

Railway Group Standard

GM/RT2400

Issue Five

Date September 2013

Engineering Design of On-Track Machines in Running Mode

Synopsis

This document mandates requirements for the design of on-track machines in running mode.

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Railway Group Standard**GM/RT2400****Issue** Five**Date** September 2013**Engineering Design of On-Track Machines in Running Mode****Issue record**

Issue	Date	Comments
One	January 1996	Original document
Two	December 2002	Replaces issue one
Three	December 2010	Replaces issue two Includes requirements for on-track machines previously contained in GM/RT2100 issue three
Four	September 2011	Replaces issue three Small scale change amendment – revision of 3.6 to align with the requirements in BS EN 14033.
Five	September 2013	Replaces GM/RT2400, issue four, GM/RT2476, issue one GM/GN2575 issue two and GM/GN2576 issue one Document aligned with Conventional Rail Locomotives and Passenger Technical Specification for Interoperability (CR LOC & PAS TSI) and BS EN 14033 series. All requirements for on-track machines in running mode are now contained within this document or with specific references to other documents.

Revisions have not been marked by a vertical black line in this issue because the document has been revised throughout.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded
GM/RT2400 issue four, September 2011 Engineering Design of On-Track Machines	All	December 2013
GM/RT2476 issue one, August 2003 On-Track Machine Requirements for Demonstrating the Reliable Operation of Track Circuits	All	December 2013
GM/GN2575 issue two, June 2004 Guidance on the Engineering Acceptance of On-Track Machines	All	December 2013
GM/GN2576 issue one, August 2003 Guidance on Vehicle Requirements for Reliable Track Circuit Operation	All	December 2013

GM/RT2400 issue four, GM/RT2476 issue one GM/GN2575 issue two and GM/GN2576 issue one cease to be in force and are withdrawn as of 07 December 2013.

Supply

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Engineering Design of On-Track Machines in Running Mode

Part 1 Purpose and Introduction

1.1 Purpose

- 1.1.1 This document mandates requirements for the design of on-track machines when they are in running mode.
- 1.1.2 This document is the national technical rule (NTR), which is able to be used as an alternative standard instead of the CR LOC & PAS TSI as permitted by the CR LOC & PAS TSI clause 7.1.1.3.

1.2 Introduction

1.2.1 Background

- 1.2.1.1 The production of GM/RT2400 issue five takes into account the Technical Specifications for Interoperability (TSI) and Euronorms (ENs). GM/RT2400 has been rewritten using the headings set out in the CR LOC & PAS TSI and mandates the requirements of BS EN 14033-1:2011, BS EN 14033-2:2008+A1:2011 and BS EN 14033-3:2009+A1:2011 and a number of other ENs.
- 1.2.1.2 Where ENs are considered complete and a suitable substitute for Railway Group Standards, reference to the EN is made.

1.2.2 Principles

- 1.2.2.1 The requirements of this document are based on one of the following principles:
 - a) All new on-track machines are manufactured in compliance with the CR LOC & PAS TSI for running mode.
 - Or
 - b) The new on-track machine is designed to this standard as permitted by CR LOC & PAS TSI clause 7.1.1.3.
- 1.2.2.2 Notwithstanding the stated scope of other Railway Group Standards (see Appendix C), this document provides all the necessary technical requirements for the design of on-track machines.

1.2.3 Related requirements in other documents

- 1.2.3.1 On-track machines are out of scope of all RGSs except for RGSs explicitly mandated in this document. For information, Appendix C sets out a list of the RGSs for which on-track machines are removed from scope following the compliance date of this standard.

- 1.2.3.2 The following RGS, which describe processes, remain applicable to on-track machines as the situation arises:

GE/RT8106	Management of Safety Related Control, Command and Signalling (CCS) System Failures
GE/RT8250	Reporting High Risk Defects
GE/RT8270	Assessment of Compatibility of Rolling Stock and Infrastructure
GM/RT2273	Post Incident and Post Accident Testing of Rail Vehicles

1.2.4 Supporting documents

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1.2.4.1 The following Rail Industry Standard complements this Railway Group Standard:

RIS-1702-PLT Rail Industry Standard for the Design of On-track Machines in Working and Travelling Modes

1.3 Approval and authorisation of this document

1.3.1 The content of this document was approved by Plant Standards Committee on 12 June 2013 and Rolling Stock Standards Committee on 28 June 2013.

