

**Railway Group Standard**  
**GM/RT2466**  
**Issue Three**  
**Date February 2010**

## Railway Wheelsets

### Synopsis

This document mandates requirements for the design, manufacture and maintenance of wheelsets and their components.

This document contains requirements that are amended under the Railway Group Standards Code (Issue Three) as a small scale change. Reference to the amended requirements is made in the 'Issue record.

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**Railway Group Standard****GM/RT2466****Issue Three****Date** February 2010**Railway Wheelsets****Issue record**

| Issue | Date          | Comments                                                                                                                                                                                                                                                                                                                                                                   |
|-------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| One   | June 2003     | Original document, superseded: GM/T0083 issue one, GM/TT0089 issue one, GM/TT0120 issue one, GM/RT2020 issue one, GM/RT2023 issue one, GM/RT2025 issue two, GM/RT2026 issue two, GM/RT2027 issue one, GM/RT2028 issue one and GM/RT2451 issue one including compliance dates.                                                                                              |
| Two   | August 2008   | Supersedes issue one                                                                                                                                                                                                                                                                                                                                                       |
| Three | February 2010 | Replaces issue two<br>Small scale change amendment – addition to Table 1 and associated note together with new clause 2.9.3, correction of reference in 4.9.1.1, revision of 4.18.1, addition of new clause 4.18.2 (following clauses re-numbered), revised drawing number in Table A.1 in Appendix A, new Appendix D and note to identify where drawings can be obtained, |

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/RT2466 issue two August 2008<br>Railway Wheelsets | All                 | 03 April 2010                     |

**Supply**

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Uncontrolled copies of this document can be obtained from Communications, RSSB, Block 2 Angel Square, 1 Torrens Street, London EC1V 1NY, telephone 020 3142 5400 or e-mail [enquiries@rssb.co.uk](mailto:enquiries@rssb.co.uk). Other Standards and associated documents can also be viewed at [www.rgsonline.co.uk](http://www.rgsonline.co.uk).

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## Part 1 Purpose and Introduction

### 1.1 Purpose

- 1.1.1 This document mandates requirements for the design, manufacture and maintenance of wheelsets and their components.

### 1.2 Introduction

#### 1.2.1 Background

- 1.2.1.1 The implementation of the Technical Specifications for Interoperability (TSIs) mandated through a series of European Union Directives has resulted in a review of all requirements mandated in Railway Group Standards.
- 1.2.1.2 Under the Strategy for Standards Management Rail Safety and Standards Board (RSSB) has given a commitment to review all of its standards with a view to mandating only those requirements that define the interface and the need for co-operation between different categories of duty-holder to manage risk safely.
- 1.2.1.3 A review of the requirements set out in standards associated with railway wheelsets has resulted in a revised Railway Group Standard on this topic.

#### 1.2.2 Principles

- 1.2.2.1 The requirements of this document are based on one of the following principles:
- a) This document mandates only those requirements that define the interface and the need for co-operation between different categories of duty-holder to manage risk safely.
  - b) This document mandates requirements that are necessary only to support an Open Point in a TSI and meet an essential requirement of the relevant EU Directive
  - c) This document mandates requirements that are necessary only for interworking on non TSI compliant GB infrastructure.

#### 1.2.3 Support to Essential Requirements

- 1.2.3.1 The EU Directives applicable to Interoperability mandate that each TSI is required to address a number of essential requirements. In supporting specific open points in Rolling Stock TSIs, in particular the as yet un-published Conventional Rail Rolling Stock TSIs, the following essential requirements are addressed.
- 1.2.3.2 The directive 2001/16/EC of the European Parliament and of the Council of 19 March 2001 on the interoperability of the conventional rail system together with the consolidated legal version (without preamble) according to Directive 2004/50/EC of 29 April 2004 contains within Annex 3 Essential Requirements the following relevant essential requirements.

