Section: 7</td>
</tr>
<tr>
<td></td>
<td>Date: Oct 2004</td>
</tr>
<tr>
<td></td>
<td>Page: 1 of 7</td>
</tr>
</tbody>
</table>

**Safety condition: SCI**

**SCHEDULED WORK**

1. Lift the rail wheels as far as possible.
2. Clean the entire wheel flange and tread, removing any grease, corrosion and debris.
3. Rotate the wheel and check that there is no sign of axial or radial play in the bearings, or noises or harshness. If float is detected, check that it does not exceed 0.05 mm.
4. Rotate the wheel slowly by hand, and examine all surfaces of the wheel, checking for cracks, cavities, metal migration and flats.

The limits for each will be found on Table 1. A description of the types of defects will be found in clauses A, B and C on pages 5 – 7. Record findings on Table 1. (See page 2.)

5. Use a P1 profile gauge (see Figure 1) and feeler gauges to check the following:

![Figure 1 P1 Profile gauge](image)

a) The hollow-wear on the tread is less than 6 mm. See clause 7, if doubt exists.
b) Flange wear is less than 4 mm. See clause 6, if doubt exists.
c) There are no steps in the flange profile greater than 1.5 mm.
d) The tread to the outside of the wheel is not more than 2 mm above the running tread surface (a false flange). (See Figure 2.)
e) Measure rail wheel diameters and back-to-back dimensions (with ** min figures).
### Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

<table>
<thead>
<tr>
<th>Machine No:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location:</td>
<td>Examiner:</td>
</tr>
</tbody>
</table>

#### Rail Wheels – Examine and Bearings – Check (Cont’d)

<table>
<thead>
<tr>
<th>Type of defect</th>
<th>Allowable limit</th>
<th>Record findings here</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracks</td>
<td>See section 3</td>
<td>None allowed</td>
</tr>
<tr>
<td>Cavities</td>
<td>See section 4</td>
<td>15 mm length</td>
</tr>
<tr>
<td>Migration</td>
<td>See section 5</td>
<td>5 mm tread roll over, otherwise no limit</td>
</tr>
<tr>
<td>Flats</td>
<td>? mm</td>
<td></td>
</tr>
</tbody>
</table>

- Tick if wear less than limits, or record amount limit
- Type of defect | Front axle | Rear axle |
  |               | LEFT* | RIGHT* | LEFT* | RIGHT* |
  | Tread hollow  | ?     |        |       |        |
  | Flange        | ?     |        |       |        |
  | Steps         | 1.5   |        |       |        |
  | False flange  | 2     |        |       |        |
  | Wheel ø       | ?     |        |       |        |
  | Back to back  | ?     |        |       |        |

* Left and right is defined as standing with one’s back to the machine in the normal direction of travel.
SCHEDULED WORK (Cont’d)

6. If required, a more accurate method of gauging flange thickness is to use gauge to Drg. B-A2-1710 (BR Cat No 39/29839), as follows:
   a) With face A squarely on the flange back, hold the gauge radially to the wheel and draw it into profile. (See Figure 3.)
   b) Acceptable profiles are indicated by the gauge contacting the profile only at the flange.

On some machines, Travelling Mode Gauge limits the amount of allowable tread wear; hence, this gauge cannot be used on such machines to measure flange height.
MAINTENANCE INSTRUCTION

FOR ROAD-RAIL MACHINES

Rail Wheels – Examine and Bearings – Check (Cont'd)  

SCHEDULED WORK (Cont'd)

7. If required, a more accurate method of gauging flange height is to use gauge to drawing B-A2 1710 (BR Cat. No 39/29839), as follows:
   
   b) With face B squarely on flange back, hold the gauge radially to the wheel and draw it on to the profile. (See Figure 1.)
   
   c) Acceptable profiles are indicated by the gauge contacting the profile only at the tread.

   ![Figure 4](image-url)

   **Figure 4** Use of GO / NO GO flange thickness and height gauge to Drg. No. B-A2-1710 to measure flange height

ARISING WORK

3. If axial or radial play in the bearing exceeds 0.05mm, or noise or harshness is detected, dismantle the bearings and rectify the defects.

Only persons assessed as competent shall carry out work relating to the maintenance and overhaul of rail bearings. This work must be carried out in a covered workshop.
ARISING WORK (Cont’d)

4, 5, 6 & 7 Assess amount of metal to be turned off to remove defect(s).

If wheels will not be turned below a minimum diameter of ** mm, arrange for wheels to be re-profiled, otherwise renew wheels as a pair.

The difference in diameters of wheels on the same axle must not exceed ** mm.

DESCRIPTIVE CLAUSES

d) **Cracks**

Cracks normally have a jagged saw tooth-type of surface profile with sharp edges. Cracks will normally form at the tread chamfer in an axial direction (across the thread). (See Figure 4.)

![Figure 4 Wheel with crack](image-url)

No cracks are permitted, but see clauses B and C overleaf. Renew wheels unless the cracks can be completely removed by re-profiling.
Rail Wheels – Examine and Bearings – Check (Cont’d)

### B. Cavities

Rolling contact fatigue causes microscopic subsurface cracks which develop into a localised network. (See Figure 5.)

![Figure 5 Microscopic cracks](image1.png)  
![Figure 6 Cavities](image2.png)

Over a long period, small sections or spalls break away leaving cavities (see Figure 6). Record the number and length of the cavities. Take action if the length of any cavity exceeds 15 mm, or if two cavities are within 50 mm of each other and their combined length exceeds 15 mm. Re-profile wheels to remove cavities and cracks, otherwise renew the wheels.

### C. Migration

Material migration results from a rolling action that forces the surface material sideways. This can occur in two places:

C1. **Tread Rollover.** This forms on the tread chamfer (see Figure 9). The maximum allowable is 5 mm. Associated with this are circumferential cracks (see Figure 7) which do not affect the integrity of the wheel.
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

MAINTENANCE INSTRUCTION

FOR ROAD-RAIL MACHINES

Rail Wheels – Examine and Bearings – Check (Cont’d)  Job No W12

DESCRIPTIVE CLAUSES (Cont’d)

Figure 7  Circumferential cracking associated with rollover

Figure 9  Rollover limit

C2. Migration down the flange, is shown in Figure 9 where the extreme edges have flaked off.

Figure 9  Migration down the flange

This does not affect the integrity of the wheel. These defects are removed when re-profiling becomes necessary to restore the wheel profile.
Appendix F  Check List for Conformity

Methods of examination

The methods of examination are indicated in the table, which consists of visual checks, measurements, functional tests, load test(s), specific verification / measurements and other controls.

Visual check

The intention is to establish, whether all elements on the machine, systems or components (for example protective devices, visual warning devices, markings), are present and that documents and drawings correspond to the requirements, as set out in the table.

Measurement

The intention is to establish whether the stated measurable parameters (for example geometric dimensions, safety distances, insulation resistance of electric circuits, noise, vibration), have met the requirements of this document.

Functional test

The intention is to establish whether the machine, including all safety devices, works as intended and all functions comply with the requirements and with the technical documentation.

Load test(s)

The intention is to establish whether the strength and stability of the equipment under load, together with all safety devices and adjustments, meets the requirements of this document.

Specific verification / measurements and other controls

The intention is to establish whether the stated requirements of this document have been met. These are, for example, calculations, technical documentation and specific records of this document.

