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**GM/RC2496
Recommendations for Railway Wheelset Maintenance
Issue Two: February 2010
Railway Group Recommendations for GM/RT2466**



Documents

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Recommendations for Railway Wheelset Maintenance

Issue Record

Issue	Date	Comments
One	August 2008	Original document Supersedes GM/RT2466 Parts C, E and G and GM/RC2566 Parts C, E and G
Two	February 2010	Replaces issue one Small scale change amendment – in GM/RT2466 reflected in 2.7 and 3.2, addition of new recommendation RC163a.

Amended or additional parts of revised pages have been marked by a vertical black line in the adjacent margin.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

Superseded documents	Sections superseded	Date when sections are superseded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/RT2496 issue one August 2008 Recommendations for Railway Wheelset Maintenance	All	03 April 2010

Supply

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Part 1 Introduction

1.1 Purpose and structure of this document

This document has been published by Rail Safety and Standards Board (RSSB) to give details of a recommended method which, if followed, would meet the requirements of Railway Group Standard GM/RT2466.

Should an infrastructure manager or railway undertaking choose not to follow the recommended method of meeting the requirements of GM/RT2466 laid out in this document, it should assure itself that the method it is following is as effective, and no less safe, than the method that is recommended here.

Relevant requirements in GM/RT2466 are reproduced in the sections that follow. Recommendations are provided as a series of sequentially numbered clauses prefixed 'RC'.

Specific responsibilities and compliance requirements are laid down in the Railway Group Standard itself.

This document contains recommendations that are amended under the Railway Group Standards Code (Issue Three) as a small scale change. Reference to the amended recommendations is made in the 'Issue Record'. All other parts of the document are unchanged from the previous issue.

1.2 Copyright

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1.3 Approval and authorisation of this document

The scope of this document was approved by:

Rolling Stock Standards Committee on 09 October 2009.

This document will be authorised by RSSB on 10 December 2009.

Part 2 Recommendations for Railway Wheelset Maintenance

2.1 Requirements for maintenance

GM/RT2466 Railway Wheelsets

4.1 Maintenance plan

- 4.1.1 All wheelsets shall remain compliant with the requirements, including limits, set out in this document. This shall be achieved through examinations in accordance with a wheelset maintenance plan.
- 4.1.2 The maintenance plan shall identify all specifications, procedures and processes, including examination, inspection and testing, for wheelset maintenance, which shall be applied at a frequency adequate to ensure that the wheelset is at all times in compliant condition.
- 4.1.3 GM/RC2496 provides recommendations for wheelset maintenance, in particular requirement for applications in the UK.

2.1.1 Compliance with limits of wear

- RC001 Railway undertakings should define as part of its safety management system the means by which the wheelsets are maintained within the specified limits in the maintenance plan.
- RC002 The procedures used for the repair / overhaul of wheelsets should be independently assessed and referenced in the maintenance plan for the vehicle. Changes should be reviewed by a technically competent authority and assessed to ensure there is no increase in risk to the original wheelset design.
- RC003 Regular monitoring and recording of wheel wear can enable the prediction of maintenance attention and permit economic re-profiling to be undertaken. Such a monitoring method could allow the identification of abnormal wear conditions within a vehicle or fleet of vehicles.
- RC004 Alternatively railway undertakings can establish dimensional limits for each wheelset / vehicle combination to ensure that mandatory safety limits of wear, as set out in GM/RT2466, are not infringed between examinations during service operation. Railway undertakings should ensure that the limits are defined in a wheelset database and form part of the relevant maintenance plan.
- RC005 The wheelset gauging requirements of Part 4 of GM/RT2466 can be met by the application of systems identified in GM/GN2497.
- RC006 All gauges and measuring equipment should be calibrated. When surface texture is specified a stylus type instrument is preferred for measurement, but comparative gauges are permitted as necessary.