##### *General Requirements*

##### *Safety*

*1.1.3. The components used must withstand the normal or exceptional stresses that have been specified during their period of service. The safety repercussions of any accidental failures must be limited by appropriate means.*

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**1.2.4 Supporting documents**

1.2.4.1 The following Railway Group documents support this Railway Group Standard:

- a) GM/RC2494 Recommendations for Railway Wheelset Design
- b) GM/RC2495 Recommendations for Railway Wheelset Manufacture
- c) GM/RC2496 Recommendations for Railway Wheelset Maintenance
- d) GM/GN2497 Guidance on Railway Wheelset Tread, Gauging and Damage Identification
- e) GM/GN2498 Guidance on Railway Wheelset Handling [proposed].

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## Part 2 Requirements for Design

### 2.1 Methodology

- 2.1.1 To achieve consistency within a chosen methodology and industry practice where British Standards, European Standards or Association of American Railroads (AAR) standards are adopted to comply with this standard the applicable full suite of British Standards, European Standards or AAR standards shall be applied. Except where otherwise defined within this document, it is not permissible to use selected elements only, nor mix between the regimes for design, manufacture and maintenance of railway wheelsets.
- 2.1.2 Wheelsets shall be designed using actual, or predictions, of service loads so that the fatigue life is not finite. The design shall withstand all the foreseeable inputs under which the vehicle is to remain fully operational. The design shall be capable of being manufactured and maintained in accordance with this document.
- 2.1.3 All new designs of wheelset shall be validated using methods appropriate to the application to demonstrate that the design satisfies the requirements of the standards and complies with the requirements set out in this document.
- 2.1.4 GM/RC2494 provides recommendations for wheelset design, in particular requirements for applications in the UK.

### 2.2 Axle design

- 2.2.1 Axles shall be designed using a proven method to satisfy the requirements of 2.1 of this document.
- 2.2.2 The axle design shall define the non-destructive testing (NDT) requirements for manufacturing and all phases of the wheelset life.

### 2.3 Wheel design

- 2.3.1 New wheelset designs shall use monobloc design wheels.
- 2.3.2 The width of the wheel rim (the distance between the flange back and the outside face of the rim) shall be within the range 127 to 150 mm.
- 2.3.3 For monobloc wheels only, it is permissible to reduce the rim thickness at the final re-profiling such that the fatigue life of the wheel rim becomes finite. The predicted fatigue life of the wheel after the final re-profiling shall be not less than three times the remaining service life.
- 2.3.4 New wheel designs shall make provision for balancing without the need for holes in the wheel.

### 2.4 Axle bearing design

- 2.4.1 The axle bearing design life shall be determined using a proven method.

### 2.5 Flange design

- 2.5.1 The nominal flange angle of a new tread profile design shall be in the range 68° to 70°.
- 2.5.2 The radius between the flange tip and the flange back blend, when new, shall not be less than 10 mm.
- 2.5.3 The flange toe radius, when new, shall not be less than 10 mm.

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- 2.6.1 The wheel tread profile for new wheelset designs shall be selected from those listed in Appendix A. The tread profile shall be chosen to suit the vehicle and suspension design, taking account of the effect on the wheel / rail interface, vehicle dynamics, and wheel / rail wear and maintenance.

**2.7 Materials**

- 2.7.1 Axle and wheel materials shall be selected from the range defined in 2.8, Axle materials, and 2.9, Monobloc wheel material, consistent with the chosen design methodology.

**2.8 Axle materials**

- 2.8.1 The axle material shall be selected from the following:
- a) BS EN 13261 Grades A1T, A4T or A1N  
or
  - b) BS 5892, Part 1, Grade A1T or Grade A4T. The hydrogen content shall be in accordance with BS EN 13261.  
or
  - c) Association of American Railroads standard M-101 Grade F.

**2.9 Monobloc wheel material**

- 2.9.1 The wheel material shall be selected from approved grades of steel for particular applications as set out in Table 1.

| Wheel type                              | BS 5892, Part 3 | BS EN 13262 (only applies to rim chilled wheels) | AAR                 |
|-----------------------------------------|-----------------|--------------------------------------------------|---------------------|
| Freight, integral brake disc wheel      | R7E             | X                                                | X                   |
| Freight, cheek mounted brake disc wheel | R8E             | X                                                | X                   |
| Other freight wheels                    | R7T or R8T      | ER7 or ER8                                       | M-107/M-208 class B |
| All passenger vehicle                   | R8T or RS8T     | ER8                                              | X                   |
| Other wheels                            | R8T             | ER8                                              | M-107/M-208 class B |

**Table 1** Monobloc wheel material

**Notes:** RS8T is not recommended for use on tread braked wheel applications.

X No approved grades of steel available.