1.3.2 This document was authorised by RSSB on 23 July 2013.

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Part 2 Design Requirements for On-track Machines

2.1 Structure and mechanical parts

2.1.1 Mechanical interfaces

- 2.1.1.1 The intention of section 2.1.1 of this document is that the end coupling system of on-track machines, where fitted, is designed to transmit, safely and without suffering significant permanent deformation all sustained and shock loads that arise between it and other rail vehicles, including on-track machines associated with:
- a) Coupling and uncoupling.
 - b) Traction and braking.
 - c) Traversing curved track.
 - d) Vertical changes in alignment.
 - e) Shock loads caused by play and flexibility in the train coupling, drawgear and buffers, if fitted.
- 2.1.1.2 The coupling system, with the exception of buffers, shall engage positively with the coupling system of any rail vehicle to which it is intended to couple.
- 2.1.1.3 The design of the system shall ensure that it is possible to determine that the coupling systems are positively engaged, either directly or by a suitable system of indication.
- 2.1.1.4 Except as set out in 2.1.1.5 of this document, the coupling systems, with the exception of buffers, shall be designed to remain positively engaged over the limiting values for track features set out below, for each feature separately:
- a) Minimum horizontal track radius of 80 m.
 - b) Minimum horizontal track reverse radii each of 80 m with a 3 m intermediate straight.
 - c) Minimum vertical track radius, concave and convex of 500 m.
 - d) Maximum installed cant of 200 mm.
 - e) Maximum cant gradient of 1 in 400.
 - f) Maximum track twist as set out in Appendix A.
- 2.1.1.5 Where an on-track machine is unable to meet the limiting values set out in 2.1.1.4 of this document, the limitation(s) shall be stated in the operating instructions, as set out in Part 3.
- 2.1.1.6 The limiting value of track features that coupling and uncoupling is possible for the particular on-track machine shall be stated in the operating instructions.
- 2.1.1.7 Systems that control the operation of the coupling or uncoupling system shall be protected from reasonably foreseeable interference that could result in the system's inadvertent or malicious operation.
- 2.1.1.8 The design of the coupling system shall allow manual uncoupling of the coupling system when the systems normally required for uncoupling are unavailable.

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- 2.1.1.9 Drawgear and its attachments to an on-track machine body shall be designed to fail at a lower tensile load than that for the primary structure of the machine.
 - 2.1.1.10 Drawgear designed to be capable of transferring shear forces between adjacent vehicles shall withstand, without significant permanent deformation, the transfer of 100 kN in both the vertical and transverse directions simultaneously.
 - 2.1.1.11 Inner couplings between different on-track machines of a fixed formation train shall be designed to withstand the forces due to the intended operating conditions, as stated in the operating instructions, see Part 3 of this document.
 - 2.1.1.12 If vehicles of an on-track machine are permanently coupled together, the coupling systems between the vehicles shall be designed to withstand forces greater than the couplings and buffers at the ends of the on-track machine.
 - 2.1.1.13 For articulated on-track machines, the joint between two parts of a machine which share the same running gear shall comply with the requirements of BS EN 12663-1:2010 clause 6.5.3 and clause 6.7.5.
 - 2.1.1.14 On-track machines not equipped with any end coupling feature shall be capable of being attached to a rescue railway vehicle in the event of failure or breakdown. The design shall include an operable failsafe through brake system between the on-track machine and the rescuing rail vehicle that automatically applies the brakes in the event of a breakaway.
 - 2.1.1.15 The coupling system shall, as a minimum, be designed such that it does not require any human presence between them whilst either the on-track machine or vehicle is moving.