2.1.2 Assessment of tread condition

- RC007 The most basic method of assessing tread profile condition is to use the flange height and thickness limit gauge. This only identifies when the tread has reached the permitted limits and remedial action is then immediately necessary to restore the tread to an acceptable condition within the permitted limits. Adoption of this method offers very limited planning of wheel remedial attention.
- RC008 Railway undertakings should ensure that tread profiles remain within the specified limits for the appropriate profile by regular inspection / measurement of flange height and thickness, as defined in the maintenance plan.
- RC009 Appropriate gauges should be used when determining acceptability of the profile. Flange height and flange thickness should be measured as set out in Appendix A of GM/RT2466. Wheel profiles should be rectified before the profile limits are infringed, including the limits for tread roll-over, rim distortion or false flange (see GM/RT2466 Figures 7, 8 and 9).

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RC010 When inspecting wheel tread condition the wheel diameters should also be checked to ensure that it is maintained within their limits at all times. Checks should be made for unusual wear such as uneven wear across the wheelset and local areas of uneven wear circumferentially around the wheel tread. Tread damage should be assessed in accordance with guidance provided in GM/RC2497 or equivalent document.

2.1.3 Periodic review of maintenance plans

RC011 Maintenance plans should be periodically reviewed to ensure that examination frequencies remain appropriate, particularly if changing conditions in operation occur. The maintenance plan should include a review process that monitors changes in performance of key components to ensure that changes in condition are being addressed by the examination frequencies.

2.1.4 Assessment of other wheelset components

RC012 The wheelset definitions are restricted solely to the axle and wheels in the context of GM/RT2466; however, a wheelset incorporates bearings and possibly axleboxes, brake discs, drive systems and associated bearings, dependent upon the type of wheelset.

RC013 When visually examining the wheelset, other components attached to the wheelset should be examined at the same time; axleboxes, bearings, brake discs, drive systems and associated bearings, suspension tubes, etc.

RC014 These components can have a significant effect on the integrity of wheelsets when in operation. Therefore wheelset examinations should include examination of these components for any unusual conditions that could affect the performance of the wheelset:

Component	Condition
Axleboxes and bearings	Check for evidence of overheating and discoloured paint. Security of bearing retaining rings (as it can damage the wheelset to journal transition). Security of attachment to the bogie. Evidence of water contamination, particularly when removing the end cover for ultrasonic axle testing (UAT) inspection. Loss of bearing lubricant, leaking from seals. Noise and vibration emitted from the bearing when rotated.
Brake discs	Check for cracks. Check that the attachment fasteners and mechanism is secure. Uneven or excessive braking surface wear Deformation of the braking surface. Discoloration indicating the disc had overheated caused by brake malfunction. Corrosion of braking surface indicating malfunction of brake.
Integral braked wheels	Cracks in the braking surface. Discoloured braking surface. Distortion of the wheel due to thermal inputs. Wear of the braking surface.
Drive system, for example final drives, suspension tubes, etc	Bearings rotate freely and smoothly. Drive system is able to rotate freely on the axle bearings (use of train borne or line side monitoring equipment).

Table 1 Component examination

2.1.5 Corrosion protection

- RC015 The responsibility for maintaining the integrity and quality of the wheelsets' corrosion protection system remains with railway undertakings.
- RC016 Railway undertakings should ensure the maintenance plan includes examinations to identify damaged coatings and that they are rectified. For example, the maintenance requirement for the protective coatings applied to certain axles is rigorous and requires the wheelset to be removed in the event of damage to the surface coating. This ensures that corrosion of the axle surface does not occur.
- RC017 Railway undertakings should have in place procedures detailing the actions necessary to rectify damaged corrosion protection on the axle body.

2.1.6 Change of duty (use)

- RC018 When a wheelset is to be subject to a change in duty a documented review of the implications of the proposed changes should be undertaken. The review should assess the risks to the wheelset, track and the interface between the two. Any change of use should not increase the risk of operating that wheelset.
- RC019 Before a change of duty is implemented, including where the wheelset is under the same vehicle, all wheelsets fitted to the vehicle should comply with the specified non-destructive testing (NDT) interval in accordance with the applicable NDT procedure for that vehicle.
- RC020 The review of the change of duty should include any alterations to the operation or utilisation of the wheelset that would increase the risk or reduce the design life of that wheelset. The change could include, but not limited to, the following:
- a) Axle load
 - b) Route change / mileage
 - c) Up-rated speed
 - d) Duty cycle
 - e) Track forces
 - f) Change of gearing / tractive effort
 - g) Transporting of corrosive commodities.