- 2.9.2 Monobloc wheels manufactured in accordance with the requirements of BS 5892 Part 3 shall have hydrogen content in accordance with BS EN 13262.

- 2.9.3 Monobloc wheels manufactured by the quenched and tempered heat treatment process in accordance with UIC 812-3 (withdrawn) shall comply with the requirements as set out in Appendix D.

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## 2.10 Wheelset assembly

- 2.10.1 Wheels, and other components that are secured to the axle by interference fit, shall be designed to remain secure for the service life and over the wheelset full operational temperature range, including thermal effects of the environment and service operation.

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**Part 3 Requirements for Manufacture and Assembly****3.1 Supporting information**

- 3.1.1 GM/RC2495 provides recommendations for manufacture and assembly of railway wheelsets, in particular requirements for applications in the UK.

**3.2 Materials****3.2.1 Steel properties**

- 3.2.1.1 All materials shall be sampled to demonstrate that the material from which the component is manufactured is homogeneous and free from macro-segregation that is likely to have a detrimental effect on performance. The metallurgical content shall be consistent with material grade. Failure to satisfy the requirements of the specified tests shall result in the complete batch of components being rejected.

**3.2.2 Axle material**

- 3.2.2.1 Axles shall be manufactured using the material defined by their design.

**3.2.3 Monobloc wheel material**

- 3.2.3.1 Monobloc wheels shall be manufactured using the materials defined by the design.

**3.2.4 Wheel centre material**

- 3.2.4.1 Wheel centres shall be manufactured to the requirements of BS 5892 Part 2. The approved grade of steel is Grade U.

**3.2.5 Tyre material**

- 3.2.5.1 Replacement tyres to be fitted to wheelsets of existing designs shall be manufactured to the requirements of BS 5892 Part 4.
- 3.2.5.2 The approved grades of steel are either B5E or B6E, dependant upon the application.

**3.2.6 Retaining (Gibson) ring material**

- 3.2.6.1 Retaining rings shall be manufactured to the requirements of BS 5892, Part 5.

**3.2.7 Other material**

- 3.2.7.1 Any wheelset components not described above shall be manufactured to the requirements of the applicable British Standard or European Standard. The materials and processes shall be selected and controlled to ensure that the finished components perform their intended duty safely.

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## 3.3 Component testing

### 3.3.1 Axle testing

3.3.1.1 Axles manufactured in accordance with BS 5892 Part 1 shall be subject to all the mandatory tests listed. They shall also be subject to the following optional tests in BS 5892 Part 1:

- a) Impact test (BS 5892 Part 1 clause 8.3.4)
- b) Ultrasonic testing (BS 5892 Part 1 clause 9.3.1) to demonstrate that the axle body is transparent to ultrasound
- c) Magnetic particle inspection (MPI) (BS 5892 Part 1 clause 9.3.2), or inspection process of at least equivalent sensitivity, over the whole surface area, excluding the axle ends. This testing shall be carried out after finish machining and prior to fitment of any components.

3.3.1.2 Axles manufactured in accordance with BS 5892 Part 1 shall also be subject to the micrographic cleanliness examination requirements set out in BS EN 13261 clause 3.4.1.

3.3.1.3 Axles designed in accordance with the requirements of BS EN 13103 or BS EN 13104 shall satisfy the requirements for axle testing set out in BS EN 13261.

3.3.1.4 Axles designed in accordance with AAR regulations shall be tested in accordance with the requirements of AAR standard M-101. In addition the axles shall be subject to magnetic particle inspection (BS 5892 Part 1, 9.3.2), or an inspection process of at least equivalent sensitivity, over the whole surface area, excluding the axle ends. This testing shall be carried out after finish machining and prior to fitment of any components.