F.1.1 The requirements for PAB assessment shall be the same for a new machine and the seven-year recertification of the first in class machine and successive machines of the same type. An exception is permitted either where explicitly stated within the requirements set out in the clause or against requirements marked with an asterisk (●) when no significant engineering change has taken place to the original certified design.

F.1.2 The requirements in the following tables of Appendix F set out the verification for which the PAB is responsible.

G F.1.2.1 F.1.2 is not intended to imply that the PAB has to actually carry out these tests. The PAB is responsible for ensuring that they have been carried out. With several of these tests, the manufacturer is also responsible and is certainly responsible for provision of a machine that is fit for purpose and in compliance with this standard.
### Clause 5

#### Common design requirements

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.1</td>
<td>Design assessment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.1.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2.2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ■ = Verification by PAB of 1st machine of a class
- ● = Verification by PAB of successive machines of the same class

---

Uncontrolled When Printed
Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015
Amendments to this document can be found on the RSSB Standards Catalogue -
http://www.rssb.co.uk/railway-group-standards
### Table of Verification to Be Effected

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Visual check</td>
</tr>
<tr>
<td>5.4.5</td>
<td>■</td>
</tr>
<tr>
<td>5.4.6</td>
<td>■</td>
</tr>
<tr>
<td>5.4.7</td>
<td>■</td>
</tr>
<tr>
<td>5.4.8</td>
<td>■</td>
</tr>
<tr>
<td>5.5</td>
<td>Wheel loadings</td>
</tr>
<tr>
<td>5.5.1.1</td>
<td>■</td>
</tr>
<tr>
<td>5.5.2.1</td>
<td>■</td>
</tr>
<tr>
<td>5.5.3.1</td>
<td>■</td>
</tr>
<tr>
<td>5.5.3.2</td>
<td>■</td>
</tr>
<tr>
<td>5.5.3.3</td>
<td>■</td>
</tr>
<tr>
<td>5.5.4.1</td>
<td>■</td>
</tr>
<tr>
<td>5.5.5.1</td>
<td>■</td>
</tr>
<tr>
<td>5.5.6.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6</td>
<td>Dynamic stability</td>
</tr>
<tr>
<td>5.6.1.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6.1.2</td>
<td>■</td>
</tr>
<tr>
<td>5.6.1.3</td>
<td>■</td>
</tr>
<tr>
<td>5.6.1.4</td>
<td>■</td>
</tr>
<tr>
<td>5.6.2.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6.2.2</td>
<td>■</td>
</tr>
<tr>
<td>5.6.2.3</td>
<td>■</td>
</tr>
<tr>
<td>5.6.3.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6.3.2</td>
<td>■</td>
</tr>
<tr>
<td>5.6.3.3</td>
<td>■</td>
</tr>
<tr>
<td>5.6.3.4</td>
<td>■</td>
</tr>
<tr>
<td>5.6.3.5</td>
<td>■</td>
</tr>
<tr>
<td>5.6.4.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6.5.1</td>
<td>■</td>
</tr>
<tr>
<td>5.6.5.2</td>
<td>■</td>
</tr>
<tr>
<td>5.6.6.1</td>
<td>■</td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
### Clause 5.7 OTP rail mode brakes

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Visual check</td>
</tr>
<tr>
<td>5.7.1.1</td>
<td>■</td>
</tr>
<tr>
<td>5.7.1.2</td>
<td></td>
</tr>
<tr>
<td>5.7.1.3</td>
<td></td>
</tr>
<tr>
<td>5.7.1.4</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.1.5</td>
<td></td>
</tr>
<tr>
<td>5.7.1.6</td>
<td></td>
</tr>
<tr>
<td>5.7.1.7</td>
<td>■</td>
</tr>
<tr>
<td>5.7.1.8</td>
<td>■</td>
</tr>
<tr>
<td>5.7.1.9</td>
<td>■</td>
</tr>
<tr>
<td>5.7.2.1</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.2.2</td>
<td></td>
</tr>
<tr>
<td>5.7.2.3</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.3.1</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.3.2</td>
<td>■</td>
</tr>
<tr>
<td>5.7.4.1</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.2</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.3</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.4</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.5</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.6</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.7</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.4.8</td>
<td></td>
</tr>
<tr>
<td>5.7.5.1</td>
<td></td>
</tr>
<tr>
<td>5.7.5.2</td>
<td>■ ●</td>
</tr>
<tr>
<td>5.7.5.3</td>
<td>■</td>
</tr>
<tr>
<td>5.7.6.1</td>
<td>■</td>
</tr>
<tr>
<td>5.7.6.2</td>
<td>●</td>
</tr>
<tr>
<td>5.7.6.3</td>
<td>●</td>
</tr>
<tr>
<td>5.7.6.4</td>
<td>■</td>
</tr>
<tr>
<td>5.7.6.5</td>
<td>■</td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
### Clause 5.8  Movement limiting devices

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8</td>
<td>Movement limiting devices</td>
</tr>
<tr>
<td>5.8.2.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.2.3</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.2.4</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.2.5</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.2.6</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.1</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.3</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.4</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.5</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.6</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.7</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.3.8</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.4.1</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.4.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.5.1</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.8.5.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9</td>
<td>Personnel areas (where fitted)</td>
</tr>
<tr>
<td>5.9.1.3</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.9.2.1</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.9.2.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.9.3.1</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
<tr>
<td>5.9.3.2</td>
<td>![ ] Visual check ![ ] Measurements ![ ] Functional test ![ ] Load test ![ ] Specific verification / measurements</td>
</tr>
</tbody>
</table>

- **■** = Verification by PAB of 1st machine of a class
- **●** = Verification by PAB of successive machines of the same class

---

**Uncontrolled When Printed**

Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015

Amendments to this document can be found on the RSSB Standards Catalogue - [http://www.rssb.co.uk/railway-group-standards](http://www.rssb.co.uk/railway-group-standards)
<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Specific Verification / Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.9.3.3</td>
<td>Visual check</td>
<td></td>
</tr>
<tr>
<td>5.9.3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.3.5</td>
<td>Measurements</td>
<td></td>
</tr>
<tr>
<td>5.9.3.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.3.7</td>
<td>Functional test</td>
<td></td>
</tr>
<tr>
<td>5.9.3.8</td>
<td>Load test</td>
<td></td>
</tr>
<tr>
<td>5.9.3.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.4.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.4.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.9.5.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.10</td>
<td>Setting up and packing away</td>
<td></td>
</tr>
<tr>
<td>5.10.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11</td>
<td>Other safety features</td>
<td></td>
</tr>
<tr>
<td>5.11.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.11.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12</td>
<td>Data logging</td>
<td></td>
</tr>
<tr>
<td>5.12.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
### Clause 5.12.5 to 5.12.9

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.12.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.12.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Clause 5.13

**Failure recovery conditions**

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.13.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.13.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Clause 5.14

**Retention of components**

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.14.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Clause 5.15