2.1.7 Design or material change

- RC021 Where the wheelset design or specification of a wheelset has changed since the original manufacture, the wheelset can be used for the remainder of its life. Wheelsets to a revised design or specifications can be introduced by suppliers of new or repaired wheelsets or via overhaul. A documented review of the proposed changes, including the design, repair, inspection and maintenance should be undertaken to ensure safe operation of the wheelset and vehicle onto which it is fitted and, as far as reasonably practicable, meet the requirements of GM/RT2466.
- RC022 Railway undertakings should establish the standard or specification to be used for the manufacture of replacement wheelsets or components.

2.1.8 Corrosive applications

- RC023 Wheelsets that regularly come into contact with materials that contaminate or cause corrosion of the axle should be subject to NDT inspection at a frequency to ensure that defective wheelsets are withdrawn from service. This NDT regime should be maintained, even after change of use to a less corrosive cargo, until the axle is overhauled, stripped of protective coating and subject to magnetic particle inspection (MPI) or similarly sensitive NDT technique.

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2.1.9 Old axles

- RC024 Old wheelsets were manufactured to earlier standards using materials and processes that produced materials that were not as consistent and reliable as those produced today. These wheelsets will have accumulated a considerable fatigue history during their service lives. Additional inspections should be applied to ensure safety of these wheelsets and minimise risks of continued service operation.
- RC025 Wheelsets over 40 years old are permitted only to continue in use subject to continuing to meet the required tests and examinations. The maintenance plan should ensure that the axle is:
- Subject to NDT at a periodicity half that of similar axles less than 40 years old
 - The axle is identified with an 'X' stamped in front of the manufacturing / assembling contractors code
 - The wheelset database is updated to recognise the increased frequency of NDT.

2.1.10 Replacement wheelsets

- RC026 Replacement wheelsets should be within the tolerance limits specified for the particular unit / vehicle, compatible with the other wheelsets on the vehicle and to satisfy the requirements of the sub-systems fitted to the vehicle. For example, some diesel multiple unit (DMU) powered bogies, with mechanically linked driven wheelsets across a bogie require a minimal diameter difference between the wheelsets to prevent damage to the drive train. Also, the minimum wheel diameter to be fitted to a vehicle following repair or overhaul is normally specified in the contractual arrangements.
- RC027 Replacement wheelsets should have valid NDT certification.
- RC028 The NDT certificate validity period of replacement wheelsets should be compatible with the other wheelsets on the vehicle to avoid premature withdrawal from service for NDT inspection.
- RC029 Wheelset records should be updated before the wheelset is despatched for overhaul.

2.1.11 NDT

a) NDT inspection

- RC030 Wheelsets should be subject to regular NDT as defined by GM/RC2494, recommendations for wheelset design. The NDT periodicity should be specific to the vehicle type, wheelset type and duty.
- RC031 NDT of axles should be in accordance with the wheelset maintenance plan.

b) NDT periodicity

- RC032 The wheelset NDT periodicity should be recorded in the maintenance plan and wheelset database.
- RC033 The NDT periodicity may be either time or distance based but should not be greater than eight years.
- RC034 A maximum period between NDT inspections has been identified to ensure that wheelsets with long periodicities between NDT inspections do not develop cracks from corrosion pitting. It is of concern that a vehicle with low utilization can remain in service for a long period of time without NDT examination of the axles, where corrosion is a significant contribution to the initiation of a fatigue fracture.

c) Change of NDT periodicity

- RC035 Before the NDT periodicity is changed a documented technical review should be undertaken to ensure the risk has been addressed. Such NDT periodicity amendments should be incorporated into the maintenance plan.
- RC036 The technical review should consider factors that affect the fatigue life, including, but not limited to, the following:
- a) Loadings
 - b) Duty cycle
 - c) Axle material properties
 - d) Suspension design
 - e) NDT inspection period
 - f) Fracture propagation prediction
 - g) Defect size
 - h) Probability of detection (NDT method used and flaw detection capabilities).