3.3.1.5 For the detection method chosen in accordance with the design requirements, no detectable transverse cracks in the axle shall be permissible.

### 3.3.2 Monobloc wheel testing

3.3.2.1 Monobloc wheels manufactured in accordance with BS 5892, Part 3 shall be subject to all the mandatory tests listed. They shall also be subject to the following optional tests in BS 5892, Part 3:

- a) Uniformity of rim hardness (BS 5892, Part 3, section 8.3.6.1).
- b) Ultrasonic test (BS 5892, Part 3, section 8.3.7). The wheel rims shall be ultrasonically tested for internal defects. It is permissible to ultrasonically test the wheel rim using the method specified in BS EN 13262.

The rejection criteria for the defect level shall be dependent upon the application as follows:

- i) Wheelsets operating up to 125 mile/h – defect larger than 2 mm
- ii) Wheelsets operating above 125 mile/h – defect larger than 1 mm.
- c) Residual stress for rim chilled wheels (BS 5892, Part 3, 10.6).

3.3.2.2 Monobloc wheels manufactured in accordance with BS 5892, Part 3 shall also be subject to the micrographic cleanliness examination requirements set out in BS EN 13262 clause 3.4.1.

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3.3.2.3 Monobloc wheels that have been approved in accordance with BS EN 13979-1 for their design shall satisfy the test requirements as set out in BS EN 13262.

3.3.2.4 Monobloc wheels manufactured in accordance with the requirements of AAR specification M-107/M-208 for their design shall satisfy the test requirements set out in M-107/M-208.

**3.3.3 Tyre testing**

3.3.3.1 Tyres shall be subject to the mandatory tests and optional requirements of BS 5892, Part 4 to ensure the safety and integrity of the tyre. It is permissible to ultrasonically test the tyre using the method specified in BS EN 13262 with a defect  $\geq 2$  mm being a cause for rejection. The ultrasonic testing dead zone shall be no greater than 10 mm from the test surface.

**3.4 Assembly****3.4.1 Assembly of wheelsets**

3.4.1.1 Wheelsets shall be assembled in accordance with the requirements of the respective standard, BS EN 13260 or BS 5892 Part 6 or AAR Manual of Standards and Recommended Practices Section G - Part II.

3.4.1.2 Wheelsets shall be measured and inspected in accordance with the applicable standard. The following inspections shall be included:

- a) Conformity of back-to-back dimension, as set out in 4.16 of this document
- b) Conformity of tread profile as selected from Appendix A of this document.

**3.4.2 Assembly of other components**

3.4.2.1 Other components, bearings, axleboxes, brake discs, etc fitted to the wheelset shall not damage or adversely affect the integrity of the assembled wheelset.

3.4.2.2 Corrosion protection shall be applied in accordance with the design specification.

**3.4.3 New and used components**

3.4.3.1 It is permissible for wheelsets to be assembled with used components or a combination of new and used components that comply with their original design.

3.4.3.2 Specific requirements for branding of wheelsets and wheelset components are set out in 3.6 of this document.

**3.4.4 Tyre security (shrink fit)**

3.4.4.1 Tyres shall be fitted to wheel centres to ensure security throughout the wheelsets' service life.

3.4.4.2 Tyre installations using retaining rings shall use only single piece ring, make up pieces are not permitted.

**3.5 Wheelset testing****3.5.1 Wheelset NDT**

3.5.1.1 Axles of assembled wheelsets shall comply with the appropriate NDT acceptance criteria defined by the design, see 2.2.

**3.5.2 Wheelset electrical continuity**

3.5.2.1 The wheelset shall be tested to comply with the requirements of the respective standard.

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## 3.5.3 Wheelset balancing

- 3.5.3.1 Wheelsets shall be balanced in accordance with the requirements of the respective standard; BS 5892 Part 6 or BS EN 13260 or AAR Manual of Standards and Recommended Practices Section G - Part II.
- 3.5.3.2 Wheelsets that operate at speeds in excess of 125 mile/h and up to 140 mile/h shall have wheelset out of balance less than 50 gram.metres.
- 3.5.3.3 Wheelsets that physically cannot be dynamically balanced, typically due to axle mounted drives, shall be shown to have the equivalent imbalance within the permitted tolerance by calculation. The tread run-out for wheelsets that cannot be physically balanced shall be minimised.