**Visibility and audibility**

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.15.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.15.3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ■ = Verification by PAB of 1st machine of a class
- ● = Verification by PAB of successive machines of the same class
<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.16</td>
<td>Electrical equipment and electrical safety bonding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.1.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.4.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.5.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.5.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.5.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.16.6.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17</td>
<td>Electromagnetic compatibility</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.17.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.18 8 Protection from overhead line equipment and / or conductor rails</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.1</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.2</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.3</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.4</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.5</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.1.6</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.2.1</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.2.2</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.2.3</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.3.1</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.3.2</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.3.3</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.4.1</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.4.2</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.4.3</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.18.5.1</td>
<td>■● ■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19 8 On and off tracking system</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.4</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.5</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.6</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.7</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.1.8</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.2.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.2.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.2.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.3.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.3.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.3.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.4.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
<tr>
<td>5.19.5.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
## Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

### Clause 5.20 Towing requirements

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.20.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.2.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.3.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.4.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.4.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.5.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.20.5.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21 Rail wheels</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.21.4.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class  
● = Verification by PAB of successive machines of the same class
<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.22</td>
<td>Doors, door handles, steps, handrails and railings</td>
<td>■</td>
<td>●</td>
<td>■</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>5.22.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.22.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.22.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.22.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.22.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.23</td>
<td>Audible warning device (in working mode)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.23.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.24</td>
<td>Demountable modules</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.24.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.24.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.24.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.24.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.25</td>
<td>Windscreens and windows</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.25.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.25.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.25.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.26</td>
<td>Remote control systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.26.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.26.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.26.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.26.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.27</td>
<td>Noise emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.27.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.27.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.28</td>
<td>Vibration emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.28.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.28.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.29</td>
<td>Structural integrity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.29.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.29.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
### Type of verification to be effected

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.30</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.3.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.30.3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.31</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.31.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5.32</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.32.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6.1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6.2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.2.2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ■ = Verification by PAB of 1st machine of a class
- ● = Verification by PAB of successive machines of the same class
### Table: Type of verification to be effected

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2.3.1</td>
<td></td>
<td></td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.3.2</td>
<td></td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.3.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.4.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.4.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.4.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.2.4.4</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.3.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.3.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.3.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.3.4</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.4</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>6.4.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.1.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.2.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.2.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.3.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.4.1</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.4.2</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
<tr>
<td>7.3.4.3</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td></td>
<td>■</td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
### Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

#### Clause number | Type of verification to be effected | Visual check | Measurements | Functional test | Load test | Specific verification / measurements
--- | --- | --- | --- | --- | --- | ---
7.4 | Lifting and jacking points for recovery | | | | | |
7.4.1 | | | | | | 

8.1 | Trolleys | General | | | | |
8.1.1 | | | | | | 
8.1.2 | | | | | | 

8.2 | Rail wheels | | | | | |
8.2.1 | | | | | | 

8.3 | Brake system | | | | | |
8.3.1 | | | | | | 
8.3.2 | | | | | | 
8.3.3 | | | | | | 
8.3.4 | | | | | | 

8.4 | Manual propulsion | | | | | |
8.4.1 | | | | | | 

8.5 | Dynamic stability | | | | | |
8.5.1 | | | | | | 

9.1 | Machines with moveable parts affecting stability | General requirements | | | | |
9.1.1.1 | | | | | | 
9.1.2.1 | | | | | | 
9.1.2.2 | | | | | | 
9.1.3.1 | | | | | | 

9.2 | Cranes (including excavators / loaders used as cranes) | | | | | |
9.2.1.1 | | | | | | 
9.2.2.1 | | | | | | 

9.3 | Mobile elevating work platforms | | | | | |
9.3.1.1 | | | | | | 
9.3.1.2 | | | | | | 
9.3.1.3 | | | | | | 

= Verification by PAB of 1st machine of a class  
= Verification by PAB of successive machines of the same class
### Type of verification to be effected

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3.1.4</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.1.5</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.1.6</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.2.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.3</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.4</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.5</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.6</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.3.3.7</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.1.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.1.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.1.3</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.2.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.3</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.4</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.5</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.6</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.4.3.7</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.1.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.1.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.2.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.3.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.3.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.3.3</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.4.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.4.2</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.4.3</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5.5.1</td>
<td>■</td>
<td></td>
<td>■</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1<sup>st</sup> machine of a class  
● = Verification by PAB of successive machines of the same class
<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Visual check</td>
</tr>
<tr>
<td>9.5.5.2</td>
<td></td>
</tr>
<tr>
<td>9.5.6.1</td>
<td></td>
</tr>
<tr>
<td>9.5.6.2</td>
<td></td>
</tr>
<tr>
<td>9.5.6.3</td>
<td>□</td>
</tr>
<tr>
<td>9.5.6.4</td>
<td></td>
</tr>
<tr>
<td>9.5.6.5</td>
<td>□</td>
</tr>
<tr>
<td>9.5.6.6</td>
<td>□</td>
</tr>
<tr>
<td>9.5.7.1</td>
<td>□</td>
</tr>
<tr>
<td>9.5.7.2</td>
<td>□</td>
</tr>
<tr>
<td>9.6</td>
<td>Dynamic stability</td>
</tr>
<tr>
<td>9.6.1.1</td>
<td>□</td>
</tr>
<tr>
<td>9.6.1.2</td>
<td>□</td>
</tr>
<tr>
<td>9.6.1.3</td>
<td>□</td>
</tr>
<tr>
<td>9.6.2.1</td>
<td>□</td>
</tr>
<tr>
<td>9.6.2.2</td>
<td>□</td>
</tr>
<tr>
<td>9.6.3.1</td>
<td>□</td>
</tr>
<tr>
<td>9.6.3.2</td>
<td>□</td>
</tr>
<tr>
<td>9.7</td>
<td>RCI</td>
</tr>
<tr>
<td>9.7.1.1</td>
<td>□</td>
</tr>
<tr>
<td>9.7.1.2</td>
<td>□</td>
</tr>
<tr>
<td>9.7.1.3</td>
<td>□</td>
</tr>
<tr>
<td>9.7.1.4</td>
<td>□</td>
</tr>
<tr>
<td>9.7.1.5</td>
<td>□</td>
</tr>
<tr>
<td>9.7.1.6</td>
<td>□</td>
</tr>
<tr>
<td>9.7.2.1</td>
<td>□</td>
</tr>
<tr>
<td>9.7.2.2</td>
<td>□</td>
</tr>
<tr>
<td>9.7.2.3</td>
<td>□</td>
</tr>
<tr>
<td>9.7.2.4</td>
<td>□</td>
</tr>
<tr>
<td>9.7.3.1</td>
<td>□</td>
</tr>
<tr>
<td>9.7.3.2</td>
<td>□</td>
</tr>
<tr>
<td>9.7.3.3</td>
<td>□</td>
</tr>
<tr>
<td>9.7.4.1</td>
<td>□</td>
</tr>
<tr>
<td>9.7.4.2</td>
<td>□</td>
</tr>
<tr>
<td>9.7.4.3</td>
<td>□</td>
</tr>
<tr>
<td>9.7.4.4</td>
<td>□</td>
</tr>
</tbody>
</table>

■ = Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
# Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

<table>
<thead>
<tr>
<th>Clause number</th>
<th>Type of verification to be effected</th>
<th>Visual check</th>
<th>Measurements</th>
<th>Functional test</th>
<th>Load test</th>
<th>Specific verification / measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.8</td>
<td>Condition of variables during calculation and testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.8.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.9</td>
<td>Burst protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.9.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.9.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.9.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10</td>
<td>Load lifting points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.10.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.1</td>
<td>Information for users</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.1.1</td>
<td>Instruction handbook</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.2</td>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

= Verification by PAB of 1st machine of a class
● = Verification by PAB of successive machines of the same class
Appendix G  Engineering Conformance Certificate (ECC)

On-Track Plant
Engineering Conformance Certificate

Name of Plant Assessment Body | Accreditation Code
---|---
Network Rail | RT

Vehicle Class / Description : 979 / LH Group / Unimog U400
Vehicle Asset manager : Network Rail
Issue Date : ** August 2016
Expiry Date : ** August 2023

Vehicle Numbers
99709 979005-4

FIRST IN CLASS * (Delete as appropriate)
Certificate Number of First in Class * .................