2.1.12 Examination

a) Examination regimes

- RC037 Wheelsets should be examined whenever a vehicle is presented for:
- a) Wheelset maintenance, as set out in the vehicle maintenance plan
 - b) General vehicle condition examination
 - c) Vehicle repair that affects either the wheelsets, bogies or suspensions.
- RC038 Additionally, wheelsets should be examined whenever required by the following:
- a) Receipt of an incident report, for example rough riding, striking an object, unusual noise, wheel flats, etc
 - b) Report of a wheel load impact detector exceedance
 - c) Activation of a hot box detector
 - d) Brake drag
 - e) Identification of other deficiencies associated with wheelsets, for example identified by High Risk Defect Reports (see GE/RT8250).
- RC039 A safety examination should be undertaken for the following reasons:
- a) Where a defective or damaged vehicle has been identified or reported owing to the potential to affect the safety of its wheelsets
 - b) The vehicle has been stored for a period of time.
- RC040 Railway undertakings should have processes for responding to reported wheelset defects, this could include using opportunities to observe and listen for wheelset damage as the vehicle is moved, in addition to visual examinations.
- RC041 It is permissible for the scope of an examination to be vehicle or wheelset specific. The examination content should include those elements listed in the examination

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recommendations RC048 to RC057 inclusive of this document that are applicable to the scope of the specific examination being undertaken and all observations recorded.

- RC042 To undertake safety examinations and in particular wheelset examinations, adequate access to the wheelsets is required. Service points generally have insufficient access to undertake safety examinations, so the vehicle should be moved to a suitable location.
- RC043 The levels at which actions are taken should be defined with the appropriate action in the wheelset maintenance plan.
- RC044 When the vehicle has been involved in an incident likely to have caused severe tread damage, the brake equipment and wheel tread should be examined for damage and appropriate action taken to rectify the damage, in accordance with the maintenance specification.
- RC045 Defects identified in the bogies and suspensions could have resulted in damage to the wheelset or, conversely, resulted from a defect on the wheelset. It is essential that not only is the defect rectified, but also that associated components and equipment should be examined for consequential damage. Table 2 identifies possible defects and consequences.

Defect	Consequences
Tread damage, ovality, flats	Suspension damage, springs, dampers, pivot bushes, axlebox structural damage, bearings, wheel slide protection installations, drive mechanisms, gearcases and suspension tubes. Seized traction motor / final drive gearbox.
Loose / broken safety straps or component that can fall onto the wheelset	Damage and scoring of the axle or other component.
Loss of motor bogie axle protective cover	Scoring of the axle by debris being retained in space between axle and motor
Loose / defective bearing retaining rings	Damage and scoring of the wheelset to journal transition and contamination of the journal bearing.
Defective current return brush	Scoring and damage to brush track.
Defective equipotential bonding and traction return connection	Bearing damage, overheating and potential failure.
Seized brake mechanism	Overheated brake disc or brake drag, moved wheel / tyre.
Defective primary damper	Rough riding.
Defective suspension location	Unusual wear pattern on the wheel tread, high flange wear.
Loose balance weights	Damage to the wheel, cracks in the wheel.
Loose bearing end caps	Bearings become loose, subsequently overheat and fail in short period.

Table 2 Defects and consequential damage

- RC046 Where a tired wheel has been subject to a dragging brake or the tyre is believed to have moved, the wheel should be examined as set out in IB/TP0001. The white lines across the tyre / wheel centre interface are used to identify whether the tyre has moved on the wheel centre. If the line is displaced circumferentially across the interface, then the tyre has moved. Railway undertakings should have in place a procedure for dealing with moved / shifted tyres, defining the actions that are to be taken following identification.

Failure to address the defect can result in loss of the tyre and derailment of the vehicle. Examination of defective components should consider other attached and associated components and the effect that the observed defect could have on their condition and future performance.