## 3.6 Wheelset identification

### 3.6.1 Branding

- 3.6.1.1 All wheelsets and components of wheelsets shall be branded in accordance with the respective requirements of:
  - a) Appendix B of this document
  - or
  - b) BS EN 13260, BS EN 13261 and BS EN 13262
  - or
  - c) AAR specification M-101 and M-107/M-208 and Recommended Practices: Section G: Wheel and Axle Manual of that document.
- 3.6.1.2 Wheelsets shall not have labels or bands attached as a means of identification as an alternative to branding; the arrangements contained in UIC 813, clause 4.2.5.2, paragraph 2 are not permitted.
- 3.6.1.3 Any markings on re-used components which refer to the original wheelset shall be erased and the wheelset records endorsed. Illegible or obscured brandings shall be erased and the component shall be re-branded according to the requirements of this document.

### 3.6.2 Unique identification of axles

- 3.6.2.1 Each new axle shall be branded with a unique serial number, allocated from the wheelset assembler's own series of numbers. Axles shall not be given the number of:
  - a) An axle it replaces
  - b) A previously scrapped axle.
- 3.6.2.2 Particular attention shall be given to the inclusion of the wheelset assembler's code.

### 3.6.3 General stamping requirements

- 3.6.3.1 Wheelset branding shall be in accordance with the appropriate standard, cold stamping is the preferred method.
- 3.6.3.2 The stamping shall not create stress raising features in the component, such as sharp corners or notches. Stamps shall be of a rounded profile that does not produce sharp indentations in the wheelset components. In avoiding stress raising features the fully worn wheel condition shall be considered. The branding shall in no circumstance create a notch in the chamfer at the edge of the tread profile.

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3.6.3.3. Automated processes shall be assessed for their suitability of marking wheelset components to meet the requirements of 3.6.3.2 of this document.

3.6.3.4. The branding shall be of a size and depth such that the information is clearly legible when the appropriate surface coating or protection is applied at any stage of the wheelset life.

**3.7 Corrosion protection**

3.7.1. After completion of all tests on the wheelset, the corrosion protection shall be completed or applied, as required by the design specification.

3.7.2. Overhangs and other moisture traps at the axle to wheel interface and similar locations shall be treated in accordance with the design specification.

**3.8 Handling and care of wheelsets**

3.8.1. Wheelsets which are not in service under vehicles and wheelset components prior to assembly shall be protected, stored, handled and transported in a manner which is not detrimental to the wheelset / component life. Guidance is set out in GM/GN2498.

**3.9 Records to ensure traceability**

3.9.1. Records shall be maintained so that wheelsets, axles, monobloc wheels, wheel centres and tyres are identified against one wheelset manufacturer, casting batch and year of manufacture. These records shall include: cast number and manufacturer's code, and year of both component manufacture and wheelset assembly.

3.9.2. A list of the suppliers and their branding codes is published on the RSSB website.

**3.10 Qualification of wheelset suppliers**

3.10.1. GM/RT2470 sets out the arrangements for qualification of suppliers of railway wheelsets, component manufacturers and wheelset assemblers.

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## Part 4 Requirements for Maintenance

### 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 a compliant condition.
- 4.1.3 GM/RC2496 provides recommendations for wheelset maintenance, in particular requirement for applications in the UK.

### 4.2 Handling and care of wheelsets

- 4.2.1 The requirements for handling and care of wheelsets are set out in 3.8 of this document.

### 4.3 Corrosion protection

- 4.3.1 After testing the axle and wheelset, corrosion protection shall be reinstated, to the requirements set out in 3.7 of this document.

### 4.4 Wheelset tread profile requirements

- 4.4.1 The tread, when newly profiled, shall be as defined by the design for the wheelset / vehicle combination and selected only from those listed in Appendix A and applied to each wheel of a wheelset.
- 4.4.2 The tread, when newly profiled, shall comply with the requirements set out in the respective standard, BS 5892, Parts 3 and 6, EN13260 and AAR Manual of Standards and Recommended Practices.