Authorised by :
Signatory Name
Network Rail

Reason for issue and Scope of Work

Guidance note :
First item – to reference last full certification assessment standard.
Then detail scope of work for this certificate, including clearly the issue number of
RIS-1530-PLT and what has been assessed.

Customer Copy Certificate Number : Page 1 of 4
Deviations associated with this certificate: (if none state ‘NONE’)

None

Previous Certificate Number: (if none state ‘NONE’) None

Maintenance Instruction Details

<table>
<thead>
<tr>
<th>Maintenance Instruction Title:</th>
<th>Issue No:</th>
<th>Date:</th>
</tr>
</thead>
</table>

Limitations of Use *(these words are mandatory where applicable)*

1. When travelling, the OTP vehicle is within Plant gauge as defined in RIS-1530-PLT.

2. The vehicle encroaches into the area reserved for infrastructure equipment:
   a) Exceedance in vertical and horizontal plane is *** mm and **** mm respectively.
   b) A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use.

3. The vehicle encroaches into the area below rail head level by *** mm. A site survey shall be undertaken to assess potential damage to infrastructure equipment prior to use.

4. The vehicle is permitted to travel (and/or work) in conductor rail areas.

5. The vehicle does not have a travelling mode.

6. The vehicle may be used with adjacent lines open to traffic, only if a safe system of work to be adopted has taken account of gauge exceedance of any adjacent line open to traffic.

   Or

7. If adjacent lines are open to traffic, the vehicle shall be used only if a safe system of work has been adopted to take account of the extra gauge exceedance caused by attachments.

8. Movement limitation devices – None specific wording – words to reflect vehicle specifics.

9. The vehicle is provided with preset movement limiting devices as follows:
   - fixed lateral slew limit of ...........
   - fixed vertical height limit ...........

10. Vehicle will not activate train operated points.

11. The vehicle shall not work on light rail systems.

12. Vehicle must not be travelled on:
   - Track cants greater than *** mm.
   - Track gradients greater than 1 in **
   - Curve less than **** m.
   - Raised check and guard rails.

Certificate Number:
13. Vehicle must not be worked on:
   - Track cants greater than *** mm.
   - Track gradients greater than 1 in **
   - Curve less than **** m.
   - Raised check and guard rails.

14. For reverse movements, there shall be an assistant provided at the designated space on the vehicle.
   Or

15. For reverse movements, the vehicle shall be controlled by ground staff.

16. During reverse movements, the vehicle is to proceed at walking speed under the control of ground staff until the superstructure can be slewed to face direction of travel.

17. The vehicle may only operate with the access adjacent to a cess or a line closed to all train movements, or the documented safe system of work must take account of adequate safe clearances to adjacent lines.

18. Setting up and packing aw–y - None specific wordi–g - words to reflect vehicle specifics.


20. The vehicle cannot be on-off tracked in laden condition.

21. Vehicle cannot be on-off tracked on cants greater than ** mm.

22. Vehicle cannot be on-off tracked on gradients greater than 1 in **.

23. Turntable must not be used on track cants greater than ***mm.

24. Not permitted under live OLE.

25. Vehicle not to be on or off tracked under live OLE.
   Or

26. Vehicle not to be on or off tracked under live OLE at a contact wire height of less than **** mm.

27. Vehicle is not permitted to tow or propel any other vehicle.


29. Maximum speed when towing or propelling unbraked trailers on rail not to exceed 10 mph.

30. Coupling systems – movemen–s - None specific wordi–g - words to reflect vehicle specifics.

31. This vehicle shall not be propelled.

32. Quick Hitch not suitable for undertaking lifting operations.

33. This vehicle shall not be used for tandem lifting operations.

34. Crane on vehicle must only be used with stabilisers deployed.
# Supplementary Information

**(Optional – minimum requirements where applicable)**

1. Manufacturer serial / chassis number.
2. Gross vehicle weight.
3. Tare weight.
5. Maximum working cant – 100 mm.
6. Maximum gradient – 1 in 25 (40/00).
7. Potential vertical load applied either side of rail head - *** kgs.
8. Maximum vehicle tail swing – ** mm.
9. Maximum speeds (travel and working) on rail not to exceed:
   - ** mph plain line.
   - ** mph switches and crossings.
   - ** mph raised check / guard rails.
   - ** mph with raised and manned platform.
   - ** mph when travelling with load on crane.
   - ** mph towing / propelling.
   - ** mph emergency recovery.
10. The vehicle is approved to carry ** persons seated in the driver's cab and ** passengers (seated / standing) in (a trailer / the load area).
11. Demountable modules - None specific wording - words to reflect vehicle specifics.
12. Vehicle incapable of moving along the track when disconnected from the towing vehicle.
13. Height of underside of rotating superstructure above rail level - ** mm.
14. Attachments for use without RCI - None specific wording - words to reflect vehicle specifics.
15. Attachments for use on specific vehicles - None specific wording - words to reflect vehicle specifics.
16. Where an attachment is known to have a significant adverse effect on stability the RCI shall always be in 'Lift Mode' when using the attachment.
17. Attachments for raising / lowering personnel - None specific wording - words to reflect vehicle specifics.
18. Load lifting point located at *, rated capacity ** tonnes SW.
19. RCI information:
   - Manufacturer
   - Model
   - Software version
   - Duty chart reference, issue number and date
20. Type of movement limiting device fitted:
   - None
   - Low performance
   - High performance

---

**Certificate Number:** 

Page 4 of 4
### Trolley Engineering Conformance Certificate

<table>
<thead>
<tr>
<th>Name of Plant Assessment Body</th>
<th>Accreditation Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta Rail</td>
<td>ER</td>
</tr>
</tbody>
</table>

#### Vehicle Class / Description
Permaquip Type B Trolley

#### Vehicle Asset Manager
Amey Rail

#### Issue Date
**November 2015**

#### Expiry Date (if any)
n/a

#### Vehicle Numbers
ABC 567890 to ABC 567914 (inclusive)

FIRST IN CLASS* (Delete as appropriate)

Certificate Number of First in Class* ER / 0678 / 15

#### Authorised by:
Signatory Name

#### Reason for Issue and Scope of Work

**Guidance note:**
First it–m – to reference last full certification assessment standard.
Then detail scope of work for this certificate, including clearly the issue number of RIS-1530-PLT and what has been assessed.

#### Customer Copy
Certificate Number: ER/0789/15

#### Deviations associated with this certificate:
None
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

Maintenance Instruction Details

Maintainance Instruction Title:  

Maintenance Instruction Number:  Issue No:  Date:

Vehicle data

Maximum load :  

Other data :  

Limitations of Use

1. Not to be used outside a possession.
2. Vehicle must not be used on:
   - Track cants greater than ** mm.
   - Track gradients greater than 1 in **.
   - Curve less than ** m.