Note: The Supply of Machinery (Safety) Regulations 2008 sets out the requirement that the coupling system is designed such that employees are not exposed to undue risk during coupling and uncoupling, or rescue operations.
 - 2.1.1.16 If an on-track machine is fitted with buffers, then under all load conditions, the buffer height shall be within the range of 940 mm and 1065 mm.

2.1.2 Strength of vehicle structure

- 2.1.2.1 The static frame strength of on-track machines shall comply with BS EN 14033-1:2011, clause 6.2. In addition on-track machines with a driving cab shall meet the requirements of BS EN 12663:2010 clause 6.2.3 and for Table 6 and Table 7 only shall be considered as category L.
- 2.1.2.2 The dynamic frame strength of on-track machines shall comply with BS EN 12663-1:2010, clause 6.6.
- 2.1.2.3 Attachments to the on-track machine frame, including bogie attachments, shall comply with BS EN 12663-1:2010 clause 6.5.2 and clause 6.7.
- 2.1.2.4 Bogies and axlebox equipment shall comply with BS EN 13749:2011 clause 4. Axleboxes and equipment fitted to non-bogied on-track machines shall also comply with BS EN 13749:2011 clause 4. The validation of these requirements shall comply with BS EN 13749:2011 clause 6.2.
- 2.1.2.5 For on-track machines that include a bogie frame, the integrity of the structure of the bogie frame, all attached equipment and body to bogie connections shall be demonstrated using one of the methods set out in BS EN 13749:2011 clause 6.2.
- 2.1.2.6 In the application of the load cases referred to in BS EN 13749:2011, the exceptional payload shall be taken as the fully laden condition.

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2.1.2.7 The hypothesis taken to evaluate the loads due to bogie running (formulas and coefficients), set out in BS EN 13749:2011 Annex C, shall be stated in the technical file.

2.1.2.8 All roofs over areas designed to be occupied by people shall resist the penetration into the on-track machine of a concrete cube weighing 100 kg dropped from a height of 3.0 m above the roof. The cube shall be dropped so that a flat surface hits the roof.

2.1.3 Lifting and jacking

2.1.3.1 Lifting and jacking points on on-track machines shall comply with BS EN 14033-1:2011 clause 6.3. Brackets used for re-railing shall either conform to the options given in prEN 16404:2012 or if different to those choices the, brackets shall be carried on the on-track machine.

2.1.4 Access doors

2.1.4.1 External on-track machine doors and their mountings shall withstand the following separate proof load cases without significant permanent deformation or loss of normal function:

- a) A concentrated perpendicular load of 2.5 kN applied over an area of 0.1 m x 0.1 m, acting from within the vehicle. The door structure shall be capable of withstanding this load at any position on the surface of the door.
- b) An external surface pressure load of 2.5 kPa.
- c) The inner surface pressure load of 2.5 kPa, applied over the internal surface of the door plus a concentrated perpendicular load, acting from within the vehicle, of 0.8 kN applied over an area of 0.1 m x 0.1 m. The structure shall be capable of withstanding the concentrated load at any position on the surface of the door.

2.1.4.2 External doors for use by personnel for access and egress directly from and to the track shall withstand as an ultimate load case a sustained pressure of 3 kPa over its internal surface. It is permissible for the door and associated components not to remain operational after the application of this load.

2.1.4.3 In addition, on-track machine personnel access doors shall comply with BS EN 14033-1:2011 clause 14.2.3 and clause 15.2 (second paragraph).

2.1.5 Mechanical characteristics of glass (other than windscreens)

2.1.5.1 All side windows shall comply with BS EN 14033-1:2011 clause 14.3.5. In this case 'safety' glass shall either be laminated or toughened glass.

2.1.5.2 Glass used in roofs shall comply with 2.1.2.8 of this document.

2.1.6 Obstacle deflectors

2.1.6.1 If a self-propelled on-track machine is designed with a maximum speed in excess of 145 km/h, it shall be fitted with obstacle deflectors that comply with Appendix B.

2.2 Track interaction and gauging**2.2.1 Gauging**

2.2.1.1 The swept envelope of on-track machines in running mode shall be determined by the process set out in GM/RT2149.