- RC047 Wheelsets observed with cracks, damage, overheating, thermal crazing, wear, movement of an interference fit or other deficiency should be assessed by measurement or gauging, as set out below, to determine whether the limits specified in GM/RT2466 have been infringed.

b) Wheelset examination key tasks

- RC048 The following is a list of examinations and inspections that should be undertaken on the wheelset as required for continued safe operation. These tasks are to be undertaken with the wheelset in its assembled state. Disassembly of the wheelset is not necessary, other than where removal of the axle end cover is required.

- RC049 The list includes a range of inspections to be undertaken in the assessment of wheelset condition and conformance with the limits specified in GM/RT2466.

c) General examination requirements

- RC050 The wheelset should be examined for integrity, including but not limited to:

- a) Corrosion anywhere on the axle, wheel (other than the tread) or wheel centre.
- b) Damage anywhere on the axle, wheel or wheel centre. This can be in the form of scoring, burrs, raised edges, sharp indentations, impact marks or fretting.
- c) Tread damage and flats.
- d) Any signs of overheating anywhere on the wheelset.
- e) Cracks in the axle, wheel or wheel centre. Thermal crazing and rolling contact fatigue cracks in the centre of the tread surface should not exceed the requirements of the appropriate maintenance specification. Tread conditions in excess of the criteria will be rectified by re-profiling.
- f) Any sign of movement at interference fit interfaces.
- g) Where there is reason to suspect that dimensions are at variance with requirements, check that relevant dimensions are within limits:
 - i) Back-to-back dimension, measured at axle height and at three equi-spaced locations around the wheelset
 - ii) Wheel tread diameters
 - iii) Wheel tread diameter difference.

- RC051 Checks for damage to, or missing, oil injection hole plug.

d) Axle examination

- RC052 The axles should be examined for, but not limited to, the following:

- a) Flame cutting damage, weld spatter or electric arc damage
- b) Integrity of the axle surface coating
- c) Damage to axle end threaded holes, when the holes are exposed for reasons other than the visual inspection

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- d) Raised edges to axle end faces, indentations, depression, poor surface texture or grooves that may hinder UAT. This examination need only be carried out when the axle end face is exposed for reasons other than the visual inspection and when the NDT policy includes UAT.
- RC053 Where the examination identifies deficiencies in the axle condition, then measurements should be undertaken to confirm the extent of defects, such as axle body run-out, surface texture, back-to-back, etc.
- e) Tread examination**
- RC054 Where the visual inspection of the tread profile suggests that it is worn or damaged, railway undertakings should:
- a) Examine for, and measure, tread damage, flats and cavities
 - b) Measure or gauge tyre / rim thickness
 - c) Measure or gauge flange thickness and flange height
 - d) Measure or gauge flange toe radius and examine for sharp flange features
 - e) Measure or gauge flange angle or flange angle dimension (European system of measurement)
 - f) Examine the profile for grooving, false flange, flange step etc to ensure they are within allowable limits.
- f) Tyred wheel examination**
- RC055 The tyres should be examined for security and integrity, including:
- a) Checks for evidence of movement between the tyre and wheel centre, (disturbed or cracked rust / dirt / paint between wheel centre / retaining ring / tyre, polishing at the interface, slivers of metal close to the interface)
 - b) Checks for cracks in the tyre
 - c) Checks for damage to the retaining ring
 - d) Where there is reason to suspect that the tyre has moved, checks with a feeler gauge that the clearance between the tyre snip and the wheel centre rim is within limits
 - e) Checking the clearances between the inside vertical face of the tyre and the retaining ring and between the retaining ring and wheel centre to ensure that they are within limits*
 - f) Checking that the retaining ring ends are not separated by more than the allowable gap and that there is no make-up piece in the retaining ring*.
 - g) Check integrity of electrical continuity bonding (resilient wheels)
- RC056 The items marked with * in RC055 e) and f) should usually only be applied at repair or overhaul when the wheelset is dismantled.
- g) Other components**
- RC057 Examine other components attached to the wheelset (for example axleboxes, gearboxes, final drives, suspension tubes, brake discs etc) for damage, cracks, oil leakage and other problems.