Supplementary Information

(Optional – minimum requirements where applicable)

1. Manufacturer serial / chassis number.

Certificate Number: ER/0789/15
Appendix H  Air Brake Inter-machine Connections

H.1  Specifications – parking brake – air

H.1.1  The parking brake line (railway terminology) is normally referred to as an emergency line in road transport terminology.

H.1.2  The system pressures shall be:

- Minimum brake system pressure: 0 bar.
- Brake fully released: 5 bar.
- Brake fully applied: 0 bar.
- Maximum brake system pressure: 10 bar.

And

- Minimum pipe diameter: ½" nominal bore.

H.1.3  Air quick release dump valves shall be used for the brake actuators on each axle, to enhance trailer breakaway brake application response.

Figure 24  Schematic of parking brake connections


C = BSAU138A-1980 red connecting pipe.

H.1.4  BSAU138B-2000 couplings shall not be used.
H.2 Specifications – service brake – air

H.2.1 The system pressures shall be:

- Pressure to apply service brake: 0 – 6 bar.
- Minimum brake system pressure: 0 bar.
- Brake fully released: 1 bar.
- Brake fully applied: 6 bar.
- Maximum brake system pressure: 10 bar.

And

- Minimum pipe diameter: \( \frac{1}{2} \)" nominal bore.

---

**Figure 25** Schematic of service brake connections

- F = BSAU138A-1980 yellow connecting pipe.

H.2.2 BSAU138B-2000 couplings shall not be used.
H.3 Specifications – optional charge brake – air

H.3.1 The charge air brake line (railway terminology) is normally referred to as an auxiliary line in road transport terminology. This line is optional and is used to charge auxiliary air receivers if fitted to the trailers.

H.3.2 The system pressures shall be:

- Minimum charge air system pressure: 0 bar.
- Minimum charge air pressure: 7 bar.
- Maximum charge air pressure: 10 bar.
- Maximum charge air system pressure: 10 bar.

And

Minimum pipe diameter: \(\frac{1}{2}\)" nominal bore.

Figure 26 Schematic of charge air connections

- **H** = BSAU138A-1980 male ‘CA’ coupling.
- **I** = BSAU138A-1980 black connecting pipe.

H.3.3 BSAU138B-2000 couplings shall not be used.
Appendix I  Not used
Appendix J  Couplings

J.1  Design categories

J.1.1  Category of trailer weights (gross laden trailer weight):

a)  < 1 tonne.

b)  1 tonne - < 5.5 tonnes.

c)  5.5 tonnes and over.

J.2  Coupling design

J.2.1  The coupling design should be suited to the design category:

a)  For trailers in J.1.1a): specific for each application.

b)  For trailers in J.1.1b): either 50 mm ball or unique arrangement for each application.

c)  For trailers in J.1.1c): automatic trailer coupler to DIN 74054, which has been European homologated 94/20/CE 40 mm type (120 kN tow force) at both ends of the trailer (see Figure 27).

The 50 mm ball in b) may have a limited towing capability. It is likely that manufacturers will develop a towing coupling to suit their own designs. This is acceptable providing the system is incompatible with any other coupling systems.

Figure 27  Drawing of typical automatic trailer coupler

J.3  Design strengths

J.3.1  The following values are draw bar forces which act longitudinally and are both tensile and compressive:

Category a)  tow bar – towing adaptor – coupling – headstock / chassis structure shall withstand minimum 10 kN.

Category b)  tow bar – towing adaptor – coupling – headstock / chassis structure shall withstand minimum 50 kN.

Category c)  tow bar – towing adaptor – coupling – headstock / chassis structure shall withstand minimum 120 kN.

G J.3.1.1  It is normal practice for the tow bar or towing adaptor to be designed to be a lower strength than the coupling and headstock / chassis in order to avoid damage to the machine.

J.4  Design position

J.4.1  The coupling shall be on the centre line of the machine.
J.4.2 Height above rail level shall be:

<table>
<thead>
<tr>
<th>Category</th>
<th>Trailer $H_1$</th>
<th>Towing machine $H_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>2–0 - 300 mm</td>
<td>&gt;200 mm but could require a bespoke towing adaptor</td>
</tr>
<tr>
<td>b)</td>
<td>200 -300mm</td>
<td>Not specified but requires bespoke towing adaptor</td>
</tr>
<tr>
<td>c)</td>
<td>300 ± 100 mm</td>
<td>Not specified but requires bespoke towing adaptor</td>
</tr>
</tbody>
</table>

Figure 28 Schematic drawing of coupling heights

J.5 Towing adaptor

J.5.1 Except as set out in J.5.2, the towing adaptor of category c) shall be fitted with 40 mm diameter eyes as per ISO 8755 and DIN 74054, type A at H3 end.

J.5.2 It is permissible for an end connection to be suitable for attachment to a UIC draw hook at the H3 end (with end height to suit wagon draw hook).

J.5.3 The height of the towing adaptor at H3 shall be compatible with trailer coupling height $H_1$.

J.5.4 Except where the towing adaptor is permanently fixed, provision shall be made on each towing machine to safely stow its towing adaptor(s).

J.6 Tow bar

J.6.1 Tow bars between category c) trailers shall be compatible with coupling set out in J.2.1c) with 40 mm diameter eyes as per ISO 8755 and DIN 74054, type A at both ends.

J.6.2 Provision shall be made on the trailer to stow a tow bar safely.

J.6.3 The manufactured tow bar shall have a serial number.

J.7 Common design criteria for towing adaptor and tow bar

J.7.1 The strength of the towing adaptor and tow bar shall comply with the requirements set out in J.3.

J.7.2 Where the method of coupling requires personnel to be between machines:

a) The towing adaptor and tow bar shall be designed to provide sufficient space between machines to accommodate the personnel required.

b) The tow bar shall be rigid to protect the personnel.

J.7.3 Consideration should be given to manual handling regulations in the design of the towing adaptor and tow bar.
G J.7.3.1 As design guidance, no individual should be required to lift in excess of 20 kg.

J.7.4 Every towing adaptor and tow bar shall be uniquely numbered, with a number incorporating the manufacturer and a serial number.
Appendix K Noise Measurement Test Code

K.1 General requirement

K.1.1 The manufacturer shall state the values of the noise emissions at personnel positions.

K.1.2 To achieve compliance with the Machinery Directive the measurement of the noise emissions shall be made using the test code as set out in K.2.

K.2 Determination of the sound pressure level

K.2.1 The A-weighted emission sound pressure level at the personnel positions shall be determined. The measurements shall be carried out at the personnel positions and under the operating conditions set out in Table 14.