### 4.5 Maximum force

- 4.5.1 Where it is established, for example by wheel impact load detection equipment, that any defect in a wheel contributes to producing a total vertical force of more than 350 kN per wheel, the wheelset shall be examined.

### 4.6 Tread requirements

#### 4.6.1 Flats damage requirements

- 4.6.1.1 Where wheel flats are found, the length of the flat around the circumference of the wheel shall be measured to the outer edge of any discolouration or of the worn / damaged area, whichever is the greater. Action for a measured flat shall be taken as set out in Table 2.

**Railway Group Standard****GM/RT2466****Issue** Three**Date** February 2010**Railway Wheelsets**

| Vehicle type                                                                             | Wheel flat length                                      | Vehicle to be removed from service                                                                                                                                          |
|------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Any vehicle permitted to operate above 125 mile/h and up to 140 mile/h                   | Above 60 mm<br>Above 40 mm to 60 mm<br><br>30 to 40 mm | Immediately<br>On completion of the journey. The speed shall be limited to 125 mile/h until the vehicle is taken out of service<br>Within 24 hours of the fault being found |
| Passenger or personnel vehicles operating at speeds up to and including 125 mile/h       | Above 60 mm<br>40 to 60 mm                             | Immediately<br>Within 24 hours of the fault being found                                                                                                                     |
| Non-passenger vehicles, locomotives, power cars, driving van trailers, on-track machines | Above 60 mm<br>40 to 60 mm                             | Immediately<br>On completion of the journey                                                                                                                                 |
| Freight vehicles up to 17.5 tonnes axle load                                             | Above 80 mm<br>60 to 80 mm                             | Immediately<br>On completion of the journey. The speed to be restricted to 60 mile/h                                                                                        |
| Freight vehicles equal to or over 17.5 tonnes axle load                                  | Above 70 mm<br>50 to 70 mm                             | Immediately<br>On completion of the journey. The speed to be restricted to 60 mile/h                                                                                        |
| Other vehicles                                                                           | Above 60 mm<br>40 to 60 mm                             | Immediately<br>On completion of the journey. The speed to be restricted to 60 mile/h                                                                                        |

**Table 2** Wheel flat criteria

- 4.6.1.2 For wheels smaller than 660 mm, the small wheel criteria set out in RIS-1530-PLT shall apply.

# Railway Wheelsets

## 4.6.2 Tread run-out

4.6.2.1 Where the presence of tread run-out is established, by measurement (see Figure 3 dimension H), action shall be taken as set out in Table 3.

| Vehicle type                                                                                | Tread run-out    | Vehicle to be removed from service                                    |
|---------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------------------------|
| Any vehicle permitted to operate above 125 mile/h and up to 140 mile/h                      | Above 1.3 mm     | Immediately                                                           |
|                                                                                             | 0.7 mm to 1.3 mm | Within 24 hours of the fault being found                              |
| Passenger or personnel vehicles operating at speeds up to and including 125 mile/h          | Above 3.0 mm     | Immediately                                                           |
|                                                                                             | 1.3 mm to 3.0 mm | Within 24 hours of the fault being found                              |
| Non-passenger vehicles, locomotives, power cars, driving van trailers and on-track machines | Above 3.0 mm     | Immediately                                                           |
|                                                                                             | 1.3 mm to 3.0 mm | On completion of the journey                                          |
| Freight vehicles up to 17.5 tonnes axle load                                                | Above 5.0 mm     | Immediately                                                           |
|                                                                                             | 3.0 mm to 5.0 mm | On completion of the journey. The speed to be restricted to 60 mile/h |
| Freight vehicles equal to or over 17.5 tonnes axle load                                     | Above 4.0 mm     | Immediately                                                           |
|                                                                                             | 2.0 mm to 4.0 mm | On completion of the journey. The speed to be restricted to 60 mile/h |
| Other vehicles                                                                              | Above 4.0 mm     | Immediately                                                           |
|                                                                                             | 2.0 mm to 4.0 mm | On completion of the journey. The speed to be restricted to 60 mile/h |

**Table 3** Tread run-out criteria