<table>
<thead>
<tr>
<th>Test number</th>
<th>Personnel positions</th>
<th>Microphone positions to determine the emission sound pressure level at the personnel positions</th>
<th>Operating conditions for measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Personnel places with seats inside cabs</td>
<td>Measuring point at a height of 0.8 m centrally above the seat surface</td>
<td>Machine travelling at maximum speed on track with a range of features (that is to say, measurement to include switches and crossings and jointed track, as appropriate)</td>
</tr>
<tr>
<td>2</td>
<td>Personnel places with seats inside cabs</td>
<td>Measuring point at a height of 0.8 m centrally above the seat surface</td>
<td>Machine in working condition, full load and maximum engine speed</td>
</tr>
<tr>
<td>3</td>
<td>Personnel places with standing positions on machines</td>
<td>Measuring point at a height of 1.60 m centrally above the standing position of personnel</td>
<td>Machine in working condition, full load and maximum engine speed</td>
</tr>
<tr>
<td>4</td>
<td>Personnel places with standing positions beside machines</td>
<td>Measuring point at a height of 1.60 m above rail level centrally above the standing position of personnel</td>
<td>Machine in working condition, full load and maximum engine speed</td>
</tr>
<tr>
<td>5</td>
<td>Personnel places at which operators are present beside the machine with control panels</td>
<td>Measuring point 1.60 m above rail level centrally above the control panel</td>
<td>Machine in working condition, full load and maximum engine speed</td>
</tr>
</tbody>
</table>

Table 14 Noise measurement of personnel areas (working condition is for travelling and working mode)

G K.2.1.1 The measurement of noise should be carried out by competent personnel. An acceptable methodology for measuring sound pressure level is given in BS EN ISO 11201:1996. Further guidance on noise measurement is given in 2.3 of GM/GN2460.
K.2.2 Further specified positions for the determination of the emission sound pressure level are described by the position of axis A in Table 15. The microphone shall be positioned above axis A at a distance of 1 m from the reference box (see BS EN ISO 3744:2010, clause 3.10) and 1.70 m above the upper edge of the rail of the adjacent track. The microphone shall be moved with the machine in both working and travelling mode. The definition of the reference box components of the machine, which can swing out, is not to be taken into consideration.

<table>
<thead>
<tr>
<th>Test number</th>
<th>Noise creating components</th>
<th>Microphone positions to determine the emission sound pressure level at the personnel positions</th>
<th>Operating conditions for measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Engine blocks or generators</td>
<td>Axis A at right angles to the track and on the centre line of the exhaust and through the openings of the air intake</td>
<td>Machine in working mode, full load and maximum engine speed</td>
</tr>
<tr>
<td>7</td>
<td>Group of grinding tools (grinding machine)</td>
<td>Axis A at right angles to the track and on the centre line of a group of grinding stones</td>
<td>Machine in working mode, full load and maximum engine speed</td>
</tr>
<tr>
<td>8</td>
<td>Equipment for ballast grading</td>
<td>Axis A at right angles to the track through the end of the plough or brush at its most extended position</td>
<td>Machine in working mode, full load and maximum engine speed</td>
</tr>
<tr>
<td>9</td>
<td>Pass by noise</td>
<td>As set out in K.3.2</td>
<td>Machine travelling at maximum speed on track with maximum engine speed</td>
</tr>
</tbody>
</table>

**Table 15** Noise measurement of machine

K.2.3 If required, the C-weighted peak sound pressure level shall be determined at the personnel positions or specified positions.

K.3 Sound power level determination

K.3.1 For measurements taken in accordance with Table 14 the A-weighted sound power level shall be determined in accordance with BS EN ISO 3744:1995.

K.3.2 Because the length of the reference box of machines might exceed 7 d (the measurement distance d is the perpendicular distance between the reference box and the measurement surface, see BS EN ISO 3744:2010, clause 7.3), the sound power level shall be determined as follows: on both sides of the machine there are five microphone positions on a vertical line, see Figure 29. For machines where the noise levels are the same on both sides of the machine, measurements need to be taken only on one side. The distance between these vertical lines and the reference box shall be 1 m. The track with the machine on it and the adjacent track shall be on the same height and shall lie in a straight line. The definition of the reference box components of the machine, which can swing out, is not to be taken into consideration.

K.3.3 The measurement shall be taken while the machine is passing in operating mode. The measurement starts when the front of the machine, defined by the front of the reference box, is at a distance of 3 m to the axis crossing the track through the microphones. The measurement shall stop when the end of the machine is at a distance of 3 m to this axis.
K.3.4 There is no environmental correction K2 because the measurement is taken out in a free field (see BS EN ISO 3744:2010, clause A.1). As the measurements shall be taken outdoors, the test environment is considered to be an acoustic free field over a sound reflective plane. Thus the environmental correction K2 is assumed to be less than 0.5 dB and therefore negligible. To avoid the influence of any sound reflecting objects in the open test site, observe the requirements in BS EN ISO 3744:2010, clause A.1.

K.3.5 For the calculation of the sound power level average measurement of the surface, use BS EN ISO 3744:2010, clause 8.

K.4 Installation and mounting conditions
K.4.1 The installation and mounting conditions shall be identical for the determination of both the sound power level and the emission sound pressure level at specified positions.

K.4.2 For the purpose of measurements, the machine shall work on a track, which is part of a sound reflecting plane outdoors providing the necessary free field above the reflecting plane.

K.5 Operating conditions
K.5.1 The operating conditions shall be the same for the determination of the sound power level and of the emission sound pressure level at the personnel positions and specified positions. The operating conditions of the machines are set out in Tables 13 and 14.

K.6 Measurement uncertainties
K.6.1 The application of the proposed noise emission measurement methods results in different measurement uncertainties. These are to be stated as standard deviations of reproducibility in the basic noise emission measurement standards. Thus a standard deviation of reproducibility sR of 0.5 –B - 2.5 dB is expected for the A-weighted emission sound pressure level determined in accordance with BS EN ISO 11201:1996.
K.6.2 In considering the sound power level determination according to BS EN ISO 3744, a standard deviation of reproducibility $s_R$ of 0.5 – 1.5 dB is required.

K.7 Information to be recorded

K.7.1 The information to be recorded shall cover all of the technical requirements of this noise test code. Any deviations from the noise test code or from the basic standards upon which it is based shall be recorded together with the technical justification for such deviations.

K.8 Information to be reported

K.8.1 The information to be included in the test report shall be at least that which the manufacturer requires to prepare a noise emission declaration, or the user is required to verify the declared values.

K.8.2 The following minimum information shall be given:

a) Identification of the manufacturer, machine type, machine model, serial number and year of production.

b) Place and date of the test and personnel involved.

c) Reference to this noise test code and the basic standards applied.

d) Description of installation and operating conditions.

e) Location of personnel positions and other specified positions.

f) Description of microphone positions (personnel position and other specified positions).

g) Description of the measurement instrument and year of calibration.

h) Description of the test environment, including background and environmental corrections.

i) Determined noise emission values:

   i) Emission sound pressure level $L_{pA}$ at the personnel positions and other specified positions.

   ii) $L_{pCpeak}$ if required.

   iii) Sound power level $L_{WA}$.

j) Confirmation that all requirements of this noise test code have been fulfilled, or, if this is not the case, any unfulfilled requirements have been identified. All unfulfilled requirements shall be specified; deviations from the requirements shall be stated and technical justifications for the deviations shall be given.

K.9 Declaration and verification of noise emission values

K.9.1 The declaration of the noise emission values shall be made as a dual number noise emission declaration according to BS EN ISO 4871. The declaration shall state the emission sound pressure level $L_{pA}$ at the personnel positions or at other specified positions and, if necessary, the sound power level $L_{WA}$ together with the respective uncertainty $K$ ($K_{pA}$ and $K_{WA}$).

K.9.2 If necessary, the peak sound pressure levels $L_{pCpeak}$ shall be given together with its uncertainty $K_{pCpeak}$.

K.9.3 The uncertainties of measurement $K_{pA}$, $K_{WA}$ and $K_{pCpeak}$ are expected to have values of 3 dB each.

K.9.4 The noise emission value shall be rounded to the nearest decibel.
K.9.5 The noise emission declaration shall explicitly state that the emission values have been measured according to the specification of this noise test code, as well as to BS EN ISO 11201:1996, respectively BS EN ISO 3744. If this statement is not true, the noise emission declaration shall indicate clearly what the deviations are from this noise test code and/or from the basic standards.

K.9.6 The noise emission declaration shall be part of the manufacturer's instruction handbook.

G K.9.6.1 An example of a noise emission declaration according to B.2 of BS EN ISO 4871:2009 is set out in Table 16.

| Machine number | ... | ... | ... |
| Type: | ... | ... | ... Model: | ... | ... | ... |
| Declared dual-number noise emission values in accordance with EN ISO 4871 |
| Scope of use of machine during test: | | | |
| Load | No Load |
| Measured A-weighted emission sound pressure level $L_{PA} \text{ (ref 20 } \mu \text{Pa)}$ at the operator's position in dB(A) | $nn$ | $nn$ |
| Uncertainty $K_{PA}$ in dB | $3$ | $3$ |
| Measured A-weighted sound power level $L_{WA} \text{ (ref 1 pW)}$ in dB(A) | $nn$ | $nn$ |
| Uncertainty $K_{WA}$ in dB | $3$ | $3$ |
| Values determined according RIS-1530-PLT, BS EN ISO 11201 and BS EN ISO 3744 |

NOTE The sum of a measured noise emission value and its associated uncertainty represents an upper boundary of the range of values that are likely to occur in measurements.

Table 16 Example of a noise emission declaration
Appendix L  Vibration Measurement

L.1  General requirement
L.1.1  The manufacturer shall state the values for vibration at the working positions. The vibration emission declaration shall be part of the manufacturer's instruction handbook.

L.2  Whole body vibration
L.2.1  Manufacturers shall either declare the highest rms value of weighted acceleration to which the whole body is subjected to by the machine using the method set out in L.2.2 to L.2.5, if it exceeds 0.5 m/s\(^2\) or, otherwise, declare that it is less than 0.5 m/s\(^2\). Additionally, the manufacturer shall also declare the degree of uncertainty of each vibration measurement.

G L.2.1.1  The degree of uncertainty can either be determined by compliance with the recommendation given in BS EN 12096:1997 Annex D or through an analysis of test methods and repeating results where the production run is sufficiently large to give readings from at least ten machines. As the latter is unusual for production runs of OTP it is recommended that the degree of uncertainty should be 50% of the measured value.

L.2.2  Measurements shall be taken at locations where personnel can either stand or sit. For standing locations the measurement shall be taken on the floor, and for seated locations the measurement shall be taken on the seat cushion (there is no requirement for measurements on the seat back support). Measurements shall be made using tri-axial accelerometers, in accordance with the requirements set out in BS EN 1032:2003. Only the largest of the three readings need to be used in the assessment process.

L.2.3  Measurements shall be taken under the following conditions, including, as a minimum, one set of switch and crossing (S&C), as applicable, where these conditions are appropriate for the intended use of the machine:

a)  Machine stationary with the engine running.

b)  Machine at maximum permitted running speed on continuous welded rail for a period of a statistically significant length of time, as determined by the technically competent person.

c)  Machine at maximum permitted running speed on jointed track for a statistically significant length of time, as determined by a technically competent person.

d)  In working mode for each of the working functions for a statistically significant length of time, as determined by a technically competent person.

L.2.4  Manufacturers are required to give information and instruction with the actual testing method, actual test results and degree of uncertainty of those results.

L.2.5  The manufacturer shall clearly state how the vibration value was derived, that is to say, the use being made of the machine and the track being traversed. The manufacturer shall record the actual vibration levels measured and the degree of uncertainty of these results. The information shall be included in the instruction handbook for the purchaser.

L.3  Hand-arm vibration
L.3.1  Manufacturers shall declare the vibration total value to which the hand-arm system is subjected by the machine, if it exceeds 2.5 m/s\(^2\) or is less than 2.5 m/s\(^2\). Additionally, the manufacturer shall also declare the degree of uncertainty of each vibration measurement.

L.3.2  Measurements shall be taken for all handheld equipment, examples of equipment that should be considered for hand-arm vibration assessment are (but not limited to):
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

a) Handheld tools.

b) Handle bars and guard rails.

c) Powered pneumatic tools.

d) Control handles of machines (where the control is held for periods of operation).

L.3.3 Measurement shall be made by using a tri-axial instrument fixed to the piece of equipment being held in the hand (as shown in BS EN 28662-1:1992).

L.3.4 The vector sum of the three readings shall be used in the assessment process. The equipment to be measured shall be in use in its intended mode and in its intended environment (for example, a handheld ballast tamper shall be measured when in use with ballast).

L.3.5 Manufacturers are required to give information and instruction with the actual testing method, actual test results and degree of uncertainty of those results.

L.3.6 The manufacturer shall clearly state how the vibration value was derived, that is to say, the use being made of the machine and the track being traversed. The manufacturer shall record the actual vibration levels measured and the degree of uncertainty of these results. The information shall be included in the instruction handbook for the purchaser.

G L.3.6.1 The requirements for permitted vibration dose levels are set out in the Control of Vibration at Work Regulations: 2005, for which guidance is available from the Health and Safety Executive, and in GM/GN2460.
Appendix M CCTV Specification

M.1 Specification

M.1.1 Camera-monitor-systems shall fulfil the following requirements:

1) ISO 16001:2008 with the exception of clause 4.3.1 concerning resolution.
2) Transmission time between recording and display not greater than 300 ms.
3) Monitor picture shall be switched into the moving direction automatically.
4) Camera-monitor-system shall start automatically with machine start.
5) Camera: a minimum of IP 69K.
6) Monitor: a minimum IP 54T.
7) Switches and plugs: to a minimum of IP 67.
8) Ambient temperature between -20° C and + 60°C.
9) Shock resistance for components out of the cabin: amplitude 15 mm for 5 to 8 Hz, 5 g for 8 to 500 Hz, 20 cycles.
10) Colour monitor with a minimum size of 5.5".
11) Luminosity able to operate in 0.5 lux and above.
12) Automatic brightness compensation of the camera.
13) Camera with built-in heater to prevent condensation.
14) The resolution threshold of the camera is defined by the formula:

\[
\omega_c = 60 \frac{f}{2N_c}
\]

where:

- \( \omega_c \): resolution threshold of the camera (arc-min).
- \( \beta_c \): angle of vision of the camera (°).
- \( N_c \): number of video lines of the camera.

15) The manufacturer shall supply the values for \( \beta_c \) and \( N_c \).

16) Opening angle: 1 m behind the machine so that the sight of the machine width shall be included and the fisheye-effect shall be minimized.

NOTE Recommendation for the maximum opening angle: horizontal 127°, vertical 115°.

17) The machine manufacturer shall state if the camera is able to reproduce colours (principally the colours used in signalling) in all lighting conditions.
References

The Catalogue of Railway Group Standards give the current issue number and status of documents published by RSSB. This information is also available from 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
GE/RT8000-TW1 Module TW1 Preparation and movement of trains on ERTMS lines
GE/RT8000 DC Module DC – DC electrified lines
GE/RT/8000 HB10 Duties of the COSS or SWL and person in charge when using a hand trolley
GE/RT/8000 HB11 Duties of the person in charge of the possession (PICOP)
GE/RT/8000 HB13 Duties of the person in charge of the siding possession (PICOS)GE/RT8006 Assessment of Compatibility of Rail Vehicle Weights and Underline Bridges
GE/RT8024 Persons Working On or Near to AC Electrified Lines
GE/RT8025 Electrical Protective Provisions for Electrified Lines
GE/RT8073 Requirements for the Application of Standard Vehicle Gauges
GM/RT2042 Braking System Requirements and Performance for Traction Units
GM/RT2045 Braking Principles for Rail Machines
GM/RT2100 Requirements for Rail Vehicle Structures
GM/RT2130 Vehicle Fire, Safety and Evacuation
GM/RT2149 Requirements for Defining and Maintaining the Size of Railway Vehicles
GM/RT2190 Compatibility Requirements for Rail Vehicle Couplings and Interconnectors
GM/RT2304 Equipotential Bonding of Rail Vehicles to Running Rail Potential
GM/RT2456 Structural Requirements for Windscreens and Windows on Rail Vehicles (superseded by GM/RT2100 issue 4)

RSSB documents
GM/GN2460 Guidance on Compliance with Noise and Vibration Legislation in the Railway Environment
GM/GN2686 Guidance on Rail Vehicle Bodyshell, Bogie and Suspension Elements
GM/RC2514 Recommendations for Equipotential Bonding of Rail Vehicles to Running Rail Potential
GE/GN8640 Guidance on Planning an Application of the Common Safety Method on Risk Evaluation and Assessment
GE/GN8641 Guidance on System Definition
GE/GN8642 Guidance on Hazard Identification and Classification
GE/GN8643 Guidance on Risk Evaluation and Risk Acceptance
GE/GN8644 Guidance on Safety Requirements and Hazard Management
GE/GN8645 Guidance on Independent Assessment
RIS-1700-PLT Rail Industry Standard for Safe Use of Plant for Infrastructure Work
RIS-1710-PLT Rail Industry Standard for Engineering Certification of Railborne Plant

Other References

Uncontrolled When Printed
Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015
Amendments to this document can be found on the RSSB Standards Catalogue - http://www.rssb.co.uk/railway-group-standards

Uncontrolled When Printed
Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015
Amendments to this document can be found on the RSSB Standards Catalogue - http://www.rssb.co.uk/railway-group-standards
Supply of Machinery (Safety) Regulations 2008 – as amended by the Supply of Machinery (Safety) (Amendment) Regulations 2011

Provision and Use of Work Equipment Regulations 1998

Control of Vibration at Work Regulations: 2005


Road Machines (Construction and Use) Regulations: 1986

97/68/EC European Directive on Non-Road mobile machinery emissions

2004/104/EC European Automotive EMC Directive

BS EN 547 Safety of machinery - human body measurement Part 1 principles for determining the dimensions required for openings for whole body access into machinery

BS 6912-19:1996 Safety of earth-moving machinery. Specification for dimensions and requirements for operator’s seat

BS 857:1967 Specification for safety glass for land transport


BS 7262:1990 Specification for automatic safe load indicators

BS EN ISO 4165:2003 Road machines. Electrical connections. Double-pole connection

BS EN 60302-2:1998 Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories

BS EN 61508:2010 series

Functional safety of electrical/electronic/programmable electronic safety-related systems. Parts 1 to 7


BS EN ISO 13849-1:2008 Safety of machinery – Safety-related parts of control systems

Part 1: General principles for design

BS EN ISO 13849-2:2008 Safety of machinery – Safety-related parts of control systems


LUL – S1051 Civil Engineering - Bridge Structures

M&EE COP0007 M&EE Networking Group Code of Practice – On/Off Tracking of Road-Rail Machines

M&EE COP0011 M&EE Networking Group Code of Practice – Planning and Executing Lifting Operations

M&EE COP0014 M&EE Networking Group Code of Practice – Trailers and attachments with RRVs and RMMMs

M&EE COP0018 M&EE Networking Group Code of Practice – Rail Mounted Manually Propelled Equipment

M&EE COP0025 M&EE Networking Group Code of Practice - Dynamic Brake Testing of RRVs

BS EN 3 series Portable fire extinguishers


BS EN 474 series Earth-moving machinery – safety

BS EN 1032:2003 Mechanical vibration – Testing of mobile machinery in order to determine the vibration emission value BS EN 12077-2:1998

BS EN 12077-2:1998 Cranes safety – Requirements for health and safety – Part 2: Limiting and indicating devices
Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

BS EN 12096:1997  Mechanical vibration – Declaration and verification of vibration emission values
BS EN 12999:2011  Cranes. Loader Cranes
BS EN 13000:2004  Cranes. Safety. Mobile cranes
BS EN 13309:2000  Construction machinery – Electromagnetic compatibility of machines with internal electrical power supply
BS EN 13977:2011  Railway applications. Track. Safety requirements for portable machines and trolleys for construction and maintenance
BS EN 15954-2:2013  Railway applications. Track. Trailers and associated equipment. General safety requirements
BS EN 15955-2:2013  Railway applications. Track. Demountable machines and associated equipment. General safety requirements
BS EN 28662-1:1992  Hand-held portable power tools. Measurement of vibrations at the handle. General
BS EN 50121-3-1:2015  Railway applications – Electromagnetic compatibility Part 3-1: Rolling stock – Train and complete vehicle
BS EN 50121-3-2:2015  Railway applications – Electromagnetic compatibility Part 3-2: Rolling stock – Apparatus
BS EN ISO 3744:2010  Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane
BS EN ISO 4165: 2003  Road vehicles. Electrical connections. Double-pole connection
BS EN ISO 4871:2009  Acoustics — Declaration and verification of noise emission values of machinery and equipment
PD CLC/TR 50126-3:2008  Railway applications. The specification and demonstration of reliability, availability, maintainability and safety (RAMS). Guide to the application of EN 50126-1 for rolling stock RAM
ISO 4305:1991  Mobile cranes – determination of stability
ISO 4310:1981  Cranes – Test code and procedures
ISO 10567:1992  Safety of earth-moving machinery. Methods for the calculation and verification of the lift capacity of hydraulic excavators
ISO 11451 series  Road machines – Machine test methods for electrical disturbances from narrowband radiated electromagnetic energy
### Rail Industry Standard for Technical Requirements for On-Track Plant and Their Associated Equipment and Trolleys

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 11452 series</td>
<td>Road machines – Component test methods for electrical disturbances from narrowband radiated electromagnetic energy</td>
</tr>
<tr>
<td>UIC 540:2002</td>
<td>Brakes – Air brakes for passenger trains and freight trains</td>
</tr>
</tbody>
</table>

Uncontrolled When Printed
Document comes into force and supersedes RIS-1530-PLT Iss 5 (all, except Part 3) and RIS-1701-PLT Iss 3 (Section 4.1) on 05/12/2015
Amendments to this document can be found on the RSSB Standards Catalogue -
http://www.rssb.co.uk/railway-group-standards